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Review



Half a century of Omega – The International Journal of Management Science: A bibliometric analysis☆

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ABSTRACT

Omega – The International Journal of Management Science is a leading international journal in management science and operations research. In 2023, *Omega* celebrated its 50th anniversary. Motivated by this event, this paper provides an in-depth, critical analysis of *Omega*'s development as a leading academic journal over fifty years. The article visualizes a dynamic and evolving academic landscape through the lens of several bibliometric indicators including bibliographic coupling, keyword co-occurrence, and institutional productivity using the Web of Science Core Collection database. The aim is to identify *Omega*'s leading trends in highly cited papers, authors, universities, countries, journals, keywords and topics. The work also develops a graphical mapping of the bibliographic material using the VOS viewer software. The results indicate that *Omega* is becoming strongly internationalized, with publications from institutions all over the world. Traditionally, English-speaking countries were leading the journal. But during the last few years, the results have visualized the strong growth of Europe and East Asia, and at a lower level, the rest of the countries of the world. The study not only highlights *Omega*'s past achievements but also points towards its future trajectory, emphasizing the importance of collaboration, diversity, and innovation in maintaining its academic prominence.

1. Introduction

Omega – The International Journal of Management Science, established in 1973, has served as a cornerstone in the fields of management science and operations research [1]. In 2023, *Omega* celebrated its 50th anniversary. This milestone presents an opportunity to reflect on the journal's development over the past five decades, analyze publication trends, highlight influential research, and identify emerging topics that have shaped the field. Over the past 50 years, *Omega* has become a leading platform for disseminating high-quality research that bridges the gap between theoretical advancements and practical applications. The journal has consistently published innovative and impactful studies that address critical issues in optimization, decision theory, operations management, supply chain management, and various quantitative methods supporting strategic and operational organizational decisions. Samuel Eilon (Imperial College London) became the founding Chief Editor, and published the inaugural issue in February 1973 [2], which comprised six research articles and eight conference paper abstracts. In 1993, George H. Mitchell (London School of Economics) took the position of editor-in-chief (EiC) until 2000, when Lawrence M. Seiford (University of Michigan) became EiC. In 2003, Benjamin Lev (at that time at the University of Michigan Dearborn, and since 2009 at Drexel University) took the position of EiC and has been leading the journal for more than twenty years [3,4].

Omega's journey from its inception to its current status as a globally recognised publication, mirrors the broader developments in management science and operations research. The journal's first volume published 42 documents in six issues released in February, April, June, August, October, and December 1973. Today, under the leadership of Ben Lev, *Omega* is recognised as a reputable and influential publication in the field with an impressive CiteScore value of 13.8 and Impact Factor (IF) of 6.7 in 2023. According to data extracted from the Web of Science (WoS) Core Collection in June 2024, the journal has published 4173 documents, including 3634 articles and reviews.

The journal's impact is reflected in its diverse and international authorship, which has expanded significantly over the years. Recent

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trends indicate a growing number of contributions from Europe, East Asia, and other regions beyond the traditionally dominant English-speaking countries. This internationalization underscores the journal's global influence and its role in advancing management science worldwide. The journal consistently maintains notable top positions in various categories based on Journal Impact Factor (JIF) ranks and percentiles. According to 2023 WoS Core Collection data, the journal is ranked 9th out of 106 journals in the 'Operations Research and Management Science' category, with a JIF percentile of 92, placing it in the first quartile (Q1). The journal has maintained its Q1 status in this category since 2007, highlighting its long-standing reputation for high-quality research and significant impact in the discipline. Note that *Omega* is also indexed in the 'Management" category achieving similar results [5]. However, it is important to recall that the main focus of the journal is on operations research and management science.

To celebrate its 50th anniversary, this study presents a bibliometric analysis of *Omega*'s publications from 1973 to 2023, using data from the Web of Science Core Collection. By analysing publication and citation trends and identifying highly cited papers, leading authors, influential institutions, and prominent countries, this study aims to expound on the major trends and contributions that have defined *Omega* over its 50-year history. Additionally, the study employs VOS viewer software to develop graphical maps illustrating co-citations, bibliographic coupling, and keyword co-occurrence, thereby providing a visual representation of the journal's scholarly network and thematic evolution. The findings will offer valuable insights into the historical development of *Omega*, the current state of research in management science, and potential future directions.

The paper is structured as follows: Section 2 outlines the methodology used. Section 3 presents the analysis of the results, covering the annual citation structure, highly cited articles, and the most influential authors, institutions, and countries. Section 4 provides a graphical representation of bibliometric indicators using VOS viewer software. Finally, Section 5 discusses the findings and concludes the paper

2. Methods

Bibliometric analysis is a robust quantitative method employed to evaluate various facets of publications within a specific domain [6,7]. By scrutinizing publication data, bibliometric analysis identifies key trends, highly cited papers, leading authors, and the most influential institutions and countries [8]. This method provides comprehensive insights into the historical evolution of a field, current research trends, and potential future directions, thereby facilitating a deeper understanding of the research landscape [9]. Thanks to the development of computers and internet, bibliometrics has become a very popular field since leading pioneers started this research area [10,11].

The application of bibliometric analysis in academic journals is multifaceted and indispensable. Firstly, it highlights significant contributions within a field, revealing emerging topics and areas of intensive research focus [12,13]. This is crucial for understanding the dynamics of scientific progress and identifying areas ripe for further exploration [8]. By spotlighting highly cited papers and leading authors, bibliometric analysis enhances our understanding of intellectual leadership and influence, guiding researchers in aligning their work with pivotal themes and leaders in their fields [14]. For researchers, bibliometric analysis serves as a strategic tool for selecting appropriate journals for paper submissions. It offers insights into the diffusion and impact of articles published in a journal, enabling authors to target journals with high visibility and influence [15,16]. This targeted approach not only maximizes the dissemination and impact of their work but also aligns their research with influential platforms that can propel their academic careers forward [9]. Furthermore, bibliometric analysis can assist researchers in identifying potential collaborators and understanding the citation landscape, which is essential for networking and establishing impactful research partnerships.

The bibliometric study enables institutions to craft and design their policy implications and can inform national and international research policies [17]. By understanding the global research landscape and identifying leading countries and institutions, policymakers can develop strategies to enhance their country's research capabilities and competitiveness [18]. Additionally, bibliometric indicators can be used to assess the effectiveness of research funding programs and initiatives, ensuring that resources are allocated efficiently and effectively. By evaluating research performance, bibliometric analysis provides a clear picture of the quality and productivity of research outputs [19]. This information is critical for strategic decision-making related to promotions, funding allocations, and resource management. Institutions can use bibliometric data to identify strengths and weaknesses in their research programs, enabling them to make informed decisions to foster innovation and advancement in their respective fields [9,20].

While bibliometric analysis is a powerful tool, it is not without limitations and challenges. One critical issue is the reliance on citation data, which can be influenced by various factors such as publication language, self-citations, and the citation practices of different disciplines [21]. Additionally, bibliometric indicators may not fully capture the societal impact of research, particularly in fields where the primary audience is not academic [22]. Another challenge is the potential for bibliometric analysis to perpetuate existing biases and inequalities in research. For instance, researchers from well-established institutions and countries may receive more citations simply due to greater visibility and access to resources, rather than the intrinsic quality of their work [21]. Therefore, it is essential to interpret bibliometric data within the broader context of research practices and to complement it with qualitative assessments.

Despite these challenges, the value of bibliometric analysis is underscored by its widespread application across various disciplines. Numerous studies have demonstrated the effectiveness of bibliometric methods in enhancing our understanding of research trends and impacts [4]. For instance, bibliometric analyses have been conducted on journals such as the *European Journal of Operational Research* [23], *International Transactions in Operational Research* [24], *Operations Research* [25], *INFORMS Journal on Applied Analytics* [26], *IEEE Transactions on Fuzzy Systems* [27], *Computers and Industrial Engineering* [28], *Manufacturing & Service Operations Management* [29], *ACM Transactions on Multimedia Computing, Communications and Applications* [30], and *International Journal of Information Technology & Decision Making* [31,32].

Additionally, bibliometric studies have explored various topics including operations research and management science [33–35], data envelopment analysis [36]; fuzzy decision making [18], and artificial intelligence in healthcare [37]. Some other studies have provided a bibliometric overview of different issues regarding metaheuristic algorithms including bilevel optimization [38], optimization algorithms [39], TSP-based scheduling optimization [40], and nature inspired optimization techniques [41]. Furthermore, Weinand et al. [42] analyzed the current trends in combinatorial optimization through a bibliometric approach, Prata et al. [43] focused on constraint programming in production scheduling, and Nikseresht et al. [44] studied sustainable green logistics and remanufacturing.

Prompted by the growing interest of researchers in the journal and the rising trend of annual citations, this paper conducts a comprehensive bibliometric analysis of *Omega*. It examines bibliometric indicators in terms of quantity, quality, and relationships, aiming to analyse the number of articles published, the most cited papers, and the most influential and productive authors, institutions, and countries. Additionally, the paper presents interactive graphical maps to explore bibliographic linkages among various indicators. These maps illustrate bibliographic coupling, co-citations, keyword co-occurrences, and the coupling of institutions and countries. For this study, data was collected from the WoS Core Collection, a comprehensive database that indexes high-quality research articles across various disciplines. All data are extracted on May-June 2024. The search was conducted using the journal title "Omega International Journal of Management Science".

This search yielded a total of 4173 documents, including articles and reviews published from 1973 to 2023. After excluding documents from 2024, the final dataset consisted of 4091 documents, out of which 3592 were articles and reviews. Note that 1973 is not directly available in WoS. Therefore, this work had to use the Cited Reference Search of WoS and the webpage of the journal to identify the papers published in 1973 with their respective citations. When including the articles and reviews from 1973, the total number of documents increases to 3634.

The paper employed multiple bibliometric techniques such as co-citation analysis, bibliographic coupling, keyword co-occurrences, graphical mapping, and several others to analyse and assess data from different perspectives. Co-citation analysis is crucial because it reveals the intellectual structure of a research field. By identifying how frequently two documents are cited together, researchers can uncover the relationships between different works and understand how ideas and concepts are interconnected [45]. Bibliographic coupling links documents that cite the same references, providing insights into current research trends and emerging topics [46]. By analysing shared references, it can highlight the common foundation upon which current studies are built, showcasing the progression and continuity of research. Keyword co-occurrence analysis examines the frequency and patterns of keyword appearances within a journal, highlighting the main research

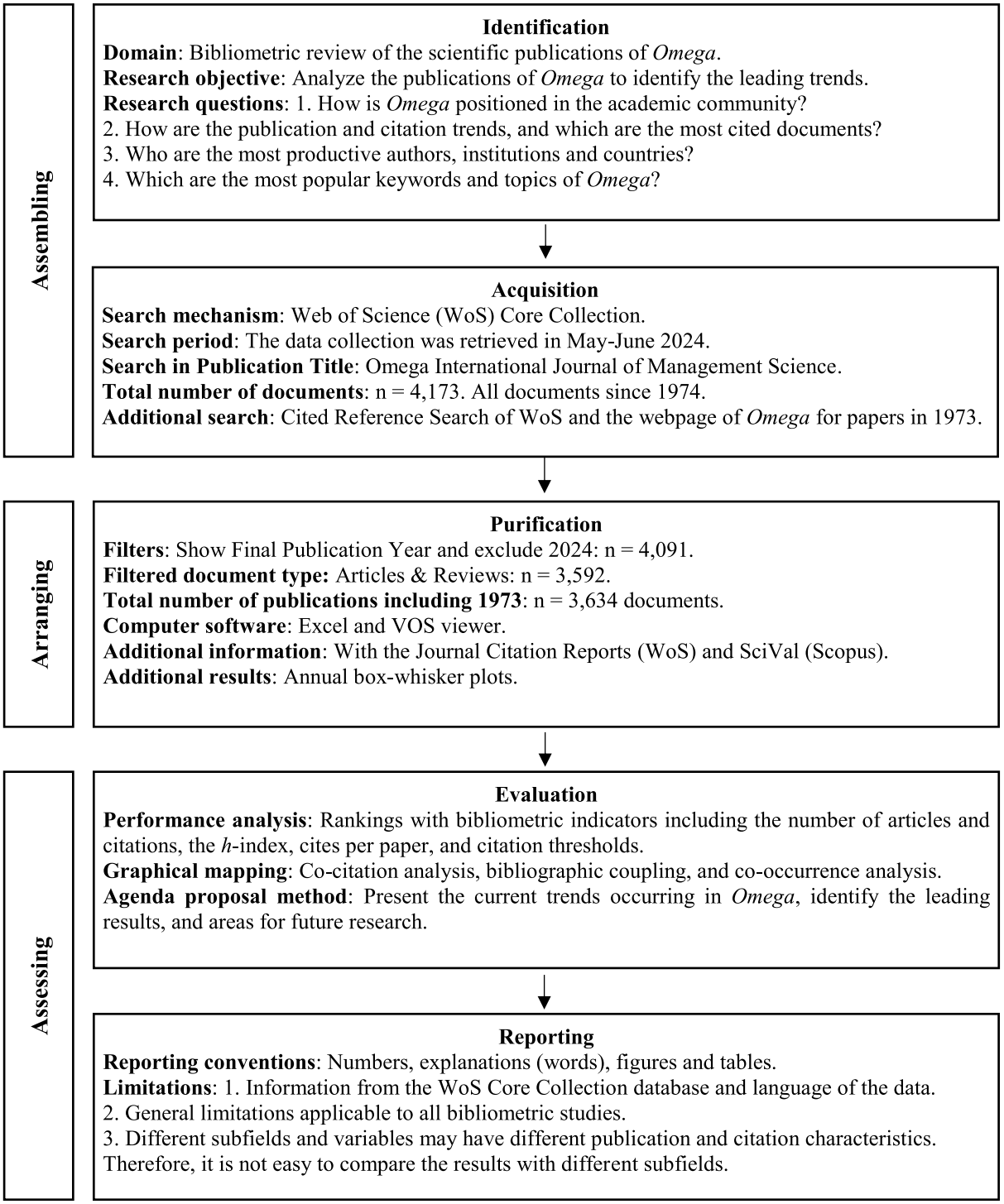


Fig. 1. Methods of the study based on the SPAR-4-SLR protocol.

themes and areas of interest [47]. This technique is vital for understanding the thematic focus of a journal and identifying key topics and concepts that are prevalent within the published research. Moreover, graphical mapping of these bibliometric metrics using software such as VOS viewer simplifies the understanding of complex relationships and trends within the research field [48,49].

Fig. 1 presents the scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR) [9,50,51] that this work uses, to give a general overview of the methods of this article.

3. Results

This section details the findings of the bibliometric analysis, structured into three comprehensive parts for clarity and depth. First, the analysis examines the journal's publication and citation patterns, providing an overview of the journal's output and its impact on the research community. Next, it identifies and analyses the most cited documents, highlighting the key papers that have significantly influenced the field. Finally, it explores the productivity of leading authors, institutions, and countries, showcasing the primary contributors to the journal and their impact on the research landscape.

3.1. Publication and citation structure of Omega

The data in Table 1 and Fig. 2 reveals a consistent pattern in the number of publications for *Omega* over five decades. From 1973 to the early 2000s, the journal maintained a relatively stable annual output, averaging around 50–60 papers per year. This steady publication rate

Table 1
Annual citation structure of Omega.

Year	TP	TC	≥500	≥200	≥100	≥50	≥20	≥10	≥5	≥1	T50	HCP
1973	42	377	0	0	0	3	4	7	12	35	0	–
1974	52	147	0	0	0	0	0	3	10	39	0	–
1975	58	1916	1	1	1	2	3	11	16	36	1	–
1976	53	338	0	0	1	1	3	7	20	40	0	–
1977	49	263	0	0	0	0	3	10	18	36	0	–
1978	51	234	0	0	0	0	4	7	15	36	0	–
1979	49	291	0	0	0	1	4	7	14	33	0	–
1980	58	454	0	0	0	1	9	14	23	45	0	–
1981	58	354	0	0	0	1	0	13	25	51	0	–
1982	60	705	0	0	3	4	7	12	20	44	0	–
1983	54	2341	1	2	2	4	7	12	21	39	1	–
1984	54	547	0	0	0	4	8	14	21	46	0	–
1985	51	452	0	0	0	2	6	14	20	36	0	–
1986	42	431	0	0	1	0	7	10	18	34	0	–
1987	49	617	0	0	0	3	7	13	27	40	0	–
1988	62	481	0	0	0	1	8	16	22	52	0	–
1989	51	1873	1	2	2	3	12	22	34	48	2	–
1990	54	1321	0	2	4	5	9	14	33	51	1	–
1991	55	881	0	0	1	6	13	20	28	50	0	–
1992	58	1296	0	1	2	6	13	23	33	51	1	–
1993	63	1159	0	1	3	6	15	26	40	59	0	–
1994	53	935	0	0	1	3	16	26	38	50	0	–
1995	52	2128	1	3	4	6	21	30	44	51	2	–
1996	59	2171	0	1	4	8	30	43	51	59	1	–
1997	59	2560	1	3	3	10	29	39	46	55	3	–
1998	52	1639	0	1	4	7	21	36	45	52	0	–
1999	54	4210	3	5	8	16	30	42	50	54	4	–
2000	53	4658	1	4	8	20	33	39	47	52	3	–
2001	47	4183	1	5	14	22	35	40	44	47	2	–
2002	39	1926	0	1	5	14	27	34	37	38	0	–
2003	45	3398	0	3	13	22	34	37	38	45	1	–
2004	43	3339	1	4	6	16	29	34	37	42	1	–
2005	49	5319	2	9	17	25	38	43	46	47	3	–
2006	52	4968	2	6	13	27	47	47	48	52	2	–
2007	62	5386	1	8	18	22	45	53	60	62	3	–
2008	87	7953	0	12	25	44	73	82	85	86	5	–
2009	95	5282	0	3	14	40	69	80	88	95	0	–
2010	53	3866	1	4	8	19	45	51	51	53	2	–
2011	74	4229	0	1	13	33	58	70	72	74	0	–
2012	89	5905	0	6	21	36	68	81	84	88	1	–
2013	92	6443	1	7	20	39	69	80	90	92	2	–
2014	93	6347	1	7	18	38	69	85	90	93	2	2
2015	117	8564	2	4	18	40	88	108	115	116	4	4
2016	108	6128	1	5	14	32	71	95	103	108	1	4
2017	106	5165	1	2	11	33	67	90	100	106	1	2
2018	113	4281	0	1	6	22	76	97	107	113	0	3
2019	137	6017	0	5	12	36	81	115	128	137	1	6
2020	144	3680	0	0	5	17	60	107	130	144	0	4
2021	226	4261	0	0	3	17	67	139	186	219	0	8
2022	122	1386	0	0	0	3	18	48	82	117	0	4
2023	136	691	0	0	0	0	5	21	46	110	0	3
Total	3634	143,496	23	119	326	720	1561	2167	2658	3358	50	40
%	100%	–	0.63%	3.27%	8.97%	19.81%	42.96%	59.63%	73.14%	92.41%	–	1.1%

Abbreviations: TP and TC = Total papers and citations; ≥500, ≥200, ≥100, ≥50, ≥20, ≥10, ≥5, ≥1 = Number of papers with equal or more than 500, 200, 100, 50, 20, 10, 5 and 1 citations; T50 = Number of papers in the Top 50 of Table 4; HCP = Highly Cited Papers according to the Essential Science Indicators of the Web of Science (June 2024).

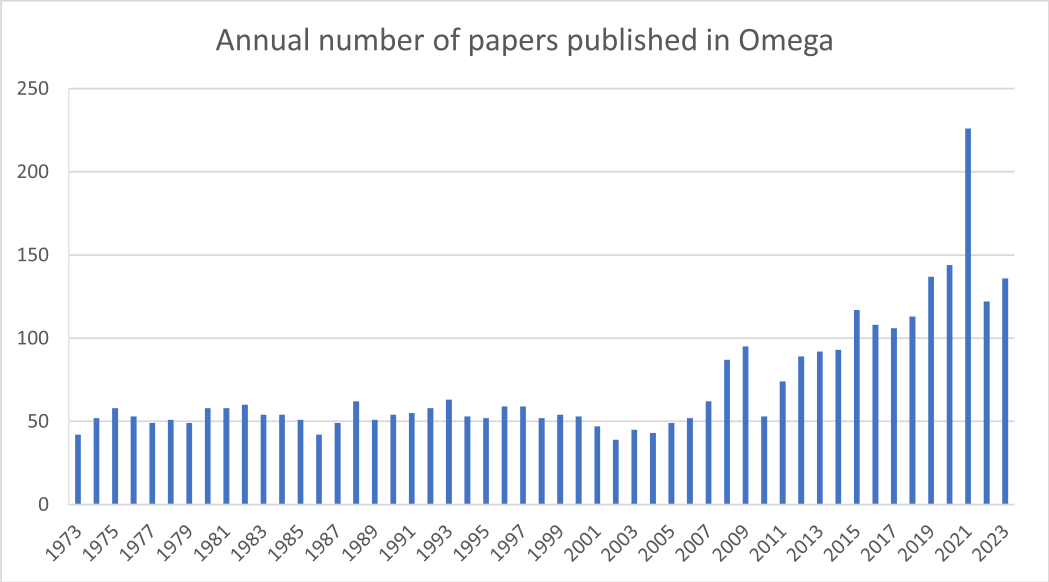


Fig. 2. Annual number of papers published in Omega.

indicates a strong and sustained commitment to contributing to the field of management science. The journal's ability to maintain this consistency is notable, given the various shifts in academic focus and research funding that can influence publication rates.

A significant shift is observed from 2008 onwards, where there is a noticeable increase in the number of publications. For instance, in 2008, the journal published 87 papers, a considerable jump from the previous years. This upward trend continued, peaking at 226 publications in 2021. The main reason for this artificial surge is an administration change in policy. Until 2021, the journal had an inventory of accepted papers which were released with each issue. This backlog of papers was eliminated in 2021 when *Omega* published papers as soon as they were accepted. Note that this change in 2021 has affected the impact factor of the journal in 2022 and 2023 (see Table 2).

The data also showcases the impact of *Omega*'s publications through citation metrics. While early years show modest citation numbers, there is a significant rise in highly cited papers (≥100 citations) in later years. Notable years include 2015 with 8564 citations, 2008 with 7953 citations, 2013 with 6443 citations, and 2014 with 6347 citations. These peaks suggest periods of particularly impactful publications that have resonated within the academic community. Compared to the data provided by Wang et al. [4] that considered the publications of *Omega*

Table 2
Analysis of Omega in the JCR of the WoS.

Year	TC*	IF	5YIF	ImIn	CI	AIS	AJIF	ROR	Q	POR	RM	Q*	PM
1997	357	0.28	–	0	59	–	28.41	28/39	Q3	29.49	43/59	Q3	27.97
1998	372	0.31	–	0.13	52	–	41.23	23/44	Q3	48.86	41/61	Q3	33.61
1999	442	0.41	–	0.01	54	–	49.22	23/50	Q2	55	35/61	Q3	43.44
2000	434	0.45	–	0.03	53	–	51.15	21/51	Q2	59.8	35/60	Q3	42.5
2001	449	0.48	–	0.02	47	–	50.86	20/53	Q2	63.21	38/61	Q3	38.52
2002	495	0.51	–	0.02	39	–	46.16	25/54	Q2	54.63	41/65	Q3	37.69
2003	551	0.55	–	0	45	–	48.28	25/57	Q2	57.02	41/67	Q3	39.55
2004	623	0.28	–	0	43	–	19.74	44/56	Q4	22.32	56/67	Q4	17.16
2005	704	0.64	–	0.04	49	–	44.48	26/56	Q2	54.46	47/71	Q3	34.51
2006	953	0.66	–	0.23	52	–	45.12	28/60	Q2	54.17	51/79	Q3	36.08
2007	1124	1.32	1.45	0.06	62	0.66	73.47	9/60	Q1	85.83	32/81	Q2	61.11
2008	1700	2.17	2.36	0.73	87	0.7	83.28	5/64	Q1	92.97	24/89	Q2	73.6
2009	2510	3.10	3.23	0.65	95	0.76	93.39	2/73	Q1	97.95	13/112	Q1	88.84
2010	3028	3.46	3.73	0.86	53	1.07	93.61	2/75	Q1	98	16/144	Q1	89.24
2011	3103	3.33	3.62	0.91	74	1.17	94.11	2/77	Q1	98.05	17/168	Q1	90.18
2012	3316	3.02	3.47	1.13	89	1.04	90.80	3/79	Q1	96.84	27/174	Q1	84.77
2013	3829	3.19	3.62	1.10	92	1.08	93.64	3/79	Q1	96.84	17/173	Q1	90.46
2014	4546	4.37	4.13	1.01	93	1.24	97.39	1/81	Q1	99.38	9/185	Q1	95.41
2015	4990	3.96	4.28	0.50	117	1.21	95.30	2/82	Q1	98.17	15/192	Q1	92.45
2016	6331	4.02	4.67	0.58	108	1.31	93.55	2/83	Q1	98.19	22/194	Q1	88.92
2017	7143	4.31	5.52	1.27	106	1.49	90.77	5/84	Q1	94.64	28/210	Q1	86.9
2018	8781	5.34	6.31	1.57	113	1.39	94.15	2/84	Q1	98.21	22/217	Q1	90.09
2019	9563	5.32	6.55	2.29	137	1.48	93.07	3/83	Q1	96.99	25/226	Q1	89.16
2020	12,730	7.08	8.55	2.12	142	1.81	88.58	5/84	Q1	94.64	40/226	Q1	82.52
2021	14,575	8.67	8.93	2.58	251	1.61	88.69	7/87	Q1	92.53	35/228	Q1	84.87
2022	14,646	6.9	7.8	2.1	147	1.50	81.7	11/86	Q1	87.8	56/227	Q1	75.6
2023	13,376	6.7	7.0	1.4	130	1.58	89.6	9/106	Q1	92.0	52/401	Q1	87.2

Abbreviations: TC* = Total citations; IF = Impact factor; 5YIF = 5-year impact factor; ImIn = Immediacy index; CI = Citable items; AIS = Article Influence Score; AJIF = Average journal impact factor percentile; ROR = Ranking in the WoS category of operations research & management science (OR&MS); *Q* = Quartile in OR&MS; POR = Journal impact factor percentile in OR&MS; RM = Ranking in the WoS category of management; *Q* = Quartile in management; PM = journal impact factor percentile in management.

between 1979 and 2018 (data collection in March 2019), this study reveals a significant growth in the number of citations due to the huge increase in the number of academic journals and articles published in WoS during the last five years. Currently, there are 119 documents with more than two hundred citations compared to 35 in March 2019. The total citations of *Omega* have grown from 70,000 to 143,000, and the total number of articles from 2564 to 3634 (including 305 between 1973 and 1978). Note that this significant growth affects most of the journals indexed in WoS.

Fig. 3 presents citations for all papers published in *Omega* from 1973 to 2023 by using a box-whisker plot methodology [52]. The horizontal axis represents the publication years, while the vertical axis indicates the number of citations, ranging from 0 to 500. Documents with more than 500 citations appear at the top showing the specific number of citations they have obtained. The box-whisker plot approach visualizes for each year the 75%, 50% and 25% most cited document, the average citations per paper, the minimum, the maximum, and outliers with a huge number of citations.

In the early years, from 1973 to 1990, the number of papers published annually is relatively low, with most papers receiving fewer than 50 citations. The box plots during this period are narrow and close to the bottom, indicating low variability in citation counts. From 1990 to 2005, there is a noticeable increase in the number of citations, with the median citation count rising and several years showing significant outliers with very high citation counts, above 200 citations. The peak years, from 2005 to 2010, exhibit the highest citation counts, particularly in 2005, with box plots showing a wide range of citation counts from 0 to 500 and outliers exceeding 500 citations. In recent years, from 2011 to 2023, there is a decline in citation counts, with narrower box plots and reduced variability, indicating fewer highly cited papers. However, notable peaks in citations are observed in certain years, such as 2008 with 7953 citations, 2015 with 8564 citations, 2013 with 6443 citations, and 2019 with 6017 citations. These metrics demonstrate the journal's significant evolution over the decades, with substantial growth in highly cited papers from 1990 to 2005 and particularly impactful work around 2005, followed by a recent decline likely due to the recency of publications.

The data presented in Table 2 provides a detailed analysis of the journal *Omega* in the Journal Citation Reports (JCR) of the Web of Science (WoS) from 1997 to 2023 [5]. Over this period, several key metrics indicate significant growth and improvement in the journal's impact and influence within the academic community [53]. Total citations (TC*) have increased dramatically, from 357 in 1997 to a peak of 14,646 in 2022, demonstrating the growing recognition and influence of the research published in *Omega*. The Impact Factor (IF), a critical measure of the journal's influence, has also seen a substantial rise from 0.28 in 1997 to a peak of 8.67 in 2021, before slightly declining to 6.7 in 2023. Similarly, the 5-Year Impact Factor (5YIF) shows a general upward trend, indicating sustained interest and relevance of the published research over time.

The Immediacy Index (ImIn), which measures how quickly articles are cited, has also shown significant improvement, particularly from 2007 onwards, reaching a high of 2.58 in 2021. The number of Citable Items (CI) has increased consistently, reflecting a growing volume of quality research output. The Article Influence Score (AIS), which measures the average influence of articles over the first five years after publication, has shown a marked increase, peaking at 1.81 in 2020, indicating that *Omega*'s articles have a strong and lasting impact on the field. Note that 5YIF and AIS were introduced in JCR in 2007.

Note that the total citations (TC*) of Table 2 differ from Table 1 because in Table 1, TC measures the citations that today (June 2024), the papers published in a specific year have obtained. For example, in 2015, *Omega* published 117 papers that currently (June 2024) have received 8564 citations according to WoS Core Collection. TC* of Table 2 measures the citations that Omega has received in a specific year to any paper (articles or reviews) published in the journal. For example, between January and December 2010, *Omega* received 3028 citations to any paper published in the journal according to WoS Core Collection.

The journal's ranking in the WoS category of operations research and

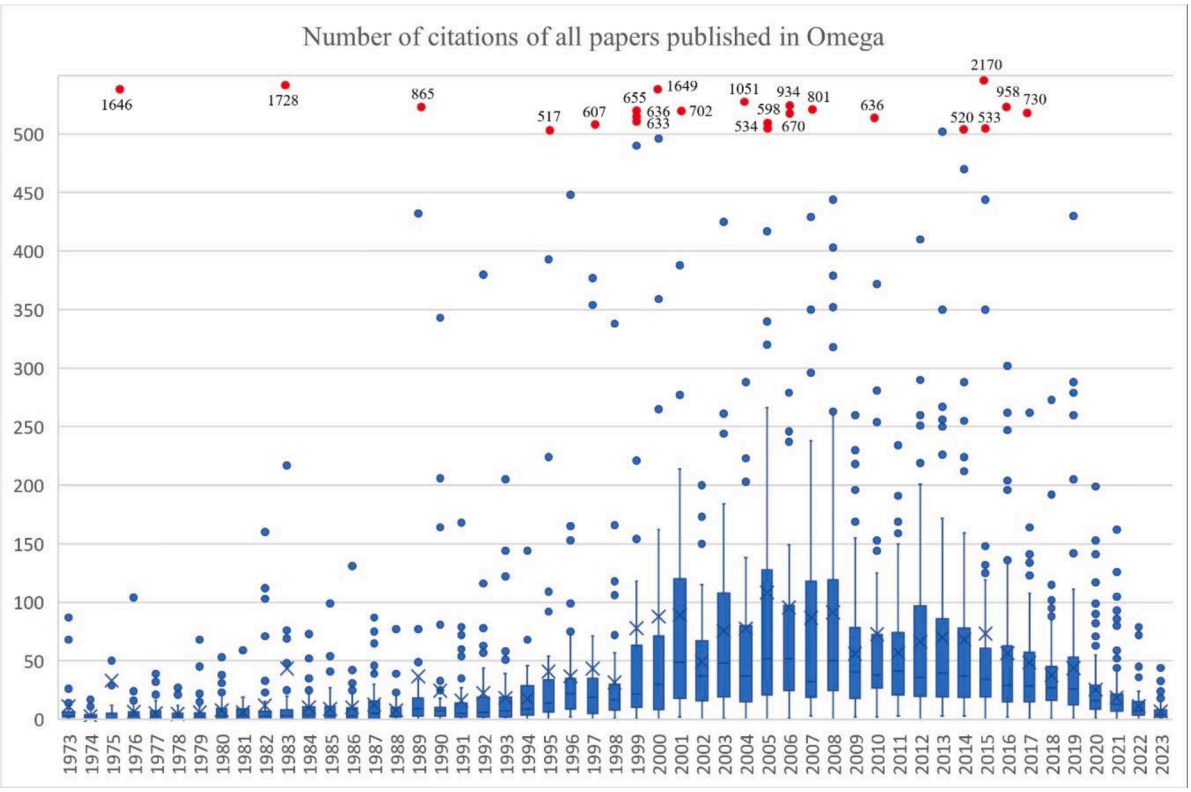


Fig. 3. Annual box-whisker plot structure of the citations of all papers published in Omega.

management science (OR&MS) has shown a notable upward trend, consistently achieving top positions over the years. Specifically, *Omega* ranked 1st in 2014 out of 81 journals, and secured 2nd in multiple years. This consistent high ranking underscores *Omega*'s competitive edge and prestige. Additionally, the journal's quartile rankings in both OR&MS and management categories have predominantly remained in Q1, the highest quartile, further cementing *Omega*'s reputation as a leading journal in these domains. The journal impact factor percentile in OR&MS (POR) and management (PM) categories has also shown significant growth, reaching as high as 99.38% in OR&MS in 2014 and maintaining high percentiles throughout the years. This high percentile ranking reflects the journal's strong influence and prominence

Table 3
Publication record of leading journals in OR&MS and other related fields strongly connected to Omega.

OR&MS	P10	C10	C/P10	H10	TP	TC	C/P	H	≥500	≥100	≥10	HCP	IF	CS	Y	YW
Omega	1302	46,520	35.73	94	3634	143,496	39.39	159	23	326	2167	40	6.9	13.8	1973	1974
Eur J Oper Res	6656	182,836	27.47	148	19,134	800,394	41.83	261	102	1624	13,108	112	6.4	11.2	1977	1978
IJ Prod Res	4156	127,075	30.58	124	11,435	335,064	29.53	173	17	491	7780	82	9.2	18.1	1961	1977
IJ Prod Econ	3023	125,554	41.53	140	7499	336,657	44.89	205	36	766	5647	115	12	19.3	1976	1980
Management Science	2871	82,899	28.87	117	8418	632,806	75.17	330	174	1471	5949	52	5.4	7.9	1954	1954
Annals Oper Res	3388	51,684	15.26	78	5951	118,573	19.92	117	8	155	2925	22	4.8	7.1	1984	1991
Comp Oper Res	2466	51,611	20.93	85	6506	212,962	32.73	162	14	439	4202	14	4.6	8.3	1974	1976
Dec Sup Syst	1176	40,308	34.27	90	3373	154,271	4.57	164	22	331	2500	15	7.5	12.5	1985	1991
Prod Oper Manag	1671	38,223	22.87	84	2326	87,783	37.74	130	9	202	1509	21	5	6.6	1992	1999
Prod Plan Control	901	27,294	30.29	76	2237	55,564	24.84	91	2	74	1405	12	8.3	12.8	1990	1994
IJ Oper Prod Manag	753	25,712	34.15	75	2042	108,324	53.05	142	12	244	1622	13	9.9	10.8	1980	1994
Operations Research	1047	20,130	19.23	61	5655	293,580	51.92	221	57	677	3889	4	2.7	4.8	1952	1952
J Oper Manag	376	19,866	54.13	74	948	126,231	133.18	193	41	372	909	17	7.8	11	1980	1999
J Oper Res Soc	1527	19,493	12.77	50	6115	140,618	23	127	12	206	3174	7	3.6	5.5	1950	1956
MSOM – Manuf Serv Op Man	725	17,289	23.85	61	1030	35,890	34.84	93	0	79	668	13	6.3	8.8	1999	2006
Int Trans Oper Res	970	13,860	14.29	47	1180	17,931	15.2	53	1	14	541	2	3.1	7.6	1994	2009
Math Oper Res	675	6798	10.07	34	2374	77,880	32.81	114	14	142	1371	8	1.7	3.1	1976	1980
OR Letters	1272	6455	5.07	26	3668	58,008	15.83	91	5	81	1373	0	1.1	2	1981	1983
Operational Research	653	6007	9.2	31	717	6641	9.26	33	0	0	229	0	2.7	4.6	2001	2011
RAIRO – Oper Res	1221	5964	4.88	29	1476	7695	5.21	32	0	1	221	0	1.8	2.9	1967	1967
Central Eur J Oper Res	536	4784	8.93	28	780	8241	10.57	37	0	4	248	1	1.7	4.9	1993	2007
OR Spectrum	377	4588	12.17	30	779	20,951	26.89	68	2	32	449	1	2.7	4.1	1979	1983
Appl Stoch Mod Bus Ind	581	4316	7.43	28	1061	10,976	10.34	40	0	7	309	2	1.4	2.5	1985	1993
Naval Res Log	491	3791	7.72	27	2872	54,322	18.91	88	1	69	1314	1	2.3	3	1954	1964
Asia Pac J Oper Res	586	2806	4.79	20	1293	8658	6.7	34	0	2	272	0	1.4	1.8	1984	1987
Interfaces*	327	2243	6.85	21	2567	41,581	16.19	82	4	60	903	0	2.1	2.1	1970	1974
TOP – Trans Oper Res	294	2104	7.15	22	498	5217	10.47	32	0	3	139	0	1.7	2.7	1993	2006
Math Meth Oper Res	368	2069	5.6	21	1287	16,299	12.66	51	0	15	434	0	1.2	1.9	1956	1997
4OR – Quarterly J Oper Res	198	1838	9.28	20	399	6323	15.85	39	0	10	150	0	2	4.1	2003	2003
SORT – Stat Oper Res Trans	144	965	6.7	13	221	1859	8.41	24	0	1	45	1	1.6	4.1	1977	2007
Military Oper Res	160	211	1.32	6	328	1023	3.12	14	0	0	27	0	0.7	1.6	1994	2003
Business & Economics																
J Financial Econ	1361	71,720	52.7	131	3454	581,270	168.28	353	218	1294	3003	79	8.9	11.3	1974	1976
Strategic Man J	1142	71,044	62.21	128	3039	608,338	200.18	362	229	1334	2762	53	8.3	11.7	1980	1980
Academy Manag J	764	55,509	72.66	121	3094	616,293	199.19	406	301	1404	2653	46	10.5	15.7	1958	1958
J Finance	690	42,571	61.7	107	4971	693,586	139.53	393	284	1498	3392	39	8	11.4	1946	1946
MIS Quarterly	596	31,553	52.94	92	1594	312,878	196.28	248	102	580	1307	59	7.3	18.7	1977	1979
J Marketing	458	30,418	66.41	92	3685	476,645	129.35	342	179	895	2087	29	12.9	22.1	1936	1936
Econometrica	698	26,339	37.73	78	4628	737,807	159.42	354	250	1189	3501	21	6.1	8.8	1933	1933
Academy Manag Rev	329	23,494	71.71	88	1476	560,231	379.56	367	241	878	1380	28	16.4	18.4	1976	1983
J Marketing Res	597	23,370	39.15	75	2896	386,098	133.32	256	256	103	737	11	6.1	11.2	1964	1964
IJ Forecasting	914	23,181	25.36	67	2149	81,266	37.82	117	15	144	1344	23	7.9	12	1985	1986
Harvard Bus Rev	757	14,497	19.15	53	7329	297,860	40.64	245	105	579	2405	8	14.7	2.4	1922	1922
Marketing Sci	520	13,999	26.92	59	1496	116,260	77.71	160	22	309	1245	5	5	8.7	1982	1987
Decision Sci	393	8112	20.64	46	1532	75,891	49.57	124	14	170	1000	3	5.5	8.1	1970	1984
J Forecasting	682	6284	9.2	34	1755	33,575	19.13	76	4	47	775	3	3.4	4.6	1982	1982
J Productivity Analysis	326	4431	13.59	29	949	33,328	35.12	88	4	76	577	1	1.6	3.2	1989	1994
Engineering & Transportation																
Expert Sys Appl	10,517	269,690	25.64	169	18,785	587,602	31.28	236	40	1221	12,126	225	8.5	12.6	1990	1991
Comp Ind Eng	5476	122,621	22.39	111	10,428	229,685	22.02	111	8	311	5522	47	7.9	11.9	1976	1976
Transportation Res E	1992	61,025	30.63	98	2794	111,158	39.78	135	5	239	2122	39	10.6	14.7	1997	1997
Transportation Res B	1625	57,788	35.56	105	3249	177,980	54.78	171	5	237	2118	20	6.8	12.8	1979	1979
Transportation Sci	710	19,031	26.8	60	1671	89,148	53.35	139	11	224	1304	18	4.6	9.1	1967	1980
IISE Trans	861	11,856	13.77	43	3289	85,522	26	112	3	133	1934	4	2.6	6.5	1969	1982

Abbreviations: P10, C10, C/P10 and H10 = Publications, citations, cites per paper and *h*-index between 2014 and 2023; TP, TC, C/P and *H* = Total publications, citations, cites per paper and *h*-index available in Scopus; ≥500, ≥100 and ≥10 = Number of articles with equal or more than 500, 100 and 10 citations; HCP = Highly Cited Papers; IF = Impact Factor (Web of Science); CS = CiteScore (Scopus); *Y* = Year of origin; YW = Year available in WoS. The numbers provided in the table only consider "Articles" and "Reviews" up to 31 December 2023.
*Note that currently, the name of Interfaces is the INFORMS Journal on Applied Analytics.

compared to its peers.

The data presented in Table 3 provides a comprehensive overview of the publication records of leading journals in Operations Research & Management Science (OR&MS) and other related fields strongly connected to *Omega*. The analysis of these metrics allows us to assess the relative performance and impact of each journal critically. Note that the journals are ranked according to the total citations of the articles published in the last ten years (C10).

Omega, with 1302 publications and 46,520 citations over the last decade, achieves a remarkable citation-per-paper ratio of 35.73 and an H-index of 94. These figures suggest that *Omega*'s articles are well-cited, indicating their relevance and quality. Over its entire publication history, *Omega* has accumulated 3634 total publications and 143,496 citations, resulting in a higher citation-per-paper ratio of 39.39 and an H-index of 159. This consistent performance is further emphasized by the presence of 23 articles with more than 500 citations and 346 articles with more than 100 citations.

Compared to the *European Journal of Operational Research* (*EJOR*), *Omega* falls short in volume but not impact. *EJOR* significantly outpaces *Omega* in terms of the number of publications (6656 over the last decade) and citations (182,836), leading to a citation-per-paper ratio of 27.47 and an H-index of 148. Despite this larger volume, *EJOR*'s total citation-per-paper ratio (41.83) is slightly higher than *Omega*'s, reflecting its broad influence. Moreover, *EJOR* boasts 102 articles with over 500 citations and 1624 articles with more than 100 citations, highlighting its extensive reach and impact.

International Journal of Production Research (*IJPR*) and *International Journal of Production Economics* (*IJPE*) also exhibit strong publication records. *IJPR*, with 4156 publications and 127,075 citations over the past decade, achieves a citation-per-paper ratio of 30.58 and an H-index of 124. However, its overall citation-per-paper ratio (29.53) is lower than *Omega*'s, indicating a potential discrepancy between recent and historical impact. Conversely, *IJPE*, while having fewer publications (3023 over the past decade), achieves a higher citation-per-paper ratio of 41.53 and an H-index of 140, with its total record showing a citation-per-paper ratio of 44.89 and an H-index of 205. This suggests that *IJPE*'s articles are consistently well-cited, reinforcing its position as a high-impact journal [54,55].

Management Science presents an interesting case with 2871 publications and 82,899 citations over the past decade, yielding a citation-per-paper ratio of 28.87 and an H-index of 117. Its total metrics include 8418 publications and 632,806 citations, leading to a remarkably high citation-per-paper ratio of 75.17 and an H-index of 330. This indicates a substantial historical impact and a significant number of highly cited articles (174 with over 500 citations and 1471 with over 100 citations), suggesting that its contributions are foundational to the field [56–58]. *Annals of Operations Research* and *Computers & Operations Research* demonstrate lower citation-per-paper ratios and H-indices compared to *Omega*. These leading journals publish a significant volume of work, but their articles are not cited as frequently, potentially reflecting a more niche focus or lower impact.

Omega's impact factor (IF) of 6.9 and CiteScore (CS) of 13.8 are competitive within the field, though not the highest. For instance, IJPR has an IF of 9.2 and a CS of 18.1, suggesting a higher immediate impact and visibility. However, *Omega*'s balanced performance across multiple metrics indicates a stable and respected position in the scholarly community [35,59].

It is worth noting that during the last years, many other journals connected to management science and operations research have been indexed in WoS, including the *Operations Research Perspectives, Journal of the Operations Research Society of China, International Journal of Management Science and Engineering Management, Journal of Management Science and Engineering, International Journal of Mathematical Engineering and Management Sciences, Advances in Operations Research, Decision Science Letters, International Journal of Applied Management Science, Operations Research and Decisions*, and the *Journal of Business Analytics*. Additionally, there are more journals that focus on specific issues of operations research and management science [60–62].

When we analyze leading journals in Business and Economics, such as the *Journal of Financial Economics* and the *Academy of Management Review*, it becomes evident that these journals operate in a different magnitude of influence. The *Journal of Financial Economics*, with 1361 publications and a staggering 71,720 citations over the last decade, results in a citation-per-paper ratio of 52.7 and an H-index of 131. Its overall impact is even more pronounced, with a total of 3454 publications and 581,270 citations, yielding a citation-per-paper ratio of 168.29 and an H-index of 353. Similarly, the *Academy of Management Review*, with a citation-per-paper ratio of 71.71 and a historical citation-per-paper ratio of 379.56, shows a strong impact and influence in the academic community. These figures highlight the intense citation activity and broader recognition within the business and economics fields compared to operations research and management science [63].

In comparison to journals in the Engineering & Transportation domain, such as *Expert Systems with Applications* and *Transportation Research Part B, Omega* obtains competitive results although the characteristics of these journals are different. *Expert Systems with Applications*, with 10,517 publications and 269,690 citations over the last decade, achieves a citation-per-paper ratio of 25.64 and an H-index of 169. Its overall metrics, including 18,785 publications and 587,602 citations, result in a citation-per-paper ratio of 31.28 and an H-index of 236. *Transportation Research Part B*, with a citation-per-paper ratio of 35.56 and an H-index of 105, also demonstrates significant influence in its field, although its overall citation-per-paper ratio of 54.78 is somewhat comparable to *Omega*'s 39.39.

All these comparisons reveal that *Omega* performs very well within OR&MS, being one of the leading journals. At the same time, it has a strong multidisciplinary profile being connected to many journals in other related fields like business, economics, engineering, computer science, and transportation.

Table 4 lists the top contributing universities, countries, and journals that cite *Omega*. Note that the countries/regions represent the current political definition. Therefore, it is important to recall that the UK includes the data of England, Scotland, Wales and Northern Ireland. China includes Hong Kong because this region became part of China in 1997. The results of Turkey include both the denomination Turkey and Türkiye.

The data suggests that the field of operational research and management science is heavily influenced by Chinese and American institutions, with significant contributions from Europe and other regions. The variety of journals, ranging from sustainability to production economics, illustrates the interdisciplinary nature of research that cites *Omega*, having diverse applications and theoretical advancements.

Islamic Azad University leads with 1594 publications, highlighting its significant role in contributing to the field. This is followed by the Chinese Academy of Sciences and Hong Kong Polytechnic University, with 1394 and 1176 publications, respectively. This concentration of citations from specific institutions underscores their pivotal role in advancing research that aligns with *Omega*'s focus. Additionally, the dominance of China (24,705 publications) and the USA (14,336 publications) reflects their leading positions in global research output. The pervasiveness of the *European Journal of Operational Research, Omega – International Journal of Management Science*, and *Computers & Industrial Engineering* as the top journals citing *Omega* indicates these journals' alignment in research scope and thematic relevance.

When comparing these results with those provided by Wang et al. [4] with data until 2018, we see some significant changes during the last five years. Especially, it is worth noting the huge increase of citing articles of China from 9951 in March 2019 to 24,705 in June 2024. The rest of the countries have also increased a lot but at a lower level compared to China. For example, the USA increased from 8566 documents citing *Omega* to 14,336, and the UK from 4721 to 8285. Some other developing countries that have more than doubled the number of

Table 4
Citing articles of Omega: Universities, countries and journals.

R	University	TP	Country/Region	TP	Journal	TP
1	Islamic Azad U	1594	China	24,705	Eur J Operational Research	2925
2	Chinese Academy of Sciences	1394	USA	14,336	Omega Int J Management Science	2278
3	Hong Kong Polytechnic U	1176	UK	8285	Computers & Industrial Engineering	2195
4	U Tehran	1025	Taiwan	5774	Int J Production Research	2125
5	Sichuan U	875	India	5503	Sustainability	2081
6	U Science Technology of China	734	Iran	5337	Int J Production Economics	1784
7	Beijing Jiaotong U	719	Spain	4709	J Cleaner Production	1524
8	Huazhong U Science Technology	697	Canada	3580	Expert Systems with Applications	1394
9	CNRS - France	682	Australia	3374	J the Operational Research Society	1206
10	Tsinghua U	678	Germany	3253	Annals of Operations Research	1166
11	Tianjin U	612	France	3015	Computers & Operations Research	1083
12	Southeast U China	592	Turkey	2954	Transportation Research Part E	681
13	Northeastern U China	580	Italy	2911	Applied Soft Computing	631
14	Tongji U	580	South Korea	2360	Mathematical Problems Engin	596
15	National U Singapore	577	Brazil	2311	IEEE Access	558
16	Shanghai Jiao Tong U	572	Malaysia	2044	Int J Advanced Manufacturing Tech	546
17	Nanjing U Aeronaut Astronaut	570	Netherlands	1904	Lecture Notes in Computer Science	490
18	City U Hong Kong	564	Portugal	1523	J Intelligent Fuzzy Systems	476
19	Iran U Science Technology	563	Poland	1356	Mathematics	440
20	Central South U	540	Japan	1209	Int Trans Operational Research	431
21	Hefei U Technology	538	Greece	1153	Soft Computing	410
22	U Lisboa	523	Saudi Arabia	1114	Int J Operations Prod Management	392
23	Xian Jiaotong U	486	Singapore	1049	Production Planning Control	382
24	U Montreal	485	Sweden	1026	Benchmarking An Int J	379
25	U Electronic Sci Tech China	485	Belgium	984	Applied Mathematical Modelling	376
26	Beijing Institute of Technology	482	Pakistan	932	Information Sciences	373
27	National Taiwan U Sci Tech	463	Denmark	886	IEEE Trans Engineering Management	369
28	South China U Technology	458	Finland	862	Environmental Sci Pollution Res	358
29	National Cheng Kung U	455	Indonesia	692	RAIRO Oper Res	357
30	Shanghai U	452	UAE	680	Tech Forecasting Social Change	356

citing articles is India, Iran, Brazil, Saudi Arabia, Pakistan, and Indonesia [64].

3.2. Influential papers in Omega

Table 5 highlights the 50 most cited documents in *Omega*, providing insights into the seminal works that have shaped the field. The top-cited paper, "Best-worst multi-criteria decision-making method", by Jafar Rezaei, published in 2015, with 2170 citations, indicates the critical impact of decision-making methodologies in operational research. This is followed by Nawaz, Enscore, and Ham's 1983 paper on a heuristic algorithm for the m-machine, n-job flowshop sequencing problem, which continues to influence scheduling research with 1728 citations.

The topic diversity among the most cited papers reflects the broad scope of *Omega*'s impact. Papers range from foundational theories in process and product innovation by Utterback and Abernathy in 1975 to contemporary issues like sustainable supply chain management and circular economy by Genovese et al. in 2017. The consistent citation of works across decades indicates the journal's role in publishing enduring and influential research. The significant citation rates of papers like those by Gefen on e-commerce trust in 2000 and Li et al. on supply chain management practices in 2006 demonstrate the journal's role in bridging theoretical advancements and practical applications. This blend of theoretical and applied research has likely contributed to *Omega*'s strong citation metrics.

Table 6 focuses on the top 50 most cited documents specifically within *Omega* publications. The high citation count of classic works like Charnes et al.'s 1978 paper in the *European Journal of Operational Research* (259 citations) and Banker et al.'s 1984 paper in *Management Science* (161 citations) signifies the foundational nature of these works in the field of operational research. These papers have provided critical methodologies and frameworks that continue to underpin contemporary research. Note that they are among the five most cited papers of all-time among OR&MS journals [35].

The presence of numerous articles by Tone and Cook in the recent decade highlights ongoing advancements and the evolving nature of research topics within *Omega*. The recurrent citation of books and book chapters, such as Saaty's "Analytical Hierarchy Process" and Nunnally's "Psychometric Theory," indicates the journal's integration of comprehensive methodologies and theoretical frameworks into its cited literature. Note that the journal has also highly cited the work of several Nobel Prize winners in Economics, including Harry M. Markowitz (portfolio selection) and Daniel Kahneman (prospect theory).

Across Tables 4, 5, and 6, a pattern of influential research, both foundational and contemporary, emerges. The citation metrics reveal a blend of seminal theories and practical applications that continue to shape the field of operational research. The geographic distribution of citations highlights the global reach and collaborative nature of research in this domain. Furthermore, the interdisciplinary citations emphasise the interconnectedness of operational research with various fields, underscoring the journal's broad impact.

3.3. Most productive authors, institutions and countries

Table 7 provides an in-depth analysis of the top 50 most productive leading authors in *Omega*, highlighting their respective universities, countries, total publications (TP), total citations (TC), H-index (H) [65, 66], citations per publication (C/P), and other key metrics [67]. This analysis sheds light on the significant contributors to the journal and their impact on the field.

At the top of the list is Benjamin Lev from Drexel University (USA), with 22 publications and 815 citations, resulting in an H-index of 13 and an impressive citations-per-publication ratio of 37.04. Lev's work, with five publications cited over 50 times and 15 cited over 10 times, demonstrates substantial influence in the field. Following closely is Samuel Eilon from the Imperial College of London (UK), with 21 publications but significantly fewer citations (81) and a lower H-index (6), reflecting a more modest impact.

Tai Chiu Edwin Cheng from the Hong Kong Polytechnic University, with 18 publications and 1218 citations, showcases a strong influence with an H-index of 13 and a citations-per-publication ratio of 67.66. Notably, Cheng has nine publications cited over 50 times and 17 over 10

Table 5
The 50 most cited documents in Omega.

R	TC	Title	Author/s	Year	Citations per year
1	2170	Best-worst multi-criteria decision-making method	Rezaei, J	2015	217
2	1728	A heuristic algorithm for the m-machine, n-job flowshop sequencing problem	Nawaz, M; Enscore, EE; Ham, I	1983	41.14
3	1649	E-commerce: the role of familiarity and trust	Gefen, D	2000	65.96
4	1646	Dynamic model of process and product innovation	Utterback, JM; Abernathy, WJ	1975	32.92
5	1051	Consumer trust in B2C e-Commerce and the importance of social presence: experiments in e-Products and e-Services	Gefen, D; Straub, DW	2004	50.05
6	958	Best-worst multi-criteria decision-making method: Some properties and a linear model	Rezaei, J	2016	106.44
7	934	The impact of supply chain management practices on competitive advantage and organizational performance	Li, SH; Ragu-Nathan, B; Ragu-Nathan, TS; Rao, SS	2006	49.16
8	865	An application procedure for DEA	Golany, B; Roll, Y	1989	24.03
9	801	Global supplier development considering risk factors using fuzzy extended AHP-based approach	Chan, FTS; Kumar, N	2007	44.5
10	730	Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications	Genovese, A; Acquaye, AA; Figueroa, A; Koh, SCL	2017	91.25
11	702	Application of support vector machines in financial time series forecasting	Tay, FEH; Cao, LJ	2001	29.25
12	670	The multiple traveling salesman problem: an overview of formulations and solution procedures	Bektas, T	2006	35.26
13	655	Intrinsic and extrinsic motivation in Internet usage	Teo, TSH; Lim, VKG; Lai, RYC	1999	25.19
14	636	Dynamic DEA: A slacks-based measure approach	Tone, K; Tsutsui, M	2010	42.4
15	636	The single-period (newsvendor) problem: literature review and suggestions for future research	Khouja, M	1999	24.46
16	633	A review of scheduling research involving setup considerations	Allahverdi, A; Gupta, JND; Aldowaisan, T	1999	24.35
17	607	Assessing the unidimensionality of measurement: A paradigm and illustration within the context of information systems research	Segars, AH	1997	21.68
18	598	Deviation measures of linguistic preference relations in group decision making	Xu, ZS	2005	29.9
19	534	A hybrid ARIMA and support vector machines model in stock price forecasting	Pai, PF; Lin, CS	2005	26.7
20	533	A critical review on supply chain risk: Definition, measure and modeling	Heckmann, I; Comes, T; Nickel, S	2015	53.3
21	520	Data envelopment analysis: Prior to choosing a model	Cook, WD; Tone, K; Zhu, J	2014	47.27
22	517	Effects of self-efficacy on computer usage	Igbaria, M; Iivari, J	1995	17.23
23	502	A survey of DEA applications	Liu, JS; Lu, LYY; Lu, WM; Lin, BJY	2013	41.83
24	496	A characterisation of logistics networks for product recovery	Fleischmann, M; Krikke, HR; Dekker, R; Flapper, SDP	2000	19.84
25	490	Adoption of new information technologies in rural small businesses	Premkumar, G; Roberts, M	1999	18.85
26	470	Dynamic DEA with network structure: A slacks-based measure approach	Tone, K; Tsutsui, M	2014	42.73
27	448	Organizational innovativeness: Exploring the relationship between organizational determinants of innovation, types of innovations, and measures of organizational performance	Subramanian, A; Nilakanta, S	1996	15.45
28	444	Sustainable supply chain network design: An optimization-oriented review	Eskandarpour, M; Dejax, P; Miemczyk, J; Peton, O	2015	44.4
29	444	Responsive supply chain: A competitive strategy in a networked economy	Gunasekaran, A; Lai, KH; Cheng, TCE	2008	26.12
30	432	Simulated annealing for permutation flowshop scheduling	Osman, IH; Potts, CN	1989	12
31	430	Green product supply chain contracts considering environmental responsibilities	Hong, Z; Guo, X	2019	71.67
32	429	Selection of logistics service provider: An analytic network process (ANP) approach	Jharkharia, S; Shankar, R	2007	23.83
33	425	The capacitated lot sizing problem: a review of models and algorithms	Karimi, B; Ghomi, SMTF; Wilson, JM	2003	19.32
34	417	Environmental proactivity and business performance: an empirical analysis	González-Benito, J; González-Benito, O	2005	20.85
35	410	Implementing coordination contracts in a manufacturer Stackelberg dual-channel supply chain	Chen, J; Zhang, H; Sun, Y	2012	31.54
36	405	Exploring the antecedents of potential absorptive capacity and its impact on innovation performance	Fosfuri, A; Tribo, JA	2008	23.82
37	403	Ranking irregularities when evaluating alternatives by using some ELECTRE methods	Wang, X; Triantaphyllou, E	2008	23.71
38	393	CEO characteristics, organizational characteristics and information technology adoption in small businesses	Thong, JYL; Yap, CS	1995	13.1
39	388	An application of the AHP in vendor selection of a telecommunications system	Tam, MCY; Tummala, VMR	2001	16.17
40	380	A critical survey on the status of multiple criteria decision-making: Theory and practice	Stewart, TJ	1992	11.52
41	379	Firm-level correlates of emergent green supply chain management practices in the Chinese context	Zhu, Q; Sarkis, J; Cordeiro, JJ; Lai, KH	2008	22.29
42	377	A review of innovation research in economics, sociology and technology management	Gopalakrishnan, S; Damanpour, F	1997	13.46
43	372	Measuring performance of two-stage network structures by DEA: A review and future perspective	Cook, WD; Liang, L; Zhu, J	2010	24.8
44	359	A multi-objective approach to simultaneous strategic and operational planning in supply chain design	Sabri, EH; Beamon, BM	2000	14.36
45	354	Multimethodology: Towards a framework for mixing methodologies	Mingers, J; Brocklesby, J	1997	12.64
46	352	Network design for reverse logistics	Srivastava, SK	2008	20.71
47	350	A practical guide to robust optimization	Gorissen, BL; Yanikoglu, I; den Hertog, D	2015	35
48	350	Data envelopment analysis 1978–2010: A citation-based literature survey	Liu, JS; Lu, LYY; Lu, WM; Lin, BJY	2013	29.17
49	350	Supplier selection with multiple criteria in volume discount environments	Xia, W; Wu, Z	2007	19.44
50	343	Research in the process and content of manufacturing strategy	Leong, GK; Snyder, DL; Ward, PT	1990	9.8

times. Liang from the University of Science & Technology of China, with 17 publications and an impressive 1932 citations, boasts an H-index of 16 and a high citations-per-publication ratio of 113.64, indicating significant contributions to the field. The presence of multiple Chinese authors underscores the strong influence of Chinese research in the journal.

William R. King from the University of Pittsburgh (USA) and Joe Zhu from Worcester Polytechnic University (USA) have also contributed significantly to the journal with 16 and 15 articles, respectively. Note that Joe Zhu is currently the Deputy Editor of *Omega*. Jose Rui Figueira

from the University of Lisbon (Portugal), and Milosz Kadzinski from Poznan University of Technology (Poland), also make significant contributions with 15 and 14 publications, respectively. Figueira has 595 citations, while Kadzinski has 713 citations, reflecting robust engagement in the field. Kadzinski's work, with six publications cited over 50 times, stands out for its higher impact per paper. Chiang Kao from National Cheng Kung University (Taiwan), and Wade D. Cook from York University (Canada), further demonstrate the global nature of influential research published in *Omega*. Kao's 14 publications have garnered 518 citations (H-index of 11), while Cook's 13 publications have received 1329 citations (H-index of 11), with Cook's work achieving a notable citations-per-publication ratio of 102.23.

Authors from Asian institutions, such as Ming-Miin Yu from National Taiwan Ocean University and Hirofumi Fukuyama from Fukuoka University (Japan), contribute significantly with citations-per-publication ratios of 51 and 218.33, respectively. Fukuyama's exceptionally high ratio indicates that each of his 13 publications is highly valued in the academic community. Thompson Sian Hin Teo from National University of Singapore stands out with 1743 citations from 10 publications, an H-index of 10, and a remarkable citations-per-publication ratio of 174.3, highlighting the significant impact of his research, and Huchang Liao from Sichuan University (China), with 10 publications and 792 citations, reflect the high influence of his scholarly contributions.

The diversity of institutions and countries in the top 50 authors highlights the international scope of impactful research published in *Omega*. Authors from the USA, China, the UK, Taiwan, Portugal, Poland, Japan, Singapore, Canada, and others contribute to a rich tapestry of high-impact research. This global representation underscores *Omega*'s role as a premier journal attracting high-quality research worldwide.

Table 8 provides a detailed examination of the temporal evolution of the most productive authors in *Omega* from 1973 to 2023. This longitudinal view highlights the changing landscape of academic contributions to the journal, revealing key trends and shifts in productivity and influence over five decades.

From 1973 to 1983, Eilon emerged as the leading author with 11 publications and 44 citations. Other notable contributors during this period included Gold, Higgins, Radford, and Moskowitz, each with 5 publications but relatively low citation counts, reflecting the nascent stage of the journal and the developing nature of the field at the time.

In the subsequent decade (1984–1993), Eilon maintained his prominent position with 10 publications and 37 citations. However, this period saw a rise in contributions from other authors such as King, who produced 7 publications and garnered 86 citations, and Raghunathan with 7 publications and 80 citations. Gupta also made a significant impact with 5 publications and a notably high citation count of 231, suggesting influential research during this period. Other key contributors included Ostermark and Beasley, the latter achieving a high citation count of 262 from just 4 publications, indicating substantial influence.

From 1994 to 2003, the field experienced further diversification and increased citation impact. Teo led with 7 publications and an impressive 1134 citations, highlighting a period of high-impact research. Sueyoshi and Doyle also made notable contributions, with 7 publications each and 423 and 218 citations, respectively. Zhu stands out with 5 publications and 512 citations, reinforcing the increasing significance of their work. Authors like Grover and Ormerod also made important contributions, reflecting the growing depth and breadth of research published in *Omega*.

The period from 2004 to 2013 marked a significant shift towards higher productivity and citation impact. Liang emerged as a leading figure with 10 publications and 1511 citations, followed closely by Chen with 8 publications and 785 citations. Cheng and Lai also made substantial contributions, with Lai achieving 1502 citations from 6 publications. This period underscores a trend towards more impactful and widely recognized research, with several authors like Paradi and Avkiran contributing multiple highly cited works.

From 2014 to 2023, there is a noticeable increase in both productivity and citation impact among the leading authors. Lev led with 15 publications and 700 citations, demonstrating sustained influence. Figueira and Kadzinski also showed high productivity with 14 and 12 publications, respectively, and significant citation counts (574 and 608). Other notable contributors include Aparicio and Fukuyama, each with 11 publications and substantial citation impacts (284 and 242). Authors like Liao and Yang, with 10 and 9 publications respectively, and high citation counts, further reflect the increasing depth and global reach of *Omega*'s influence.

The temporal evolution depicted in Table 8 illustrates that there has been a clear trend towards increased productivity and higher citation impacts, reflecting the journal's growing prestige and the broader acceptance and recognition of its published research. The early years were characterized by foundational contributions with moderate citation impacts, while the later periods show a significant rise in both the number and impact of publications. This trend highlights the journal's successful adaptation to the evolving landscape of management science and operations research, continually attracting high-quality and impactful research from a diverse array of global contributors.

Table 9 provides an in-depth analysis of the most productive and influential institutions in *Omega*, highlighting the contributions from various universities worldwide.

The Chinese Academy of Sciences leads with 65 publications and 4447 citations, achieving an H-index of 35 and a citations-per-publication ratio of 68.41. This institution also has a significant number of highly cited papers, with 12 papers having over 100 citations and 29 papers with over 50 citations. The presence of 56 papers cited at least 10 times highlights the broad and sustained impact of research from this institution.

Imperial College London in the UK also stands out with 65 publications, though with a lower total citation count of 1393, resulting in an H-index of 11 and a citations-per-publication ratio of 21.43. Despite this, Imperial College has produced impactful work, with 4 papers cited over 100 times and 6 papers cited over 50 times. The university's high global standing is affirmed by its QS ranking of 6 and ARWU ranking of 25, which adds to the prestige of its contributions to *Omega*. The University of Manchester, another UK institution, has 53 publications and 1663 citations. With an H-index of 16 and a citations-per-publication ratio of 12.5, its contributions are notable but not as high-impact as those from Drexel or the Chinese Academy of Sciences. The University of Manchester has 5 papers with over 100 citations and 7 papers with over 50 citations, indicating steady contributions to the field. Manchester's global reputation is solidified by its QS ranking of 32 and ARWU ranking of 35.

The Hong Kong Polytechnic University shows strong performance with 49 publications and 3217 citations, achieving an H-index of 28 and a citations-per-publication ratio of 65.65. The institution's 12 papers cited over 100 times and 19 papers cited over 50 times highlight its significant research output and impact. National University of Singapore (NUS) is another prominent institution with 44 publications and 3926 citations. NUS has an H-index of 25 and a high citations-per-publication ratio of 89.22. NUS holds a top QS ranking of 8 and an ARWU ranking of 75, underscoring its global academic leadership.

Drexel University in the USA follows closely with 39 publications and 4390 citations. With an H-index of 21 and an impressive citations-per-publication ratio of 112.56, Drexel University's research in *Omega* is highly influential. The university has 6 papers cited over 100 times and 13 papers cited over 50 times, emphasizing its significant contributions to the field.

The data in this analysis reveals that several institutions not only produce a high volume of research but also achieve high impact, as evidenced by their citations and H-indices. Institutions like Drexel University, the Chinese Academy of Sciences, and the National University of Singapore stand out for their high citations-per-publication ratios, indicating the quality and influence of their research. The presence of highly ranked institutions such as Imperial College London, National

Table 6
Top 50 most cited documents in Omega publications.

Rank	Year	First author	Reference	Vol	Page	Type	TC
1	1978	Charnes A	Eur J Oper Res	v2	p429	A	259
2	1984	Banker RD	Manage Sci	v30	p1078	A	161
3	1957	Farrell MJ	J R Stat Soc Ser A-G	v120	p253	A	81
4	1976	Keeney RL	Decisions Multiple Objectives			B	72
5	1980	Saaty T	Analytical Hierarchy Process			B	58
6	2001	Tone K	Eur J Oper Res	v130	p498	A	58
7	2008	Kao C	Eur J Oper Res	v185	p418	A	52
8	1993	Andersen P	Manage Sci	v39	p1261	A	49
9	2010	Cook WD	Omega-Int J Manage S	v38	p423	A	48
10	2009	Tone K	Eur J Oper Res	v197	p243	A	48
11	1952	Markowitz H	J Financ	v7	p77	A	41
12	1999	Khouja M	Omega-Int J Manage S	v27	p537	A	40
13	2010	Tone K	Omega-Int J Manage S	v38	p145	A	40
14	1978	Nunnally JC	Psychometric Theory	2nd ed		B	38
15	1985	Charnes A	J Econometrics	v30	p91	A	37
16	2013	Liu JS	Omega-Int J Manage S	v41	p893	A	36
17	1998	Silver EA	Inventory Management			B	36
18	1974	Tversky A	Science	v185	p1124	A	36
19	2009	Melo MT	Eur J Oper Res	v196	p401	A	35
20	2009	Yu HS	Omega-Int J Manage S	v37	p788	A	35
21	1962	Charnes A	Nav Res Logist Q	v9	p181	A	34
22	2009	Chen Y	Eur J Oper Res	v196	p1170	A	34
23	2009	Cook WD	Eur J Oper Res	v192	p1	A	34
24	2000	Fare R	Soc Ec Planning Sci	v34	p35	A	34
25	2008	Liang L	Nav Res Log	v55	p643	A	34
26	2004	Bertsimas D	Oper Res	v52	p35	A	33
27	2005	Cachon GP	Manage Sci	v51	p30	A	33
28	1998	Chambers RG	J Optimiz Theory App	v98	p351	A	33
29	2007	Cooper W	Data Envelopment Analysis	2nd ed		B	33
30	1979	Graham RL	Discrete Optimisation		p287	BC	33
31	2014	Tone K	Omega-Int J Manage S	v42	p124	A	32
32	2003	Chiang WYK	Manage Sci	v49	p1	A	31
33	2014	Cook WD	Omega-Int J Manage S	v44	p1	A	31
34	1983	Nawaz M	Omega-Int J Manage S	v11	p91	A	30
35	1979	Garey MR	Computers Intractability			B	29
36	1977	Saaty TL	J Math Psychol	v15	p234	A	29
37	1999	Seiford LM	Manage Sci	v45	p1270	A	29
38	1974	Baker KR	Intro Sequencing Sch			B	28
39	1994	Fare R	Am Econ Rev	v84	p66	A	28
40	2010	Fukuyama H	Omega-Int J Manage S	v38	p398	A	28
41	1979	Kahneman D	Econometrica	v47	p263	A	28
42	2006	Tomlin B	Manage Sci	v52	p639	A	28
43	2009	Avkiran NK	Omega-Int J Manage S	v37	p930	A	27
44	1996	Chambers RG	J Econ Theory	v70	p407	A	27
45	1963	Cyert RM	Behavioral Theory Fi			B	27
46	1997	Lee HL	Manage Sci	v43	p546	A	27
47	1999	Petruzzi NC	Oper Res	v47	p183	A	27
48	2016	Snyder LV	IIE Trans	v48	p89	A	27
49	1958	Wagner HM	Manage Sci	v5	p89	A	27
50	2003	Cachon GP	Handbook Oper Res	v11	p229	BC	26

Abbreviations are available in the previous tables except for: Vol = Volume; *A* = Article; *B* = Book; BC = Book Chapter.

University of Singapore, and the University of Manchester within *Omega*'s most productive contributors highlights the journal's alignment with globally recognized centres of excellence. The consistent output from these prestigious institutions ensures a continuous infusion of high-quality research, reinforcing *Omega*'s status as a leading journal and contributing to the advancement of the field on a global scale.

The temporal evolution of the most productive institutions in *Omega* reflects significant shifts in global academic productivity and influence over time. Table 10 reveals how different institutions have dominated various periods, highlighting trends in geographic and institutional shifts in research productivity.

From 1973 to 1983, the leading institutions were predominantly from the United Kingdom and the United States. Imperial College London has the highest total publications (TP = 34) and citations (TC = 356), indicating its strong influence in this early period. Other notable institutions include the University of Manchester and the University of Sussex, which have contributed significantly to the research landscape during this decade. The prominence of these UK institutions underscores the historical dominance of British academia in research productivity during the early years of *Omega*.

The period from 1984 to 1993 shows a continuation of Imperial College London's dominance (TP = 27, TC = 789), but with a more pronounced focus on impact, as evidenced by the significant increase in total citations. This reflects the institution's ability to maintain a strong presence in research while increasing the influence of its work. During this decade, American institutions like the University of Toledo and Ohio State University also began to emerge as key players, with Ohio State University particularly notable for its high citation count (TC = 491), indicating impactful research contributions.

The shift in institutional dominance became more apparent from 1994 to 2003, when Asian institutions, particularly from Singapore and China, started to feature prominently. The National University of Singapore takes the lead with a substantial number of citations (TP = 20, TC = 2712), marking a pivotal moment where Asian academia begins challenging Western institutions' traditional dominance. The rise of Cardiff University (TP = 16, TC = 1138) and the University of Warwick

Table 7
Top 50 most productive authors in Omega.

R	Author Name	University	Country	TP	TC	H	C/P	≥50	≥10	T50	HCP
1	Lev B	Drexel U	USA	22	815	13	37.04	5	15	0	1
2	Eilon S	Imperial Coll London	UK	21	81	6	3.85	0	2	0	0
3	Cheng TCE	Hong Kong Polytech U	CHN	18	1218	13	67.66	9	17	1	0
4	Liang L	U Sci & Tech China	CHN	17	1932	16	113.64	12	17	1	0
5	King WR	U Pittsburgh	USA	16	365	9	22.81	1	9	0	0
6	Zhu J	Worcester Polytech Inst	USA	15	1889	15	125.93	11	15	2	1
7	Figueira JR	U Lisbon	POR	15	595	12	37.18	5	14	0	0
8	Kadzinski M	Poznan U Tech	POL	14	713	11	50.92	6	11	0	1
9	Kao C	Natl Cheng Kung U	TWN	14	518	11	37	4	11	0	0
10	Cook WD	York U	CAN	13	1329	11	102.23	5	11	2	1
11	Yu MM	Natl Taiwan Ocean U	TWN	13	663	10	51	3	10	0	0
12	Fukuyama H	Fukuoka U	JAP	13	655	10	218.33	3	10	0	0
13	Lim A	Natl U Singapore	SGP	13	356	11	27.38	1	13	0	0
14	Chen Y	U Massachusetts Lowell	USA	11	931	11	84.64	8	11	0	0
15	Sawik T	Reykjavik U	ICE	11	903	10	82.09	8	10	0	1
16	Pastor JT	U Miguel Hernandez	SPA	11	530	10	48.18	5	10	0	0
17	Aparicio J	U Miguel Hernandez	SPA	11	284	9	25.81	2	9	0	0
18	Teo TSH	Natl U Singapore	SGP	10	1743	10	174.3	7	10	1	0
19	Wu J	U Sci & Tech China	CHN	10	836	10	83.6	5	10	0	0
20	Liao HC	Sichuan U	CHN	10	792	8	79.2	5	8	0	3
21	Yang LX	Beijing Jiaotong U	CHN	10	579	9	57.9	4	9	0	0
22	Li YJ	U Sci & Tech China	CHN	10	571	10	5.1	4	10	0	0
23	Dolgui A	CNRS	FRA	10	149	6	14.9	0	6	0	0
24	Khouja M	U N Carolina	USA	9	790	7	87.77	2	5	1	0
25	Slowinski R	Poznan U Tech	POL	9	626	9	69.55	5	9	0	1
26	Beasley JE	Brunel U	UK	9	576	7	6.33	4	6	0	0
27	Greco S	U Portsmouth	UK	9	498	8	55.33	4	8	0	0
28	Wang SY	Chinese Acad Sci	CHN	9	425	8	47.22	3	8	0	0
29	Gao ZY	Beijing Jiaotong U	CHN	9	403	7	44.77	3	7	0	0
30	Kowalski K	State Connecticut	USA	9	213	7	23.66	1	7	0	0
31	Nutt PC	Ohio State U	USA	9	100	6	11.11	0	4	0	0
32	Raghunathan TS	U Toledo	USA	9	93	5	10.33	0	2	0	0
33	Lu WM	Natl Def U	CHN	8	1361	8	170.12	5	8	2	0
34	Paradi JC	U Toronto	CAN	8	704	7	88	4	6	0	0
35	Stewart TJ	U Cape Town	S.A	8	682	7	85.25	2	7	1	0
36	Sueyoshi T	Tokio U Sci	JAP	8	490	7	61.25	5	7	0	0
37	Liu WB	Hunan U	CHN	8	414	7	51.75	4	7	0	0
38	Vanhoucke M	Ghent U	BEL	8	400	8	50	4	7	0	0
39	Li XY	Tongji U	CHN	8	346	7	43.25	2	7	0	0
40	Chen LH	Peking U	CHN	8	295	8	36.87	2	7	0	0
41	Grover V	Clemson U	USA	8	293	7	36.62	2	7	0	0
42	Doyle JR	Cardiff U	UK	8	278	6	34.75	2	5	0	0
43	Zhou XY	Drexel U	USA	8	225	5	28.13	2	5	0	0
44	Adlakha V	U Baltimore	USA	8	184	7	23	1	6	0	0
45	Lunday BJ	Air Force Inst Tech	USA	8	160	6	20	1	6	0	0
46	Sculli D	U Hong Kong	CHN	8	120	6	15	0	4	0	0
47	Mehrez A	Ben Gurion U Negev	ISR	8	66	4	8.25	0	2	0	0
48	Gold B	Claremont Graduate U	USA	8	40	4	5	0	1	0	0
49	Higgins JC	U Bradford	UK	8	29	3	3.62	0	1	0	0
50	8 authors	–	–	7	–	–	–	–	–	–	–

Abbreviations are available in the previous tables. Note that the 8 authors ranked in the position 50 are: Paul D. Berger (1943–2021) (Bentley University, USA), Barrie G. Dale (University of Manchester, UK), Magid Igbaria (1958–2002) (Claremont Graduate University, USA), Kee Hung Lai (Hong Kong Polytechnic University, China), Sebastian Lozano (University of Seville, Spain), Stefan Nickel (Karlsruhe Institute of Technology, Germany), Francisco Saldanha-da-Gama (University of Sheffield, UK), and Kaoru Tone (National Graduate Institute for Policy Studies, Japan).

(TP = 17, TC = 876) in the UK also reflects a diversification of leading institutions within Europe, suggesting a broader distribution of research excellence.

From 2004 to 2013, the landscape shifts further towards Asian institutions. The Hong Kong Polytechnic University tops the list with a notable citation count (TP = 18, TC = 2116), emphasizing the increasing global influence of Hong Kong's academic research. Similarly, the Chinese Academy of Sciences (TP = 16, TC = 1987) and the University of Science and Technology of China (TP = 16, TC = 1751) highlight the growing dominance of Chinese institutions. This period marks a significant turning point, as Chinese institutions increased their productivity and impact on the global research community, as reflected by the high citation counts.

In the most recent period from 2014 to 2023, Chinese institutions solidify their dominance. The Chinese Academy of Sciences (TP = 49, TC = 2467) emerges as the most productive and highly cited institution, reflecting China's ascendancy in global research. Other Chinese universities, such as the University of Science and Technology of China (TP = 29, TC = 1898) and Sichuan University (TP = 29, TC = 1634), also feature prominently, being among the five most productive institutions, and illustrating the broadening of research excellence across multiple Chinese institutions. Additionally, note that Sichuan University has six articles recognized as Highly Cited Papers by the Essential Science Indicators (ESI) of the WoS Core Collection (see Table 9). This period also sees the rise of European institutions like the University of Lisbon (TP = 32, TC = 1553) and the University of Montréal (TP = 30, TC = 662), indicating a strong European presence alongside the dominant Chinese institutions.

The increasing diversity of institutions from different geographic regions, particularly in the most recent decade, reflects the globalization of academic research. The rise of Chinese and other Asian institutions, alongside established Western universities, suggests a more balanced

Table 8
Temporal evolution of the most productive authors.

R	Author	TP	TC	R	Author	TP	TC
1973–1983				2004–2013			
1	Eilon S	11	44	1	Liang L	10	1511
2	Gold B	5	24	2	Chen Y	8	785
3	Higgins JC	5	16	3	Cheng TCE	7	807
4	Radford KJ	5	14	4	Lai KH	6	1502
5	Moskowitz H	5	5	5	Paradi JC	6	638
1984–1993				6	Lev B	6	104
1	Eilon S	10	37	7	Avkiran NK	5	471
2	King WR	7	86	8	Wee HM	5	337
3	Raghunathan TS	7	80	9	Asmild M	4	235
4	Gupta SK	5	231	10	Jacobson SH	4	42
5	Ostermark R	5	37	2014–2023			
6	Beasley JE	4	262	1	Lev B	15	700
7	Gupta YP	4	231	2	Figueira JR	14	574
8	Guimaraes T	4	34	3	Kadzinski M	12	608
9	Mesak HI	4	14	4	Aparicio J	11	284
10	Mehrez A	4	12	5	Fukuyama H	11	242
1994–2003				6	Liao HC	10	792
1	Teo TSH	7	1134	7	Yang LX	9	438
2	Sueyoshi T	7	423	8	Lim A	9	218
3	Doyle JR	7	218	9	Yu MM	9	188
4	Zhu J	5	512	10	Dolgui A	9	126
5	Grover V	5	148	11	Wu J	8	547
6	Ormerod RJ	5	120	12	Kao C	8	353
7	Goodwin P	4	163	13	Gao ZY	8	262
8	Adlakha V	4	105	14	Zhou XY	8	258
9	Horowitz I	4	79	15	Lunday BJ	8	160
10	Arthurs AJ	4	75				

Abbreviations are available in the previous tables.

and competitive global research environment. The substantial citation counts for institutions like the Chinese Academy of Sciences and the University of Science and Technology of China demonstrate that these institutions are not only prolific in terms of publications but also highly influential in shaping the direction of research within *Omega*.

Next, let us group the previous results of Tables 9 and 10 into countries. For doing so, Table 11 provides a comprehensive overview of the most productive and influential countries in *Omega*, reflecting the global distribution of research contributions and their impact. This table uses similar indicators as in Tables 7 and 9. However, in this case, the analysis also considers the number of documents and citation per million inhabitants. The objective is to normalize the population size of the countries to get a more complete picture of the most productive regions of *Omega*. Note that in this table the data of UK includes England, Scotland, Wales, and Northern Ireland. China includes Hong Kong. Additionally, other political changes in the regions may also affect the data of *Omega*. Particularly, it is worth mentioning the case of Germany that includes the data from the Federal Republic of Germany, and Turkey, that today is called Türkiye in WoS Core Collection.

The United States leads the table with 1197 total publications (TP) and 48,319 total citations (TC), achieving an impressive H-index of 101 and a citations-per-publication (C/P) ratio of 40.37. The USA also boasts a significant number of highly cited papers, with 103 papers having over 100 citations and 679 papers cited over 10 times. This dominant position underscores the depth and breadth of American research in the field, further highlighted by 21 papers in the top 50 most cited (T50) and seven highly cited papers (HCP).

The United Kingdom follows with 677 publications and 19,402 citations, achieving an H-index of 70 and a C/P ratio of 28.65. The UK has produced 44 papers with over 100 citations and 319 papers with over 10 citations, indicating substantial contributions to the field. The UK's productivity is also notable on a per capita basis, with 10.10 papers per million inhabitants (P/Pop) and 289.58 citations per million inhabitants (C/Pop), showcasing its high research output relative to its population.

China ranks third with 573 publications and 28,891 citations, reflecting a high C/P ratio of 50.42 and an H-index of 92. China's impact is further evidenced by 86 papers with over 100 citations and 430 papers with over 10 citations. The country also has 10 papers in the top 50 and 18 highly cited papers. Despite its lower P/Pop and C/Pop values of 0.41 and 20.49, respectively, China's overall contributions demonstrate rapid growth and increasing influence in the field [68].

Germany, Italy, and France also contribute substantially. Each of these countries has a considerable number of highly cited papers, further emphasising their roles in advancing research in the field. The Netherlands and Australia also performed strongly. The Netherlands, with 89 publications and 6110 citations, achieves an H-index of 27 and a high C/P ratio of 68.65, while Australia has 77 publications and 3344 citations, achieving an H-index of 31 and a C/P ratio of 43.42. Countries like Portugal, and India also make significant contributions, with high C/P ratios and substantial numbers of highly cited papers.

Singapore stands out with a remarkable C/P ratio of 76.75 from 58 publications and 4452 citations. The country has 11 papers with over 100 citations and 48 papers with over 10 citations, indicating high-quality research output. Its per capita metrics are exceptional, with 11.60 papers per million inhabitants and 890.24 citations per million inhabitants, underscoring Singapore's significant research impact relative to its population.

From the above analysis, we realise that countries like the USA, UK, China, and Canada are leading in both productivity and impact. These countries consistently produce high-quality research that attracts significant citations, contributing to the advancement of the field. The per capita metrics further highlight the efficiency and impact of research output from smaller countries/regions like Taiwan, Singapore, and the Netherlands. This analysis underscores the global nature of high-impact research in *Omega*, with significant contributions from a diverse range of countries.

Table 12 provides a comprehensive overview of the annual number of papers published by various countries in the journal *Omega* over several decades, categorized by different time periods (D1-D5) and yearly outputs from 2004 to 2023. The data reveals the USA as the dominant contributor with 1197 papers, maintaining consistent output across all decades, particularly in the most recent decade (D1: 286 papers). This consistency underscores the USA's longstanding influence and leadership in the field. The UK follows with 677 papers, with a notable increase in contributions during D1 (2014–2023), reflecting a strong recent presence.

China shows a remarkable growth trajectory, moving from minimal contributions in earlier decades to producing the third-highest number of papers overall (573), most of which are concentrated in D1, indicating China's rapid ascension in research output and impact in recent years. Note that since 2017, China is the country publishing the highest number of articles annually in *Omega*. This contrasts with more established countries like Canada, which, despite having a significant presence (231 papers), shows a steadier output without the explosive growth seen in China.

European countries like Spain, Germany, Italy, and France demonstrate a stable yet less dominant presence compared to the USA and China, with their contributions spread more evenly across different decades, reflecting sustained research activity without the dramatic increases seen in other regions.

Taiwan and South Korea show significant outputs as well, particularly in D1, highlighting the increasing research contributions from Asian countries/regions beyond China. While contributing fewer papers, smaller countries like Belgium, Turkey, and Portugal exhibit focused periods of activity, with spikes in certain decades suggesting periods of intensified research focus or development in these regions. Countries like India and Iran, while lower on the list, show growth potential, as indicated by their contributions primarily concentrated in the most recent decade, signalling emerging research hubs [64,69].

Countries with traditionally smaller outputs, such as South Africa, Brazil, and New Zealand, maintain a more sporadic contribution pattern, with occasional bursts of activity, possibly reflecting varying

Table 9
The most productive and influential institutions in Omega.

R	Institution	Country	TP	TC	H	C/P	≥100	≥50	≥10	T50	HCP	QS	ARWU
1	Chinese Academy Sciences	CHN	65	4447	35	68.41	12	29	56	0	1	–	–
2	Imperial College London	UK	65	1393	11	21.43	4	6	13	1	0	6	25
3	U Manchester	UK	53	1663	16	12.5	5	7	22	0	2	32	35
4	Hong Kong Polytechnic U	CHN	49	3217	28	65.65	12	19	40	1	1	65	151–200
5	National U Singapore	SGP	44	3926	25	89.22	10	16	39	1	0	8	75
6	U Warwick	UK	44	1785	21	40.56	4	10	30	0	1	67	101–150
7	U Lisbon	POR	43	2394	29	55.67	7	16	38	1	0	266	201–300
8	U Science Technology China	CHN	42	3644	28	86.76	11	24	39	0	1	137	62
9	Cardiff U	UK	42	1848	19	44	6	10	26	0	0	154	151–200
10	Drexel U	USA	39	4390	21	112.56	6	13	30	1	1	601–610	301–400
11	U North Carolina	USA	37	1597	17	43.16	2	8	22	0	0	132	29
12	U Montréal	CAN	37	1079	19	29.16	2	5	25	0	0	141	101–150
13	U Pittsburgh	USA	35	745	14	21.28	2	2	19	0	0	222	101–150
14	Virginia Polytech Inst St U	USA	34	733	17	21.55	0	5	21	0	0	302	201–300
15	U Bath	UK	32	722	15	22.56	1	5	16	0	0	148	301–400
16	Sichuan U	CHN	31	1715	18	55.32	5	11	21	0	6	355	151–200
17	National Cheng Kung U	TWN	29	1430	20	49.31	4	10	25	0	0	228	401–500
18	City U Hong Kong	CHN	29	1150	18	39.65	4	6	20	0	1	70	151–200
19	Tsinghua U	CHN	28	1187	19	42.39	3	6	24	0	1	25	28
20	U Bradford	UK	28	334	9	11.92	1	0	9	0	0	641–650	401–500
21	U Toledo	USA	27	1801	13	66.7	4	5	13	1	0	1001–1200	701–800
22	Erasmus U Rotterdam	NET	27	1017	14	37.66	1	4	18	1	0	176	101–150
23	Huazhong U Science Tech	CHN	26	1501	17	57.73	4	6	21	0	2	61	96
24	Pennsylvania State U	USA	24	2429	13	101.2	3	4	14	1	0	83	101–150
25	York U Canada	CAN	24	1442	12	60.08	3	6	14	1	1	353	401–500
26	KU Leuven	BEL	24	1231	15	51.29	4	9	17	0	0	83	87
27	Poznan U Technology	POL	23	1236	18	53.73	4	10	19	0	0	1001–1200	–
28	U Sevilla	SPA	23	840	17	36.52	2	2	18	0	0	494	401–500
29	U Southampton	UK	22	837	12	38.04	1	3	14	1	0	81	151–200
30	U Michigan	USA	22	706	12	32.09	2	4	12	0	0	33	26
31	Ohio State U	USA	22	678	12	30.81	1	3	14	1	0	151	101–150
32	Bilkent U	TUR	22	648	13	29.45	1	3	14	0	0	502	–
33	Beijing Jiaotong U	CHN	21	957	16	45.57	3	6	18	0	0	901–950	501–600
34	CNRS	FRA	21	855	10	40.71	2	4	10	0	1	–	–
35	U Nottingham	UK	21	827	13	39.38	3	6	14	0	0	100	101–150
36	U Miguel Hernandez Elche	SPA	21	787	14	37.47	2	7	15	0	0	–	801–900
37	Xi An Jiaotong U	CHN	21	476	13	22.66	0	2	15	0	0	291	101–150
38	U Sussex	UK	21	140	7	6.66	0	1	4	0	0	218	201–300
39	Shanghai Jiao Tong U	CHN	20	1201	15	60.05	2	5	16	1	1	51	46
40	U Toronto	CAN	20	953	15	47.65	3	4	16	0	0	21	24
41	Tianjin U	CHN	20	806	12	40.3	2	6	14	0	1	285	101–150
42	Tongji U	CHN	20	723	14	36.15	2	5	14	0	0	216	151–200
43	Worcester Polytech Inst	USA	19	2384	16	20.21	8	13	16	2	1	851–900	–
44	National Taiwan Ocean U	TWN	19	874	14	46	2	5	15	0	0	1201–1400	–
45	Chinese U Hong Kong	CHN	19	807	11	42.47	4	4	11	0	0	47	101–150
46	Loughborough U	UK	19	741	10	39	1	3	15	1	0	212	601–700
47	U Porto	POR	19	463	12	29.63	2	3	12	0	0	253	201–300
48	Aston U	UK	19	323	9	17	0	2	9	0	0	446	–
49	U Hong Kong	CHN	18	1549	11	86.06	4	5	12	1	0	26	96
50	U Cape Town	S.A	18	796	10	44.22	2	2	10	1	0	173	201–300

Abbreviations are available in previous tables except for: ARWU = Academic Ranking of World Universities; QS = Quacquarelli & Symonds University Ranking.

levels of research funding or shifts in academic focus. On the lower end, nations like Saudi Arabia, Malaysia, and Chile have limited contributions, indicating either emerging research capabilities or niche focuses within the broader field.

The trends suggest a diversification of research contributions, with non-Western countries, particularly in Asia, becoming increasingly influential in the academic landscape. The table also underscores the importance of sustained investment in research infrastructure, as evidenced by the consistent outputs from countries like the USA and UK, as well as the rapid growth observed in China.

To go a step further and to analyse the contributions of supernational regions, Table 13 provides a detailed analysis of the publication structure, revealing significant disparities in research output, influence, and density. Europe is the most productive region in terms of total publications (1486). But it has a much larger population base of 750 million, which results in a lower P/Pop ratio of 1.98 and a C/Pop of 70.36. Despite having fewer top-tier papers compared to North America, Europe's research output remains substantial, contributing significantly to the global academic landscape, albeit with a lower overall impact per capita [70].

North America, with 1389 total publications (TP) and a total citation count (TC) of 54,107, stands out as a leading region in both volume and impact. This region also has the second-highest number of highly cited papers (≥500 citations) and the top 50 papers, reflecting its strong influence. Despite a relatively small population of 381 million, North America exhibits a high publication per population (P/Pop) ratio of 3.65 and an exceptionally high citation per population (C/Pop) of 142.01, underscoring its efficiency in producing highly impactful research.

Asia presents a contrasting scenario, with a high total citation count (60,162) surpassing both North America and Europe, yet with fewer total publications (1131). This region boasts the highest number of highly cited papers (≥500 citations) and the top 50 papers, indicating a growing influence in the academic world. However, considering Asia's large population of 4.7 billion, the P/Pop ratio (0.24) and C/Pop ratio (12.80) are much lower, reflecting the challenges of scaling research output and impact across such a vast population [71].

Table 10
Temporal evolution of the most productive institutions.

R	Institution	TP	TC	R	Institution	TP	TC
1973–1983				2004–2013			
1	Imperial College London	34	356	1	Hong Kong Polytechnic U	18	2116
2	U Manchester	21	45	2	Chinese Acad Sciences	16	1987
3	U Sussex	18	69	3	U Sci Tech China	16	1751
4	Virginia Polytech Inst St U	12	93	4	National Cheng Kung U	10	680
5	Case Western Reserve U	10	42	5	Cardiff U	10	524
1984–1993				6	U Lisbon	10	6
1	Imperial College London	27	789	7	U Toronto	9	713
2	U Manchester	14	173	8	U Michigan	9	379
3	U Toledo	13	223	9	Drexel U	8	1405
4	Ohio State U	11	491	10	Feng Chia U	8	588
5	U Bradford	11	61	2014–2023			
6	U Pittsburgh	10	118	1	Chinese Acad Sciences	49	2467
7	Case Western Reserve U	8	84	2	U Lisbon	32	1553
8	Florida International U	7	272	3	U Montréal	30	662
9	National Tech U Athens	7	62	4	U Sci Tech China	29	1898
10	Loughborough U	7	22	5	Sichuan U	29	1634
1994–2003				6	Hong Kong Polytechnic U	25	833
1	National U Singapore	20	2712	7	Huazhong U Sci Tech	24	1001
2	U Warwick	17	876	8	Xi'an Jiaotong U	21	487
3	Cardiff U	16	1138	9	Beijing Jiaotong U	20	817
4	U Bath	12	250	10	Tianjin U	20	806
5	Kent State U	11	508	11	Drexel U	20	789
6	U North Carolina	10	841	12	Erasmus U Rotterdam	20	371
7	U South Carolina	9	287	13	KU Leuven	19	713
8	U Southampton	8	134	14	Tsinghua U	19	603
9	City U Hong Kong	8	98	15	CNRS France	18	720

Abbreviations are available in the previous tables.

Oceania, despite its small size and population (44 million), shows a strong research output relative to its size, with a C/P ratio of 43.95, the second highest after North America. However, its total output and influence are limited, with only 98 publications and 4308 citations. The P/Pop ratio (2.23) and C/Pop ratio (97.91) highlight the region's efficiency and high-impact research relative to its small population, though its global influence remains modest.

Latin America and Africa represent regions with relatively low research output and impact. Latin America, with 64 publications and 1864 citations, has a low C/P ratio (29.12) and negligible representation in top-tier papers. With a P/Pop ratio of 0.10 and a C/Pop ratio of 2.82, it indicates that the region's research is sparse and not widely cited. Similarly, Africa has the lowest output [72], with only 46 publications and 1263 citations, resulting in a C/P ratio of 27.45 and the lowest P/Pop and C/Pop ratios (0.03 and 0.90, respectively). This underscores significant challenges in research capacity and influence within these regions [73].

The results in the above table highlight the global inequality in research output and impact, with North America and Europe leading in both volume and influence. At the same time, Asia is growing in prominence despite challenges in scaling impact across its vast population. Oceania demonstrates high efficiency in research relative to its size, whereas Latin America and Africa face significant barriers to achieving similar levels of research productivity and impact. The analysis reflects broader disparities in research infrastructure, funding, and access to academic resources across these regions, with profound implications for global knowledge production and dissemination.

4. Mapping *Omega* with VOS viewer software

4.1. General overview

This section visually represents the dependencies and interrelationships among various bibliometric indicators. The analysis showcases co-citations, bibliographic coupling, and keyword co-occurrences using the Web of Science (WoS) Core Collection database and VOS viewer software [48,49]. VOS viewer highlights the semantic similarities that citation analysis reveals, detailing the connections between authors, journals, institutions, and other entities. Note that in the literature, other software is available for mapping graphically the bibliographic material [14,74].

The section begins by examining the co-citations within *Omega*, emphasising documents from different journals that are frequently cited together in a third journal, thereby illustrating the network of scholarly influence and collaboration. Fig. 4 and Table 14 presents the co-citation of journals in *Omega* between 1974 and 2023 with a citation threshold of 50 and the 100 most representative co-citations link. The figure shows that the *European Journal of Operational Research* (*EJOR*) and *Omega - The International Journal of Management Science* (*Omega*) are the most prominent nodes, signifying their critical roles and widespread influence in operational research and management science. Other influential journals, such as *Management Science* and *Production and Operations Management* (*POM*), also play significant roles.

The visualisation delineates several distinct clusters, each representing a specific research domain and the interconnection of journals within *Omega*. The blue cluster, dominated by *EJOR*, focuses on operational research, including journals like *Annals of Operations Research* (*ANOR*) and *Computers & Operations Research* (*COR*). The green cluster, featuring *Management Science* and economic journals like *American Economic Review* (*AER*) and *Econometrica*, emphasizes management science and economics. The red cluster, with journals like the *Journal of Marketing* (*JMK*) and *Harvard Business Review* (*HBR*), highlights business and marketing research. The purple cluster, cantered around *Omega*, underscores a strong emphasis on management science. Significant linkages between clusters illustrate the cross-disciplinary nature of research, with findings in operational research often informing management science and vice versa.

Although the visualisation highlights citation density and influence, larger nodes like *EJOR* and *Management Science* serve as foundational references. Their high citation density underscores their significance. However, the analysis may overlook emerging or less-cited journals that are establishing innovative research. Additionally, as co-citation analysis relies on historical data, it might not fully capture the latest research trends and shifts.

The Figures 5(A – D), depict the co-citation of journals in *Omega* over different periods (1974–1993, 1994–2003, 2004–2013, and 2014–2023) with varying citation threshold and link to best illustrate the evolving landscape of academic research. Table 14 presents the global and temporal analysis of co-citation data. These visual representations reveal significant changes in the network structure of co-cited journals, reflecting broader trends in research focus, journal prominence, and disciplinary consolidation over time. These time periods are described as below:

Period 1974–1993: Emerging Foundations: In the earliest period (1974–1993), the co-citation network is relatively sparse, which suggests that the research field associated with *Omega* was still in its formative stages. The network likely features a limited number of journals that are repeatedly co-cited, indicating the establishment of foundational literature. The sparseness of the network points to a more fragmented research landscape where different subfields may not have been as interconnected, and a smaller number of journals had established their dominance. The prominent nodes are *Management Science, Omega, Operations Research* and *HBR*. The few clusters that do exist are likely small, representing niche areas of research that had begun to

Table 11
The most productive and influential countries/regions in Omega.

R	Country/Region	TP	TC	H	C/P	≥100	≥10	T50	HCP	P/Pop	C/Pop
1	USA	1197	48,319	101	40.36	103	679	21	7	3.59	144.98
2	UK	677	19,402	70	28.65	44	319	5	6	10.10	289.58
3	China	573	28,891	92	50.42	86	430	10	18	0.41	20.49
4	Canada	231	8029	43	34.75	16	149	2	5	5.92	205.60
5	Spain	172	8563	49	49.78	24	140	3	3	3.60	179.22
6	Taiwan	166	10,014	58	60.32	29	141	3	0	7.22	435.38
7	Germany	129	4561	35	37.69	9	88	1	4	1.54	54.30
8	Italy	107	3519	34	32.88	5	75	0	2	1.84	60.67
9	France	103	2961	27	28.74	4	61	1	1	1.54	44.19
10	Netherlands	89	6110	27	68.65	7	56	4	5	5.24	359.40
11	Australia	77	3344	31	43.42	11	51	0	0	2.96	128.59
12	Turkey	75	3410	30	45.46	8	49	2	1	0.88	40.13
13	Portugal	73	3205	34	73.9	8	60	0	0	7.30	320.49
14	India	67	3424	32	51.1	9	43	2	0	0.05	2.42
15	Israel	61	2073	18	33.98	4	30	0	0	6.78	230.33
16	Greece	60	2189	28	36.48	4	42	0	0	5.75	209.94
17	South Korea	60	1541	22	25.68	1	40	0	0	1.16	29.85
18	Belgium	59	2047	27	34.69	6	44	0	0	5.05	175.17
19	Singapore	58	4452	30	76.75	11	48	4	0	11.60	890.24
20	Japan	58	3495	28	60.25	7	42	3	1	0.46	27.96
21	Poland	52	2967	33	57.05	9	44	0	3	1.41	80.19
22	Sweden	45	951	15	21.13	1	22	0	0	4.50	95.10
23	Norway	42	1286	17	30.61	1	24	1	1	7.64	233.82
24	Iran	37	2056	19	55.56	6	30	1	2	0.42	23.22
25	Finland	35	1450	17	41.42	1	25	1	0	7.00	289.97
26	Denmark	30	836	14	27.86	3	18	0	0	5.03	140.17
27	Brazil	27	856	16	31.7	2	20	0	0	0.13	3.98
28	South Africa	27	832	11	30.81	2	11	0	0	0.46	14.10
29	New Zealand	25	1148	13	45.92	4	14	1	1	5.00	229.60
30	Austria	21	733	13	34.8	2	15	0	0	2.34	81.63
31	Switzerland	17	317	12	2.176	0	12	0	0	2.12	39.62
32	Mexico	15	247	9	16.46	0	9	0	0	0.12	1.94
33	Chile	14	476	8	34	1	2	0	1	0.74	25.05
34	Saudi Arabia	12	827	11	68.91	3	11	1	0	0.33	22.71
35	Malaysia	12	442	8	36.83	1	8	0	0	0.35	13.02
36	Czech Republic	10	469	8	46.9	1	7	0	0	1.00	46.90
37	Kuwait	9	872	7	96.88	1	7	1	0	2.09	202.79
38	Hungary	9	88	5	9.77	0	4	0	0	1.00	9.78
39	U Arab Emirates	8	435	7	54.37	2	3	0	0	0.89	48.33
40	Ireland	8	339	6	42.375	1	5	0	0	1.60	67.80
41	Thailand	7	73	4	10.42	0	3	0	0	0.10	1.03
42	Tunesia	6	253	6	42.16	0	6	0	0	0.50	21.08
43	Russia	5	100	4	20	0	2	0	0	0.03	0.70
44	Colombia	4	409	4	102.25	0	1	3	0	0.08	8.02
45	Iceland	4	138	4	34.5	0	3	0	0	10.61	366.05
46	Indonesia	4	116	3	29	0	3	0	0	0.01	0.42
47	Serbia	4	84	4	21	0	3	0	0	0.60	12.60
48	Oman	4	65	4	16.25	0	3	0	0	0.85	13.83
49	Belarus	4	64	4	16	0	3	0	0	0.44	7.11
50	Morocco	4	35	3	8.75	0	2	0	0	0.11	0.95

Abbreviations available in previous tables except: P/Po and C/Po = Papers and cites per million inhabitants.

coalesce around specific topics or methodologies.

Period 1994–2003: Growing Consolidation: In the period from 1994 to 2003, the co-citation network becomes denser, showing a significant increase in the number of co-cited journals and the formation of more substantial clusters. Along with existing journals, *Management Science* and *Omega*, and some new journals such as *EJOR, Journal of the Operational Research Society* (*JORS*) and *MIS Quarterly*, took place in top co-cited venues. This shift reflects a period of consolidation within the field, where certain journals emerged as central hubs in the academic discourse. The increase in density suggests that the research community was increasingly referencing a common set of journals, indicating the development of a more unified academic field. This period likely saw the expansion of *Omega*'s influence as the journal itself and its most frequently cited counterparts became central to the research being conducted. The appearance of more complex networks may also indicate the beginning of interdisciplinary influences as research topics broadened and diversified.

Period 2004–2013: Network Complexity and Interdisciplinary Growth: The period from 2004 to 2013 shows a further increase in the complexity of the co-citation network. The network becomes even more densely populated with co-citation links, suggesting a mature and well-developed research field. During this period, the number of frequently co-cited journals increased, reflecting both the growth of the field and the rising prominence of interdisciplinary research. The prominent nodes are *Omega, EJOR, Management Science, JORS* and *Operations Research*. The clusters in this network are larger and more interconnected, indicating that different subfields within the broader domain interact more closely. This period may also reflect the impact of digitalisation in academia, where the ease of access to a wide range of journals could have facilitated more comprehensive literature reviews and broader citation practices. This growing network complexity suggests that researchers were increasingly drawing from various sources, leading to a richer, more interconnected body of knowledge (Fig. 5).

Period 2014–2023: Maturity and Dominance of Core Journals: In the most recent period (2014–2023), the co-citation network reaches its

Table 12
Annual number of papers classified by countries/regions.

R	Country/Region	Total	D1	D2	D3	D4	D5	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	USA	1197	286	205	229	247	230	18	12	19	18	30	27	12	25	14	30	20	20	24	22	23	39	28	52	24	34
2	UK	677	114	83	120	159	201	5	4	7	7	8	9	10	7	16	10	14	12	13	13	10	8	8	21	5	10
3	Peoples R China	573	437	95	24	13	4	3	4	5	7	18	10	3	11	21	13	20	30	21	23	37	56	42	96	49	63
4	Canada	231	108	42	20	26	35	2	2	5	2	3	2	1	7	9	9	8	12	7	9	11	11	12	23	9	6
5	Spain	172	93	61	17	1	0	6	3	4	3	3	9	8	11	10	4	7	9	12	12	6	9	11	11	9	7
6	Taiwan	166	53	88	22	3	0	2	11	6	14	10	8	7	4	10	16	7	6	10	5	1	4	5	6	4	5
7	Germany	129	85	24	10	7	3	1	1	1	2	0	4	2	3	3	7	5	8	9	6	7	10	7	17	6	10
8	Italy	107	87	11	4	2	3	1	1	0	0	1	1	1	0	3	3	4	3	10	9	13	7	16	8	8	9
9	France	103	73	12	4	6	8	0	0	1	0	1	5	1	1	2	1	4	7	4	4	5	4	10	11	13	11
10	Netherlands	89	61	12	10	3	3	0	2	2	2	0	2	0	2	1	1	2	7	3	3	6	6	12	9	5	8
11	Australia	77	35	19	10	9	4	1	3	1	0	2	2	1	4	5	0	1	4	5	3	4	2	1	9	1	5
12	Turkey	75	42	21	7	4	1	2	0	3	2	3	1	2	2	5	1	3	7	4	4	2	2	3	8	4	5
13	Portugal	73	56	15	1	1	0	0	0	1	0	3	2	0	3	5	1	6	5	1	5	7	6	6	10	5	5
14	India	67	22	25	6	10	4	1	6	1	3	4	5	0	1	1	3	3	3	1	3	1	2	0	3	2	4
15	Israel	61	10	8	9	9	25	1	1	0	0	3	1	0	0	1	1	2	1	3	1	1	1	1	0	0	0
16	Greece	60	21	18	7	9	5	0	1	1	1	3	0	6	1	4	1	5	2	3	1	1	3	2	0	2	2
17	South Korea	60	32	15	11	1	1	0	0	2	3	0	5	2	2	0	1	4	1	2	5	0	3	3	7	5	2
18	Belgium	59	39	16	1	1	2	1	0	2	0	0	2	1	3	3	4	4	0	5	1	4	7	8	5	3	2
19	Singapore	58	18	10	22	8	0	0	3	1	1	2	2	0	1	0	0	1	2	2	0	2	1	1	7	0	2
20	Japan	58	25	14	9	7	3	0	1	2	0	1	1	3	0	2	4	2	1	4	4	3	4	1	2	4	0
21	Poland	52	34	15	1	0	2	0	1	1	2	1	1	3	2	1	3	2	5	2	6	2	4	2	4	4	3
22	Sweden	45	15	11	3	8	8	0	1	1	2	2	4	0	0	1	0	0	2	1	0	1	5	2	2	1	1
23	Norway	42	18	11	4	3	6	1	0	1	1	0	3	2	0	2	1	1	4	0	4	1	1	2	1	1	3
24	Iran	37	29	7	1	0	0	0	1	0	0	0	2	0	2	1	1	1	0	1	2	3	2	3	5	6	6
25	Finland	35	10	8	4	10	3	0	0	0	0	1	5	0	2	0	0	3	1	1	0	1	0	0	4	0	0
26	Denmark	30	19	6	0	2	3	0	0	0	1	1	2	0	0	0	2	0	0	0	3	0	3	4	4	4	1
27	Brazil	27	16	8	2	0	1	0	0	0	1	2	1	1	1	1	1	0	2	0	0	3	0	3	6	1	1
28	South Africa	27	2	7	4	13	1	1	0	0	0	0	3	1	0	1	1	0	0	1	0	1	0	0	0	0	0
29	New Zealand	25	9	7	6	2	1	0	1	1	0	0	3	0	1	1	0	0	0	1	1	3	0	0	2	1	1
30	Austria	21	12	4	1	1	3	0	0	0	0	2	1	0	0	0	1	0	1	0	0	0	1	4	3	2	1
31	Switzerland	17	11	5	0	1	0	0	0	0	1	1	0	0	0	2	1	1	1	0	1	0	3	2	0	2	1
32	Mexico	15	11	3	0	0	1	0	1	0	0	0	0	0	0	1	1	0	1	0	1	0	1	3	3	1	1
33	Chile	14	12	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	4	2	1	1
34	Saudi Arabia	12	8	1	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	1	2	0	1	1
35	Malaysia	12	8	1	1	2	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	0	2	0
36	Czech Republic	10	8	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	3	1	0
37	Kuwait	9	1	3	3	1	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
38	Hungary	9	6	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	2	1
39	U Arab Emirates	8	6	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0	2	0	0
40	Ireland	8	4	1	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	1	0	1	0

Abbreviations: D1 = 2014–2023; D2 = 2004–2013; D3 = 1994–2003; D4 = 1984–1993; D5 = 1973–1983; rest of columns indicate the annual number of papers between 2004 and 2023.

Table 13
Publication structure classified by supranational regions.

Region	TP	TC	H	C/P	≥500	≥100	T50	HCP	Population	P/Pop	C/Pop
Europe	1486	52,768	105	35.51	5	110	13	21	750	1.98	70.36
North America	1389	54,107	105	38.95	10	114	21	10	381	3.65	142.01
Asia	1131	60,162	118	53.19	12	160	25	22	4700	0.24	12.80
Oceania	98	4308	34	43.95	0	14	1	1	44	2.23	97.91
Latin America	64	1864	25	29.12	0	3	0	1	660	0.10	2.82
Africa	46	1263	20	27.45	0	2	1	0	1400	0.03	0.90

Abbreviations available in previous tables. Population in millions.

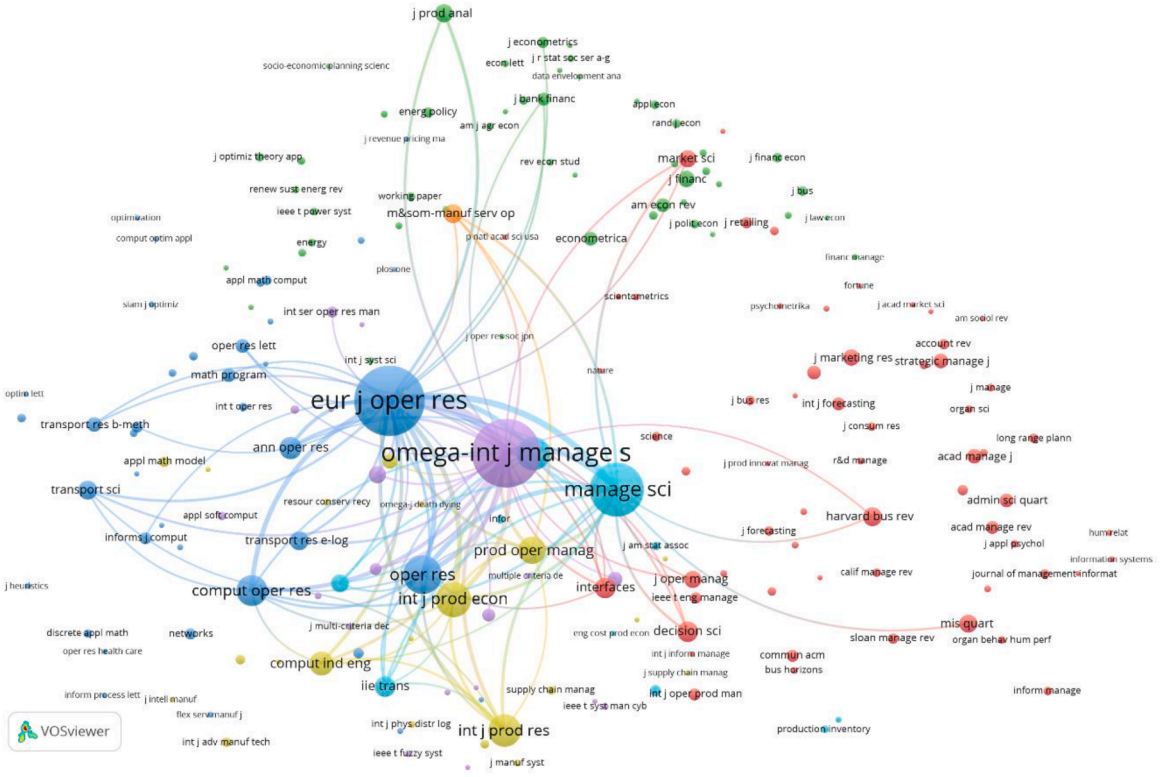


Fig. 4. Co-citation of journals in Omega: minimum citation threshold of 50 and 100 links.

highest level of complexity and density. The minimum citation threshold is raised to 40, reflecting the vast expansion of the field and the need to focus only on the most influential journals to maintain clarity in the network. This highly interconnected network indicates that the research field has reached a high level of maturity, with certain journals emerging as dominant forces. The prominent nodes in this era are *EJOR, Omega, Management Science* and *Operational Research*. These journals likely serve as critical nodes in the network, facilitating the flow of knowledge across different subfields and possibly even across disciplines. The dominance of these journals in the co-citation network suggests that the field has solidified around a few key sources of authority, which are now central to both the production and dissemination of knowledge. This period might also reflect a trend toward the specialisation and deepening of subfields, where research is concentrated around established journals that are seen as leaders in specific areas. Multiple large clusters could indicate the coexistence of several dominant subfields within the broader research landscape. Additionally, the dense interconnections between these clusters suggest that while the field may be specialised, there is still significant interdisciplinary collaboration and influence as researchers draw on various sources to inform their work.

Overall Analysis: Evolution from Fragmentation to Integration: Across these four periods, the evolution of the co-citation network in *Omega* reveals a clear trajectory from a fragmented, nascent field to a mature, integrated research community. The increasing density and complexity of the networks over time reflect broader trends in academic research, including the consolidation of knowledge, the emergence of core journals, and the increasing importance of interdisciplinary approaches, as presented in Table 14.

In the early years, the research landscape was more dispersed, with a few key journals beginning to establish themselves as foundational to the field. As the field grew and matured, these journals became more central, and the research community began to coalesce around them, leading to the denser networks seen in later periods. The rise in the minimum citation threshold over time reflects the growing research volume and the need to focus on the most influential sources to understand the field's development clearly.

By the most recent period, the research field had reached a level of maturity where a small number of journals dominated the discourse, serving as essential hubs for knowledge dissemination. This maturity is also reflected in the network's complexity, indicating a highly interconnected and interdisciplinary field where research is both deepening within specific areas and broadening across traditional boundaries.

This analysis of the changing landscape of co-citation in *Omega* highlights the dynamic nature of academic research and the ongoing evolution of scholarly communication. The network structure shifts provide valuable insights into how research fields develop, consolidate,

Table 14
Co-citation of journals in Omega: Global and temporal analysis.

	Global		2014–2023		2004–2013		1994–2003		1974–1993	
R	Journal	Cit	Journal	Cit	Journal	Cit	Journal	Cit	Journal	Cit
1	Eur J Oper Res	9215	Eur J Oper Res	6590	Omega-Int J Manage S	2199	Manage Sci	771	Manage Sci	889
2	Omega-Int J Manage S	8794	Omega-Int J Manage S	5749	Eur J Oper Res	1935	Eur J Oper Res	533	Omega-Int J Manage S	446
3	Manage Sci	5373	Manage Sci	2734	Manage Sci	979	Omega-Int J Manage S	400	Oper Res	387
4	Oper Res	2787	Int J Prod Econ	1842	J Oper Res Soc	579	J Oper Res Soc	333	Harvard Bus Rev	298
5	Int J Prod Econ	2374	Oper Res	1598	Oper Res	526	MIS Quart	278	Interfaces	289
6	J Oper Res Soc	2130	Prod Oper Manag	1275	Int J Prod Econ	461	Oper Res	276	Int J Prod Res	264
7	Int J Prod Res	1948	Comput Oper Res	1273	Comput Oper Res	399	Decision Sci	271	J Oper Res Soc	243
8	Comput Oper Res	1842	Int J Prod Res	1161	Int J Prod Res	279	Int J Prod Res	244	MIS Quart	178
9	Prod Oper Manag	1403	J Oper Res Soc	975	IIE Trans	190	Harvard Bus Rev	181	J Financ	160
10	Comput Ind Eng	1131	Comput Ind Eng	879	Fuzzy Set Syst	188	Interfaces	175	Oper Res Quart	160
11	Ann Oper Res	974	Ann Oper Res	781	J Oper Manag	188	J Marketing Res	173	Eur J Oper Res	157
12	Interfaces	820	M&SOM-Manuf Serv Op	683	Strategic Manage J	185	Acad Manage J	156	Admin Sci Quart	146
13	IIE Trans	809	Transport Res E-Log	628	Comput Ind Eng	173	Strategic Manage J	137	Decision Sci	134
14	Decision Sci	778	Transport Sci	591	Decision Sci	166	Commun ACM	127	Manage Sci B-Appl	134
15	M&SOM-Manuf Serv Op	707	IIE Trans	478	J Prod Anal	163	Admin Sci Quart	118	Account Rev	128
16	Harvard Bus Rev	703	Expert Syst Appl	456	Int J Oper Prod Man	140	J Manage Inform Syst	117	Long Range Plann	94
17	Transport Res E-Log	690	Market Sci	432	J Bank Financ	137	Acad Manage Rev	113	Comput Oper Res	88
18	Transport Sci	681	J Prod Anal	417	Nav Res Log	136	Int J Forecasting	110	Econometrica	86
19	MIS Quart	635	J Clean Prod	390	Ann Oper Res	134	J Financ	104	Acad Manage J	80
20	Nav Res Log	635	Transport Res B-Meth	376	Harvard Bus Rev	131	J Marketing	96	Commun ACM	79
21	J Prod Anal	606	Nav Res Log	364	J Marketing Res	127	Inform Manage	90	Organ Behav Hum Perf	76
22	Market Sci	569	Oper Res Lett	276	Interfaces	125	IIE Trans	87	AIIE T	75
23	J Oper Manag	559	J Oper Manag	274	Prod Oper Manag	122	Sloan Manage Rev	85	J Bus	73
24	Expert Syst Appl	550	Math Program	268	MIS Quart	120	Decis Support Syst	84	J Accounting Res	72
25	J Marketing Res	511	Decis Support Syst	251	J Marketing	118	Comput Oper Res	82	J Marketing Res	70
26	J Financ	490	INFORMS J Comput	232	Acad Manage J	116	J Oper Manag	79	Acad Manage Rev	68
27	Strategic Manage J	424	Interfaces	231	Acad Manage Rev	109	J Forecasting	78	Decision Sciences	68
28	Decis Support Syst	423	OR Spectrum	226	Market Sci	104	Inform Syst Res	77	Nav Res Log	64
29	Transport Res B-Meth	410	Inform Sciences	216	J Financ	100	Int J Prod Econ	71	J Am Stat Assoc	62
30	J Clean Prod	402	Decision Sci	207	Expert Syst Appl	83	Nav Res Log	71	J Marketing	62
31	Acad Manage J	392	Appl Math Model	200	Int J Forecasting	75	Account Rev	65	Sloan Manage Rev	59
32	Econometrica	377	Am Econ Rev	188	Am Econ Rev	69	J Consum Res	62	IIE Trans	54
33	J Marketing	371	Energ Policy	181	J Econometrics	69	Ann Oper Res	54	J Forecasting	54
34	Oper Res Lett	365	Econometrica	178	IEEE T Eng Manage	68	Comput Ind Eng	54	Strategic Manage J	53
35	Admin Sci Quart	351	J Bank Financ	174	Decis Support Syst	67	IEEE T Eng Manage	53	Am Econ Rev	49
36	Math Program	349	Networks	173	Oper Res Lett	67	Int J Oper Prod Manage	50	J Appl Psychol	48
37	Am Econ Rev	348	Int J Adv Manuf Tech	161	Econometrica	66	J Int Bus Stud	50	J Financ Quant Anal	47
38	Int J Forecasting	344	J Retailing	154	Inform Syst Res	66	Organ Behav Hum Dec	50	Harv Bus Rev	45
39	J Bank Financ	336	J Scheduling	145	Transport Sci	66	Calif Manage Rev	49	Hum Relat	43
40	Fuzzy Set Syst	324	Int T Oper Res	143	Sloan Manage Rev	65	Econometrica	47	Financ Manage	42

Abbreviations: Cit = Citations; CLS = Citation link strength.

and mature and how journals play a crucial role in shaping the direction and focus of academic inquiry.

Fig. 6 shows the network of co-citation of documents in *Omega*, illustrating how certain documents have become central to the research community. This network is based on a minimum citation threshold of 20 and displays 100 links.

The prominent key nodes in this network are Charnes et al. (1978), Banker et al. (1984), and Cook et al. (2001), which are foundational in operations research and management science, particularly in decision making, data envelopment analysis (DEA) and optimisation methodologies. These heavily cited documents form prominent nodes in the network, indicating their critical role in shaping subsequent research within *Omega*.

The network also reveals several distinct clusters, each likely representing a particular subfield within *Omega*'s research landscape. For instance, the red cluster, dominated by works like Charnes (1978), is likely focused on DEA, while the purple cluster, including Keeney (1976) and Tversky (1974), seems to revolve around decision-making theories and behavioural economics. Another cluster, marked by green nodes, appears to represent research in supply chain management and inventory theory. These distinct clusters suggest that while the research areas are interrelated, they have developed into specialised fields with their own key references and methodologies, indicating the depth and specialisation of *Omega*'s coverage.

Interestingly, the network also shows cross-cluster connections, indicating some level of interdisciplinary influence or the application of theories across different fields. These connections highlight the interconnected nature of modern research, where insights from one area can enhance another, showing how methodologies in operations research, for instance, might influence behavioural decision-making.

Moreover, the network distinguishes between well-established and potentially emerging research areas. The densely connected clusters represent mature fields where foundational works have been extensively cited, while smaller or less connected clusters might indicate newer research areas still developing critical mass. The temporal aspect is evident as earlier works, such as Charnes (1978) and Markowitz (1952), form the backbone of their clusters, showing long-standing influence, whereas more recent works from 2010 onwards are beginning to form their networks, hinting at the journal's evolving research focus.

In addition to the above analysis, when we look closely at Fig. 6, we find that compared to other citation networks, *Omega's* co-citation network appears more specialised, with a few key areas dominating the landscape. Unlike journals with a broader focus, where the network might be more diffuse, *Omega* demonstrates deep, well-defined clusters,

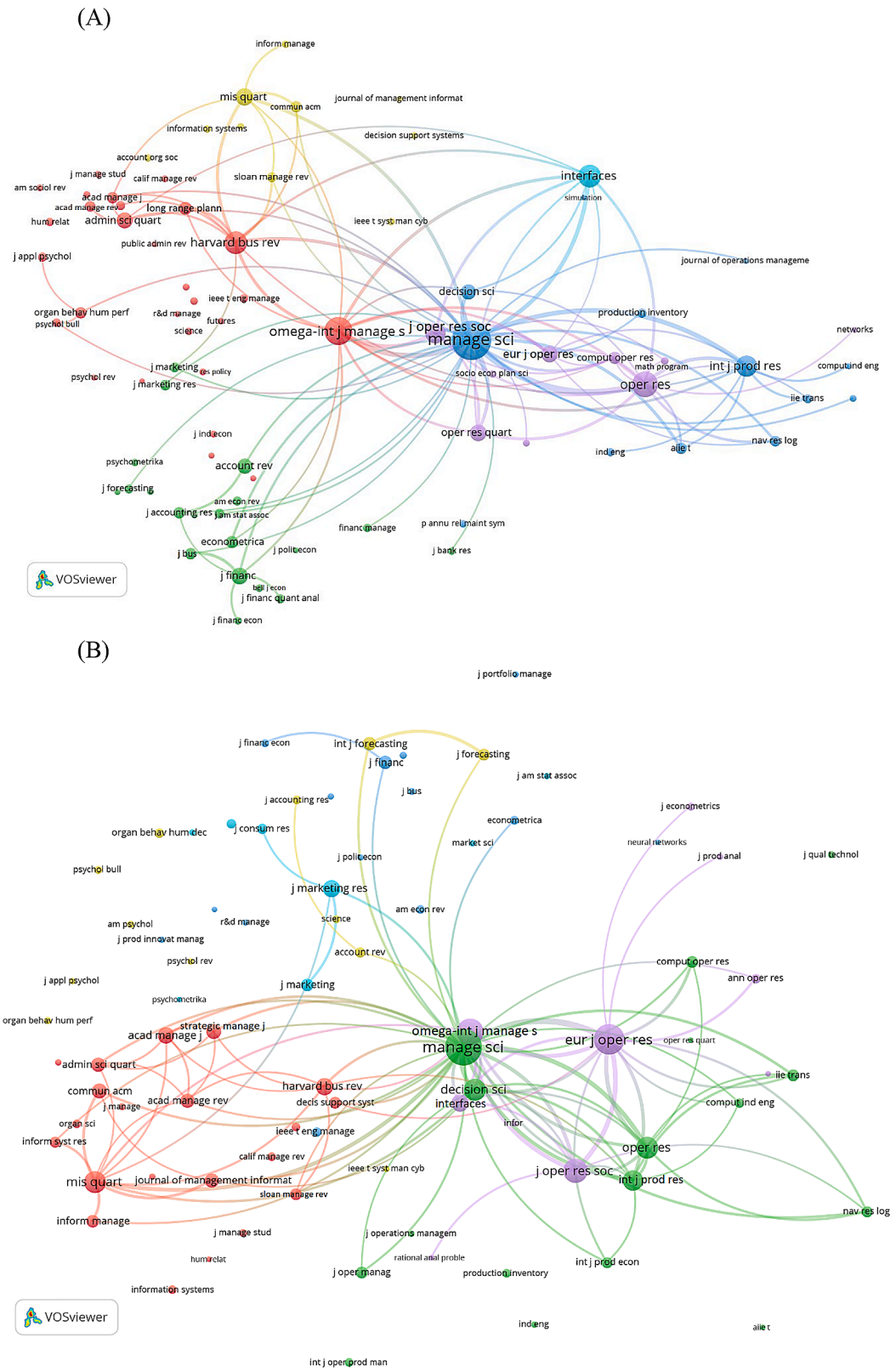


Fig. 5. (A). Co-citation of journals in Omega: 1974–1993 (minimum citation threshold of 20 and 100 links). (B). Co-citation of journals in Omega: 1994–2003 (minimum citation threshold of 20 and 100 links). (C). Co-citation of journals in *Omega*: 2004–2013 (minimum citation threshold of 20 and 100 links). (D). Co-citation of journals in *Omega*: 2014–2023 (minimum citation threshold of 40 and 100 links).

indicating its strong identity within specific research areas like operations research, management science, and decision-making. This suggests that *Omega* is a central hub for concentrated academic discussions in these fields, with its tightly knit co-citation network underscoring its role in advancing specific methodologies and theories.

The co-citation network of authors depicted in Fig. 7 provides a

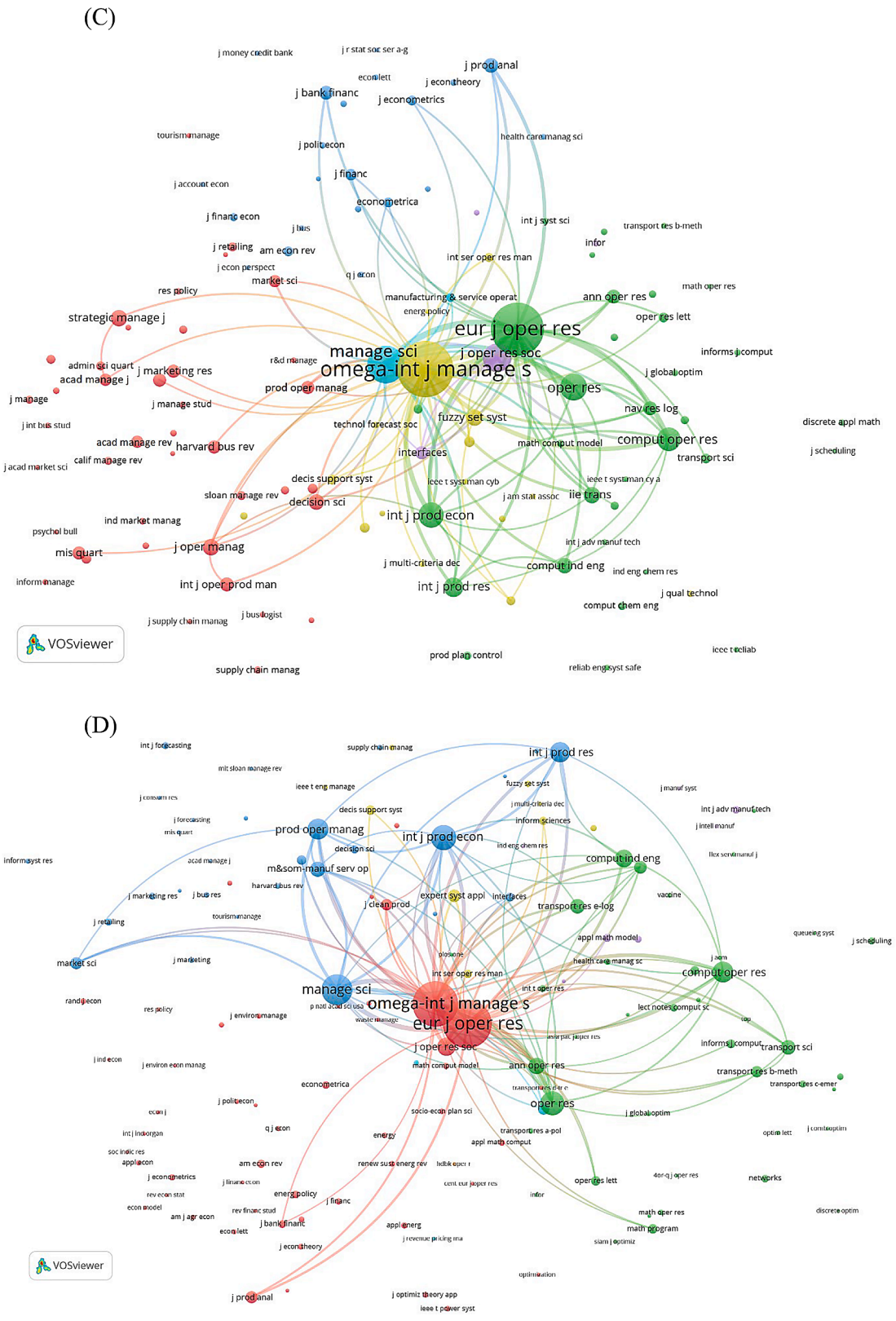


Fig. 5. (*continued*).

detailed representation of the intellectual structure and scholarly influence within the *Omega*. This visualisation, based on a minimum citation threshold of 50 and including 100 links, reveals the prominence of certain authors and the relationships between their works, reflecting how these authors are grouped together based on their co-citation patterns in the academic literature.

The network is characterised by several distinct clusters, each representing a different thematic focus within the journal. The most prominent cluster, depicted in red, is dominated by figures such as Charnes, Banker, and Tone. These authors are central to the field of DEA

and related optimisation methods. The dense interconnections within this cluster suggest that these works are frequently cited together, indicating their collective influence in shaping research in this area. The close proximity and strong connections between these authors highlight the cohesive nature of this research community and its impact on *Omega's* broader scholarly landscape.

Another significant cluster, shown in green, includes authors like Cachon, Silver, and Khouja, who are influential in the fields of supply chain management and inventory theory. The slightly looser connections in this cluster, compared to the DEA cluster, may suggest a broader range of methodologies and applications within this area, or it could indicate the development of newer or more diverse research avenues within supply chain management.

The blue cluster, which includes authors such as Saaty, Zadeh, and Simon, represents another critical area of research within *Omega*: decision-making theories and systems. This cluster's position and connections indicate its importance in the journal, though its influence appears more dispersed compared to the red cluster, suggesting that while it is an essential area, it may not be as central as the DEA-focused research.

Additionally, the presence of smaller clusters, such as those involving authors like Keeney and Greco, suggests the existence of niche but significant research areas within *Omega*. These clusters are less densely connected, which might indicate specialised subfields or emerging areas of research that are still gaining traction in the broader academic community. The network also highlights some cross-cluster connections, where authors from different research areas are co-cited together. This suggests a degree of interdisciplinary influence, where ideas or methods from one field (such as decision-making theories) are applied to another (like supply chain management). These connections are crucial for fostering innovation and advancing knowledge, as they represent the flow of ideas across traditional academic boundaries.

In comparison to other academic journals, *Omega's* co-citation network seems to be highly specialised, with a few dominant clusters that indicate the journal's focus on particular research areas such as DEA, supply chain management, and decision-making. This specialisation suggests that *Omega* plays a critical role in advancing these fields, serving as a key platform for the dissemination of influential research.

Fig. 8 provides a visual representation of bibliographic coupling among documents in the *Omega* journal, based on a minimum citation threshold of one hundred and including 100 links. The nodes represent individual documents, while the links indicate the strength of bibliographic coupling between them. The colour of the nodes corresponds to the average year of publication, with a gradient from blue to yellow indicating older to more recent publications. The spatial distribution and clustering of the nodes provide insights into the thematic areas within *Omega* that are most interconnected through shared citations. Note that this figure is related to the results of Table 5.

The figure reveals several distinct clusters, each representing a different research theme within the journal. For example, one prominent cluster involves works by Rezaei and others around it, which seem to focus on topics related to decision-making, supply chain management, and related operational research areas. This cluster is tightly knit, indicating strong bibliographic coupling, which suggests that these documents heavily rely on a common set of references, thus forming a cohesive research community.

Another notable cluster involves older foundational works, such as those by Gefen and Utterback. These works are still being frequently cited together in more recent literature, highlighting their enduring influence in the field. The clustering of these older documents with more recent publications also suggests that foundational theories and models continue to underpin current research, providing a stable intellectual foundation across decades.

The distribution of documents across Fig. 8 also highlights the evolution of research topics within *Omega*. For instance, newer research areas are indicated by the yellow nodes, which are dispersed across different clusters, showing how recent studies are building upon various existing bodies of work. The dispersion of these newer nodes suggests a

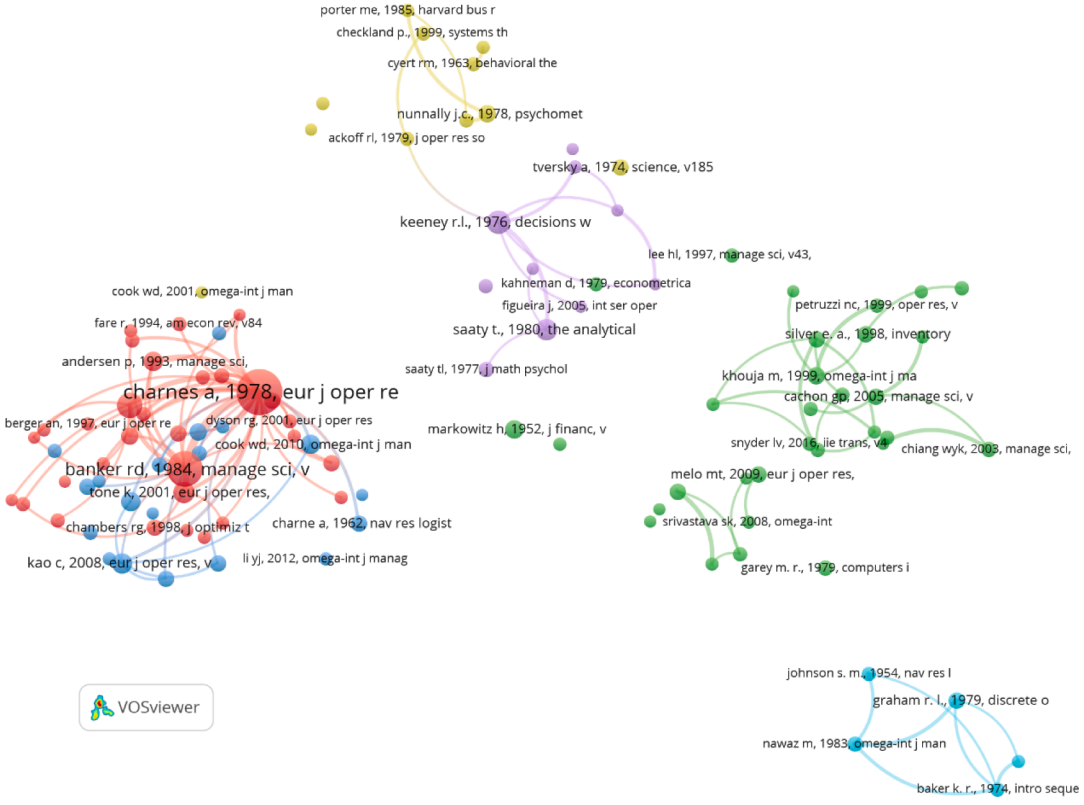


Fig. 6. Co-citation of documents in Omega: minimum citation threshold of 20 and 100 links.

diversification of research interests in recent years, with new studies drawing from a broader range of earlier work.

In contrast, some clusters show more concentrated areas of bibliographic coupling with little connection to other clusters. This indicates specialised research areas within *Omega* where studies are more self-contained, heavily citing each other but less connected to broader research trends. These clusters can represent niche areas of study or highly specialised methodologies that are distinct from the journal's other thematic areas.

Moreover, the figure shows that while some clusters are tightly interconnected, others are more loosely coupled, suggesting varying degrees of interdisciplinarity. The tightly connected clusters indicate areas where research is closely related, with documents frequently citing the same references, whereas the more loosely connected clusters suggest areas where research draws from a more diverse set of sources, possibly indicating the integration of ideas from different fields or the application of established methods to new problems.

Fig. 9 illustrates the bibliographic coupling of authors in *Omega*, with a minimum publication threshold of five and 100 links. Bibliographic coupling here reflects the degree to which different authors' works are linked through shared references. This method helps to reveal the intellectual connections among researchers by showing how their works are interconnected based on the common literature they cite.

The figure presents authors as nodes, with lines connecting them based on the strength of their bibliographic coupling. The colour gradient represents the time dimension, with older publications in blue and more recent ones in yellow. Note that the specific colour that each author gets, is formulated with the average year of publication of the author in *Omega*. That is, we sum the year of each article and divide by the total number of papers of the author. The network visualizes clusters of authors who are grouped together based on the frequency with which their works cite similar literature, revealing collaborative or thematic research networks within the journal.

Several distinct clusters can be identified, each representing a group of authors who frequently cite the same or similar sets of references. A significant cluster, indicated by a mix of green to yellow nodes, includes authors such as Lev, Wu, and Liang. This cluster is predominantly composed of more recent publications, suggesting that these authors are contributing to emerging or currently active areas of research within *Omega*. The strong connections between these authors indicate a closely-knit research community where ideas and references are highly interdependent, pointing towards a shared focus on specific themes or methodologies.

Another notable cluster includes more established authors like Eilon and Gold, whose nodes are primarily blue, indicating older publications. The presence of these authors in a tightly connected group suggests that their works have laid down foundational research that continues to influence more recent studies. The connections between these older authors and some of the more recent ones in the same cluster suggest a continuity of research topics, where foundational theories or methods are being built upon by contemporary researchers.

The spatial arrangement of the clusters also reveals the degree of interdisciplinarity and the evolution of research within *Omega*. Authors like Raghunathan and Grover, who are located in a somewhat isolated blue cluster at the top of the figure, seem to represent a more specialised or perhaps dated area of research that has less direct connection with the more central and contemporary themes being explored by other authors. This suggests that while their work was once central, it might have diverged from the main research currents of the journal or represents a niche area that remains relevant to a specific subset of researchers.

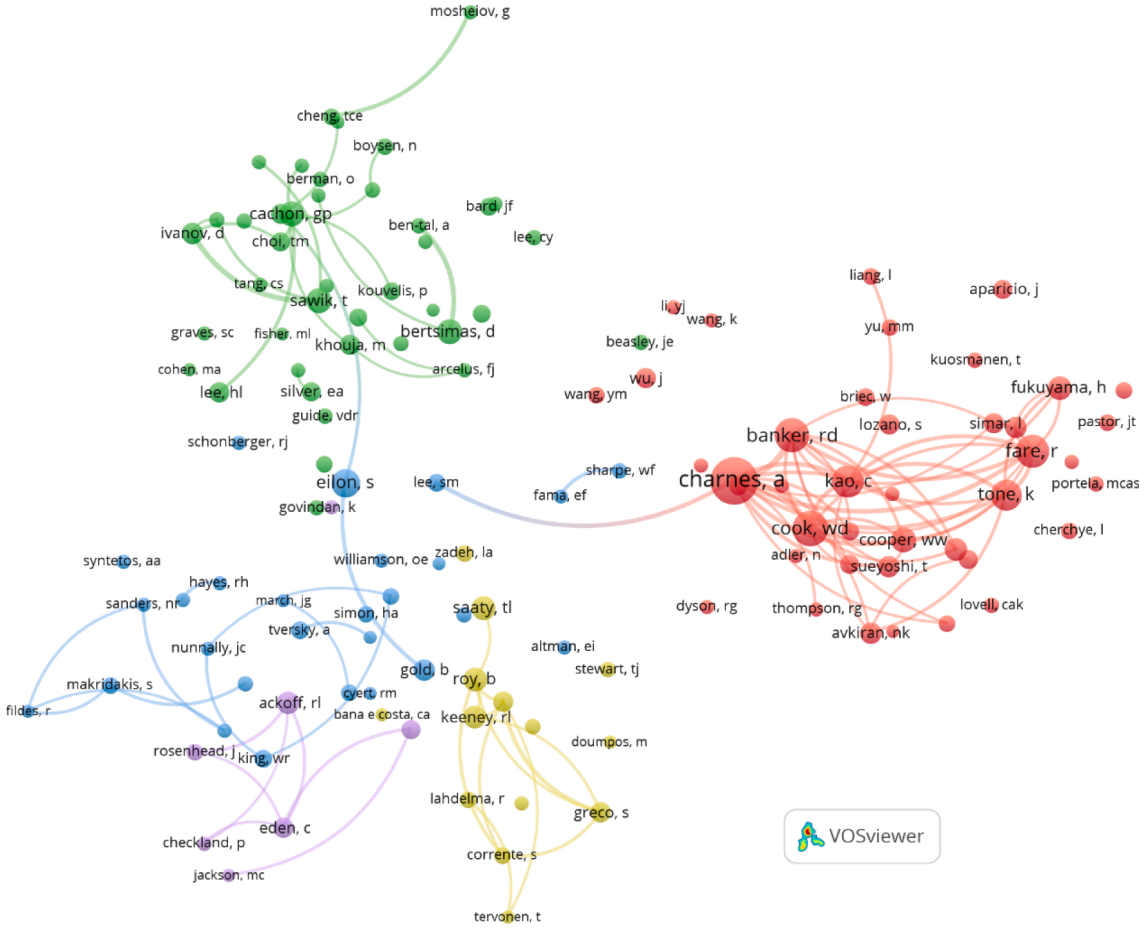


Fig. 7. Co-citation of authors in Omega: minimum citation threshold of 50 and 100 links.

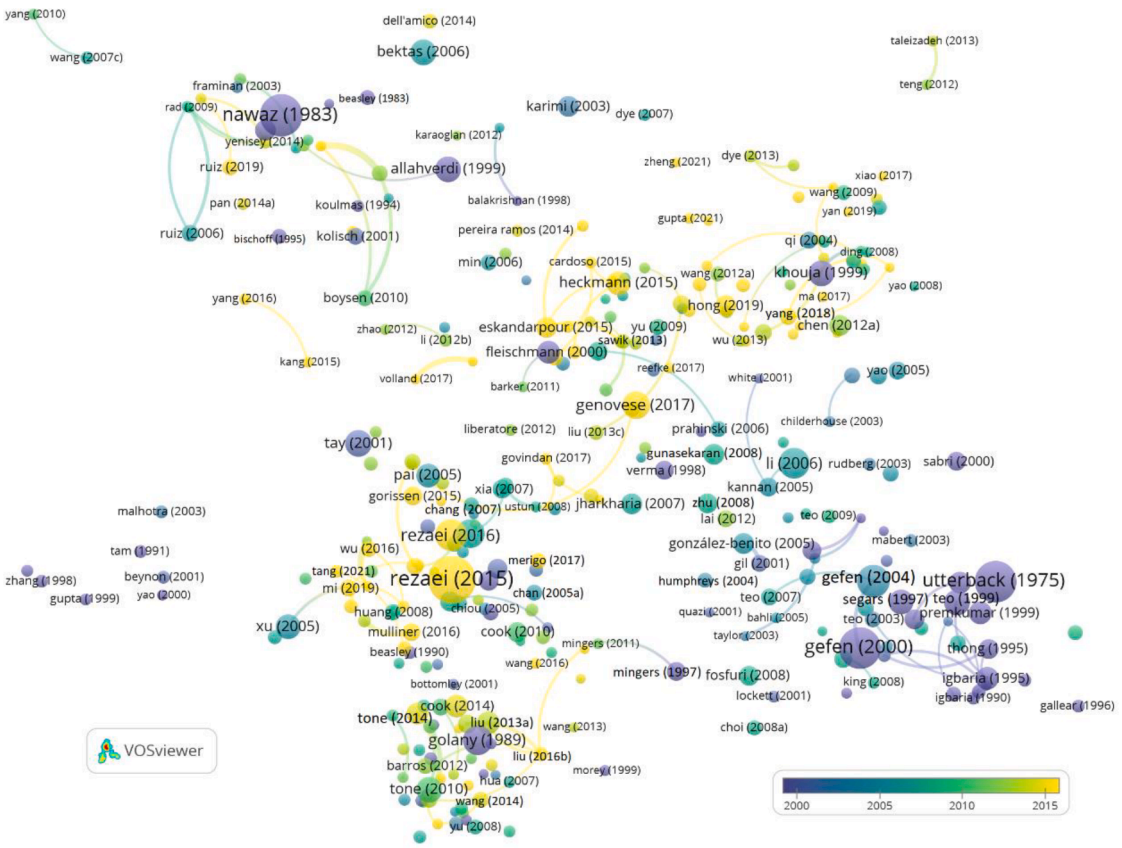


Fig. 8. Bibliographic coupling of documents in Omega: minimum publication threshold of 100 and 100 links.

On the other hand, the yellow nodes scattered throughout various clusters represent the more recent contributions, showing how new research is integrating with established knowledge. Authors like Shouyang Wang, and Lev, for instance, are centrally located in their clusters, indicating that their recent work is widely referenced and plays a crucial role in the ongoing discourse within the journal.

The varying density of connections between clusters suggests different levels of collaboration or thematic overlap between authors. For instance, the relatively dense network around the central cluster indicates a high level of bibliographic coupling, implying a closely related set of research questions or methodologies. In contrast, the sparser connections seen in some of the outer clusters may indicate that these authors are working in more specialised areas that do not frequently cross-reference the works of those in other clusters.

Fig. 10 presents the bibliographic coupling of institutions that publish in *Omega*, with a minimum publication threshold of five documents and 100 links. Bibliographic coupling in this context shows how institutions are connected based on the shared references in the research papers they produce. The nodes represent institutions, while the connecting lines illustrate the strength of their bibliographic coupling, or in other words, the degree to which these institutions' publications cite common sources. The color gradient from blue to yellow indicates the timeline, with blue representing older publications and yellow representing more recent ones. Note that the specific colour that each institution receives, is calculated with the average year of publication.

Several clusters stand out in this network, indicating groups of institutions closely interconnected by their research outputs. One of the most prominent clusters is centred around Chinese institutions like University of Science & Technology of China, Beijing Jiaotong University, and the University of Electronic Science & Technology of China. This cluster is heavily concentrated with yellow nodes, signifying that these institutions have been prolific in recent years, producing highly interconnected research through shared references. The centrality and density of this cluster suggest that these Chinese institutions play a significant role in the current research landscape of *Omega*, contributing to a shared body of knowledge that other institutions widely cite.

Adjacent to this cluster is another significant group that includes institutions like Hong Kong Polytechnic University and City University of Hong Kong. The connection between these institutions and the aforementioned Chinese universities indicates a regional concentration of research collaboration or thematic alignment. This could imply that these institutions work on similar problems or within the same academic or industrial fields, leading to a high degree of bibliographic coupling.

In contrast, the nodes representing Western institutions such as the University of Manchester, the University of Massachusetts, and Erasmus University are spread out in different parts of the network. These institutions tend to form smaller, less densely connected clusters, often indicated by green and blue nodes, representing research dating back to the early 2000s. The dispersal of these institutions might suggest a more diverse set of research topics or a broader range of collaborations that span multiple disciplines, leading to less tightly coupled bibliographic connections within the scope of *Omega*.

Some institutions like the University of Michigan, the National University of Singapore, and the University of North Carolina are positioned in more central locations within their respective clusters. This centrality suggests that these institutions have maintained a significant influence over time, contributing research that continues to be relevant and frequently cited by other institutions. Their work likely bridges older foundational research and more recent studies, facilitating the evolution of key themes within *Omega*.

Another interesting observation is the presence of institutions like Harvard University and MIT in less connected, more isolated positions in the network. Despite their global reputation, their specific contributions to *Omega* may be more specialised, focusing on niche areas that do not

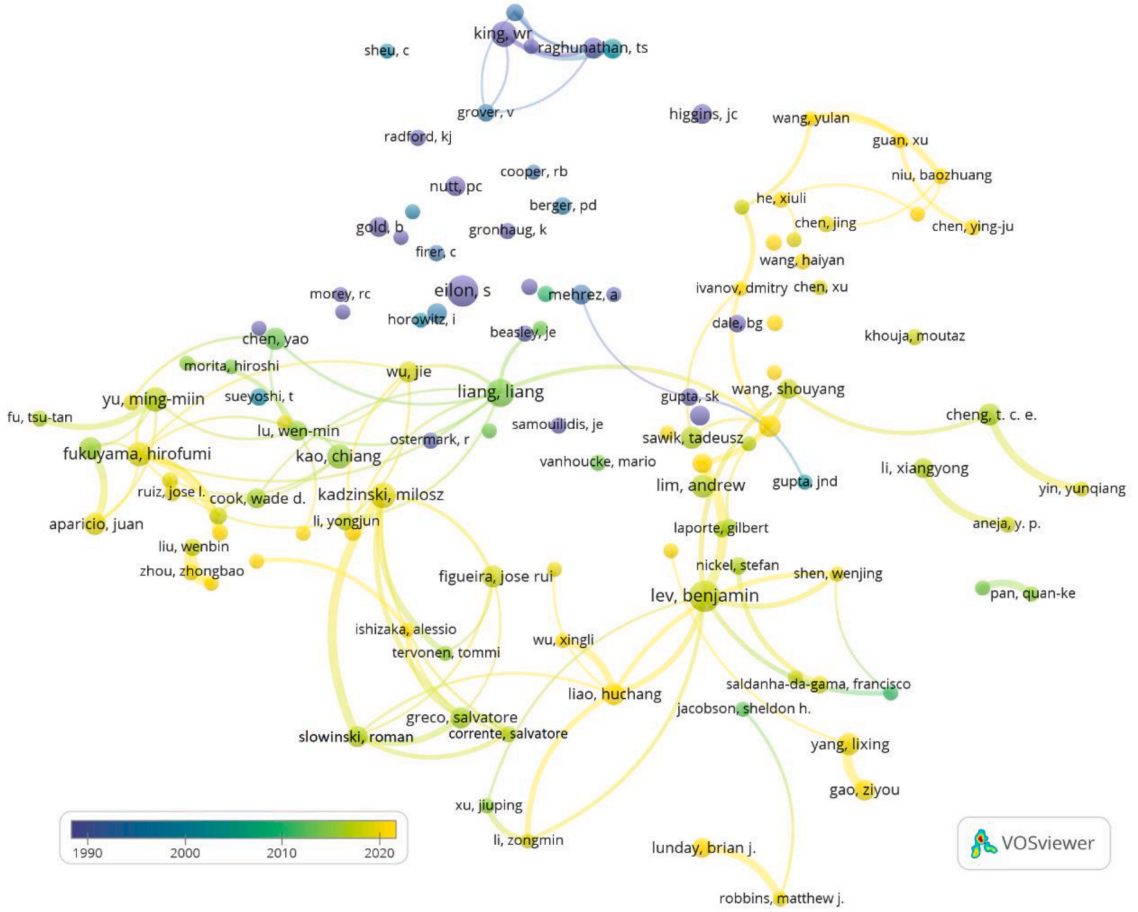


Fig. 9. Bibliographic coupling of authors in Omega: minimum publication threshold of 5 and 100 links.

overlap as much with the broader research trends reflected in the journal. This could imply that their work is either very pioneering or very specialised, contributing to cutting-edge fields that have yet to fully integrate into *Omega*'s mainstream research landscape.

The figure also highlights the global nature of research collaboration, with connections stretching across continents, linking institutions from Europe, Asia, and the Americas. For instance, institutions like the National University of Singapore and the University of Michigan are connected through bibliographic coupling, indicating shared references in their publications despite geographical distance. This suggests a global exchange of ideas and a cross-pollination of research that transcends regional boundaries.

Fig. 11 illustrates the bibliographic coupling of countries/regions contributing to the journal *Omega*, with a minimum publication threshold of five documents and 50 links. Bibliographic coupling here refers to how countries are connected based on shared references in the research papers. Each node represents a country, and the lines connecting these nodes indicate the strength of their bibliographic coupling, essentially, how often publications from these countries cite the same sources. The colour gradient, ranging from blue to yellow, represents the timeline, with blue signifying older research and yellow representing more recent contributions.

The most prominent nodes in this network are the USA, China, and England, which are depicted as the graph's largest and most central nodes. These countries/regions are connected by thick lines to many other nations, indicating that their research outputs are frequently cited and have strong bibliographic coupling with many other countries. This suggests that these countries/regions are central hubs in the global research network, heavily influencing and contributing to the academic discourse within *Omega*.

The USA stands out as a major player, depicted in a blue colour, implying that its research contributions date back in time but continue to be heavily cited. The USA is connected to various countries, including Canada, Australia, the Netherlands, Germany, and Italy. This indicates that American research has historically had a broad impact, fostering strong international collaborations and a significant presence in the global research community.

China is another central node, depicted in yellow, indicating that it has significantly contributed to research in recent years. The dense connections between China and other countries, particularly with Japan, South Korea, India, Spain, and Belgium, highlight China's growing influence in global research. The rise of China as a central hub in this network reflects the country's increasing investment in research and development and its growing academic collaborations with other nations.

England is also a key node, connecting to European and non-European countries like Spain, France, Italy, Canada, and Australia. The purple hue of England's node suggests that its research contributions are more evenly spread across the timeline. England's central position in the network indicates that it serves as a bridge between various countries, connecting European research with other global regions.

Interestingly, countries like Germany, Netherlands, and Australia are connected to the larger nodes but are not as central. This positioning suggests that while these countries contribute significantly to the research within *Omega*, they do so in a more specialised or regionally focused manner. Their research may be influential within specific areas of study, leading to strong bibliographic coupling with certain countries/regions but not as broad an influence as the USA, China, or England.

The presence of other countries, such as Spain, France, Italy, and

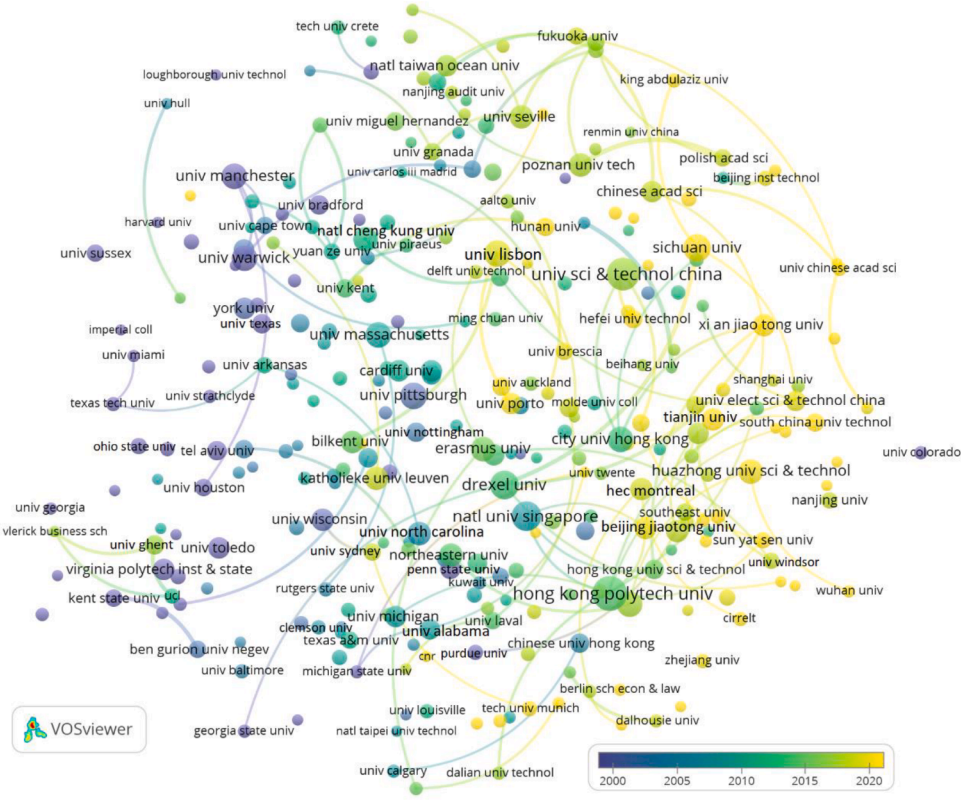


Fig. 10. Bibliographic coupling of institutions publishing in Omega: minimum publication threshold of 5 documents and 100 links.

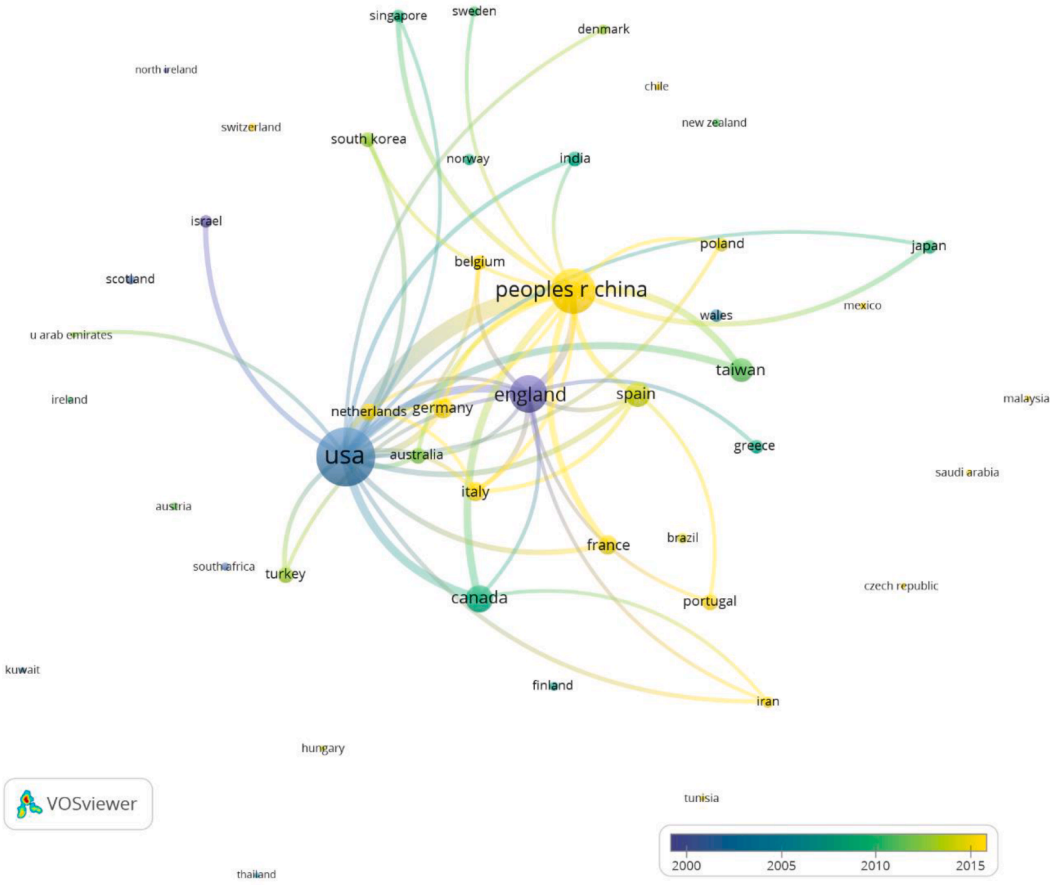


Fig. 11. Bibliographic coupling of countries/regions publishing in Omega: minimum publication threshold of 5 documents and 50 links.

Canada, in this network further highlights the collaborative nature of global research. These countries are shown to have strong bibliographic coupling with the central hubs and each other, indicating a robust exchange of academic ideas across these regions. This suggests that while they may not be as dominant as the central hubs, they still play crucial roles in the dissemination and development of knowledge within the global academic community.

On the network's periphery are countries/regions like South Korea, Singapore, Taiwan, and Iran, which have fewer and thinner connections while connected to the central nodes. This could imply that these countries are either emerging contributors to the global research landscape or have more specialised areas of research that do not overlap as extensively with the mainstream trends represented by the central hubs. However, their presence in the network still underscores their participation in the global knowledge exchange, though in a more niche capacity.

In contrast, some countries like Tunisia, Thailand, Hungary, and Kuwait are positioned at the very edges of the network with fewer connections. This suggests that their contributions are either more recent or less integrated into the broader research discourse within *Omega*. These countries might be in the early stages of developing their research capabilities or focusing on highly specialised fields that do not have wide bibliographic overlap with other countries.

4.2. Keyword and topical analysis

Fig. 12 shows the co-occurrence of author keywords within the journal *Omega*, with a minimum occurrence threshold of five keywords and 200 links. The nodes in this network represent individual keywords used by authors in their publications, while the links between them indicate how often these keywords appear together in the same papers. The size of each node reflects the frequency with which a particular keyword appears across all the publications, and the colour coding differentiates clusters of closely related topics. Note that *Omega* uses author keywords since 1989. Therefore, the analysis covers the period between 1989 and 2023.

One of the most prominent clusters centres around "*supply chain management*". This keyword appears in green and is connected to a dense network of related terms like "*inventory*", "*game theory*", and "*supply chain*". This cluster highlights the centrality of supply chain management as a dominant theme within the journal. The interconnectedness of this cluster suggests that research in this area is highly integrated, with frequent cross-referencing and shared methodologies across these subtopics.

Another significant cluster, coloured in light yellow, revolves around *"data envelopment analysis (DEA)"*. DEA is frequently associated with terms such as *"efficiency", "benchmarking", "productivity"*, and *"efficiency measurement."* The prominence of this cluster indicates a strong focus on efficiency and performance measurement within the journal. DEA is a popular method in operational research and management science for assessing the efficiency of decision-making units, and its strong presence in the keyword network highlights its importance as a research tool in these fields [36]. The connections of this cluster suggest a well-established body of research where DEA methodologies are applied across various domains, including banking, game theory, and multi-criteria decision making. *"Optimization"* is another critical node, appearing in yellow, that intersects with multiple clusters, linking keywords such as "*heuristics", "simulation"*, and *"scheduling"*. This indicates that optimisation is a pervasive theme that cuts across many areas of research in *Omega*. The diversity of connected terms suggests that optimization techniques are being applied in various contexts, from supply chain management to decision support systems. This cluster underscores the journal's focus on improving decision-making through advanced mathematical and computational methods.

The *"scheduling"* and *"heuristics"* cluster, represented in red, is another major area of focus, closely linked to keywords such as "*integer programming", "flowshop", "timetabling"*, and *"routing"*. Scheduling is a critical aspect of operations management, and the extensive network of related terms suggests that this area has been a significant focus for research in the journal. The connections to optimisation and heuristics further indicate that much of the work in this area is concerned with finding efficient and practical solutions to complex scheduling problems.

There is also a notable cluster focused on "*decision-making"* and *"decision support systems"* (DSS), depicted in light blue and brown. This cluster connects with a wide array of terms, including *"multi-criteria decision-making", "forecasting", "risk analysis"*, and *"information systems"*, The breadth of this cluster reflects the journal's interest in the various tools and methodologies used to support decision-making in organisations. The connections to related keywords suggest a strong interdisciplinary approach, integrating insights from economics, psychology, and information technology. *"Simulation"* appears as a distinct cluster, coloured in light green, and is linked with keywords such as *"optimization", "scheduling", "inventory control"*, and *"forecasting"*. This cluster highlights the importance of simulation techniques in modelling and analysing complex systems, a recurring theme in the journal. The strong presence of this cluster indicates that simulation continues to be a valuable tool for researchers aiming to test hypotheses, model uncertainty, and optimise decision-making processes.

Finally, smaller but significant clusters include *"forecasting", "operations management", "risk", "robust optimization"*, and *"analytic hierarchy process"*, which, while not as central as the other clusters, represent important niche areas of research within *Omega*. These clusters suggest emerging or specialised areas of study that contribute to the diversity of topics covered by the journal. The connections between these keywords and the larger clusters indicate that these areas are increasingly integrated into the broader research themes.

The analysis of co-occurrences of author keywords in *Omega* from 1989 to 2023 in Fig. 12 reveals distinct shifts in research focus, the evolution of thematic interconnectedness, and the progression towards specialisation in the field. By comparing the visualisations from each period, we can critically examine how the structure and emphasis of research topics have transformed over time. Therefore, in Fig. 13, the paper split the time between four periods, explained below:

1989–1993 (Figure 13 (A)**)**: In the earliest period, from 1989 to 1993, the co-occurrence network of author keywords is relatively sparse and loosely connected. Various general themes in management science and operations research characterise the network. Key terms such as "*scheduling*", "*heuristics*", "*strategy*", "*decision-making*", "*simulation*", and "*forecasting*", dominate this period, reflecting the foundational stage of the field where researchers were focused on establishing basic principles and methodologies. The minimal clustering indicates that research topics were still being established, with little overlap or interaction between different areas. Using a low occurrence threshold (2) and many links (100) highlights the exploratory nature of research during this time, as scholars were investigating a wide array of subjects with a limited focus on specialisation.

1994–2003 (Figure 13 (B)): Moving into the period from 1994 to 2003, there is a noticeable shift towards a more connected and complex network. The co-occurrence of keywords becomes denser, suggesting that research topics were beginning to consolidate. The clusters of keywords are more pronounced, indicating the emergence of key research areas that were starting to gain prominence. New keywords like "*supply chain management*" and "*data envelopment analysis*" begin to emerge, highlighting the introduction of more applied research topics and a broadening of the field's scope. The relationships between these clusters show that certain themes were being explored more deeply, with increasing interconnections between related topics. This period reflects a transitional phase where the field was moving towards more structured and focused research, though still retaining a degree of diversity in topics.

2004–2013 (Figure 13 (C)): The period from 2004 to 2013 shows

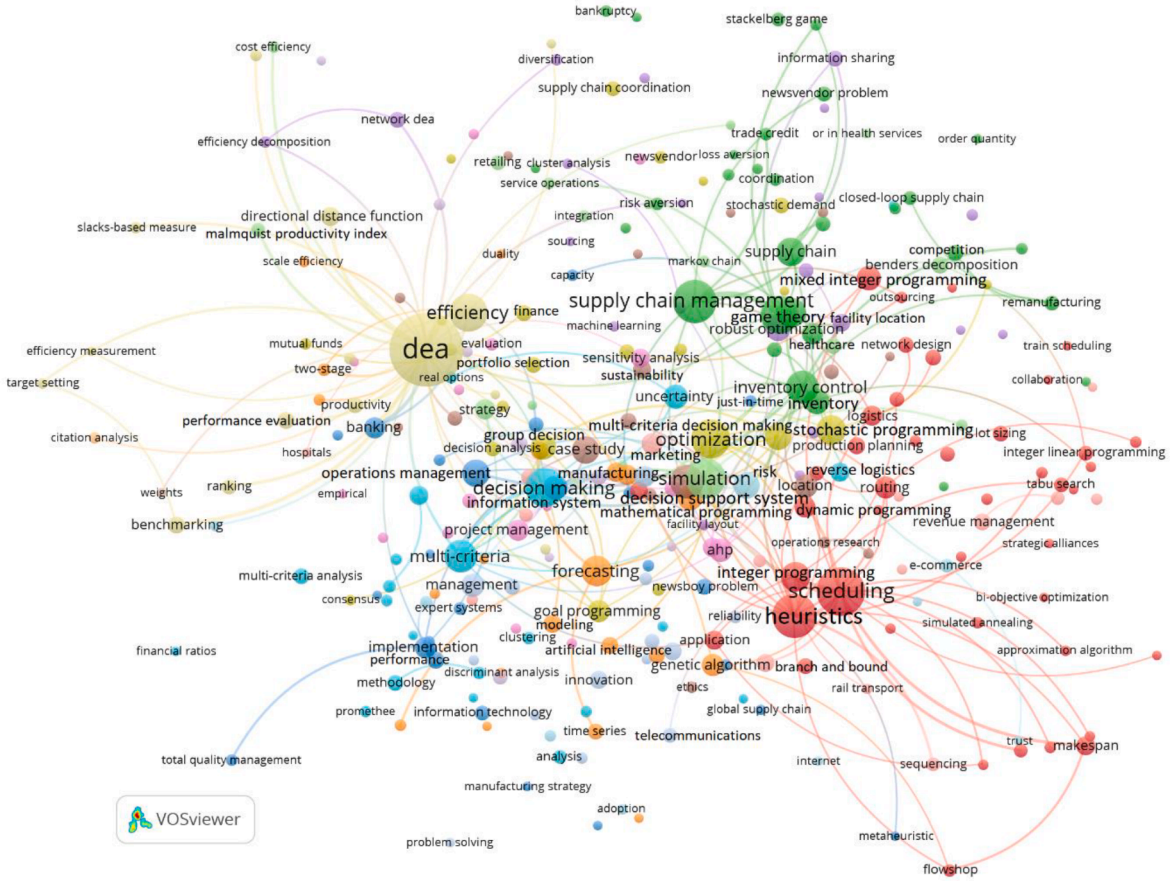


Fig. 12. Co-occurrence of author keywords in Omega: minimum occurrence threshold of 5 and 200 links.

further evolution with the emergence of highly specialised terms such as "*integer programming*", "*game theory*", and "*genetic algorithms*". The same minimum occurrence threshold (3) and number of links (100) still apply. This era reflects a significant move towards specialisation, with researchers digging into niche areas and sophisticated methodologies. The dense clustering of keywords during this time indicates that these specialised areas are growing and becoming more interconnected, as evidenced by links between topics like "*decision making*", "*heuristics*", "*scheduling*", and "*data envelopment analysis*", which suggest the increasingly complex nature of decision-making processes in modern management science.

2014–2023 (Figure 13 (D)): The most recent period, from 2014 to 2023, presents the most intricate and highly connected network. Prominent keywords like "*pricing*", "*sustainability*", "*business analytics*", and "*covid-19*", underscore the field's shift towards addressing current global challenges and leveraging new technologies. The increase in the minimum occurrence threshold to 5 reflects a significant growth in research output, with certain keywords appearing more frequently. The dense clustering and high interconnectivity of these keywords suggest that research has become increasingly interdisciplinary, with areas such as "*pricing*" and "*game theory*" being closely linked, as well as "*sustainability*" and "*supply chain management*" forming essential components of modern research. However, unlike in previous periods, the connections between different clusters are stronger, suggesting that while research is specialised, it is also increasingly interdisciplinary. This period reflects a mature and highly developed field where the boundaries between different subfields are blurred, and research topics are highly interrelated.

Comparative Analysis: Comparing these periods, we observe a clear trajectory from a broad, exploratory approach in 1989–1993 to a deeply specialised and interconnected field by 2014–2023. The network's evolution from sparse connections to dense clusters mirrors the field's progression towards maturity. The increase in the threshold of keyword occurrences from 2 to 5 underscores the growth in research volume and the consolidation of key themes. Each successive period reflects a refinement in research focus, with the development of more complex and specialised subfields and an increasing interplay between different areas of study.

Table 15 provides a detailed analysis of the co-occurrence of author keywords in *Omega*, highlighting global and regional research trends. The keyword "Data Envelopment Analysis" (DEA), appearing 299 times globally, underscores its foundational role in evaluating efficiency across industries. DEA's prominence varies by region, with Europe (134 occurrences) and East Asia (128) showing the highest concentration, followed by North America (78) and the Rest of the World (53). The high occurrence of DEA in Europe and East Asia suggests a strong regional focus on industrial productivity, likely driven by Europe's emphasis on efficiency in economic frameworks and East Asia's robust manufacturing sector, which demands streamlined processes.

North America emphasises keywords like "Scheduling" (44) and "Decision Support Systems" (36), reflecting its orientation toward operational efficiency and advanced technological integration across sectors. This focus aligns with North America's approach to optimising complex operations in sectors such as finance, healthcare, and large-scale manufacturing, where advanced scheduling and decision-support systems are essential for managing resources effectively. Meanwhile, East Asia's top keyword, "Supply Chain Management" (52), underscores the region's concentration on logistics and manufacturing, which is crucial for its export-oriented economy. East Asia's research around supply chain optimisation reflects a strategic aim to improve trade logistics and reduce costs, reinforcing its role as a major player in global manufacturing and distribution.

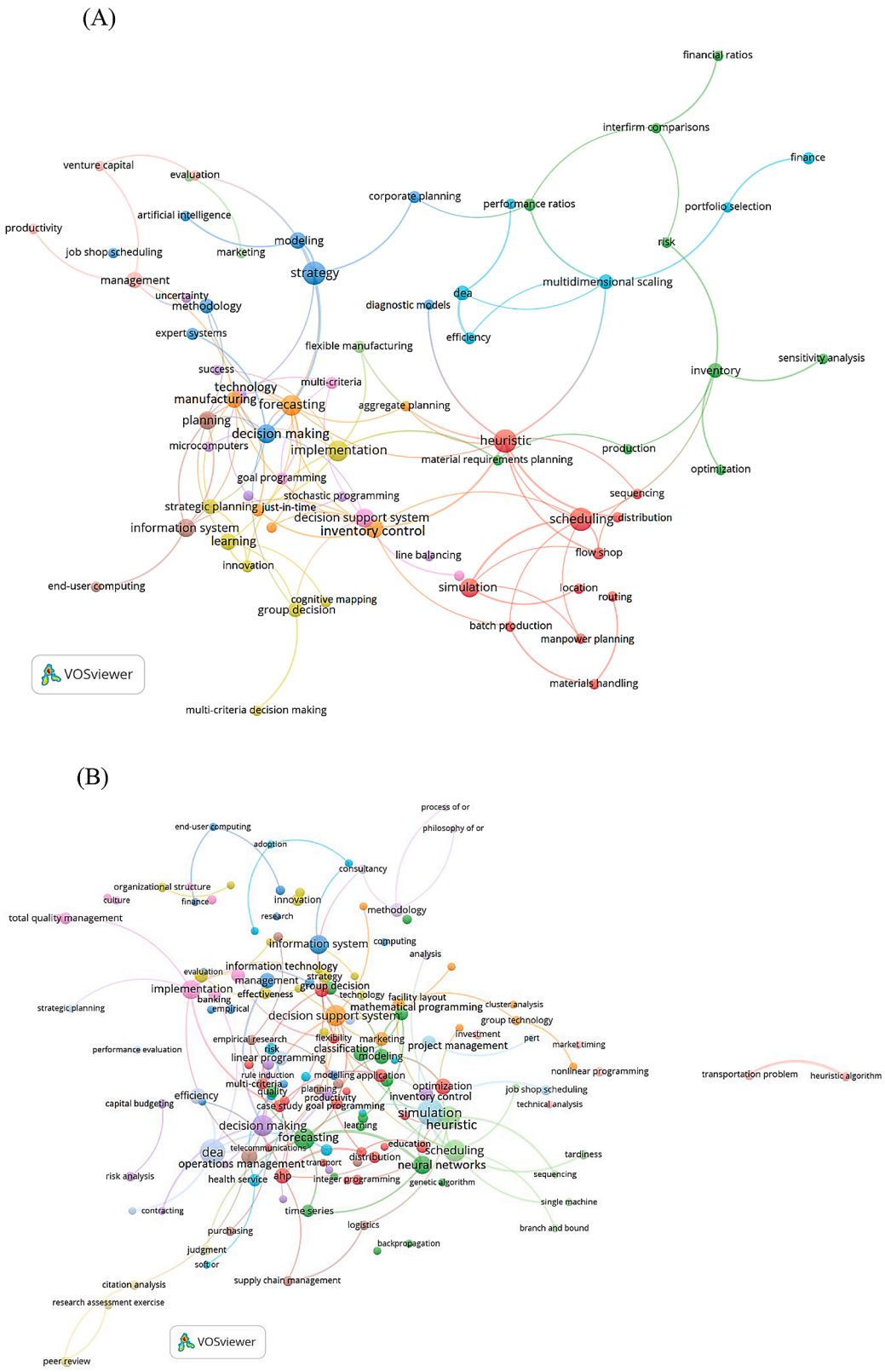


Fig. 13. (A). Co-occurrence of author keywords in Omega: 1989–1993 (minimum occurrence threshold of 2 and 100 links. (B). Co-occurrence of author keywords in Omega: 1994–2003 (minimum occurrence threshold of 3 and 100 links). (C). Co-occurrence of author keywords in *Omega*: 2004–2013 (minimum occurrence threshold of 3 and 100 links). (D). Co-occurrence of author keywords in *Omega*: 2014–2023 (minimum occurrence threshold of 5 and 100 links).

Europe displays a unique focus on "Decision Making" (41) and "Multi-Criteria Decision Making" (35), indicating that European research often explores complex decision-making scenarios involving multiple stakeholders and criteria. This trend aligns with studies indicating that European scholars are increasingly focusing on research that supports policy and regulatory frameworks, especially in sustainability and risk

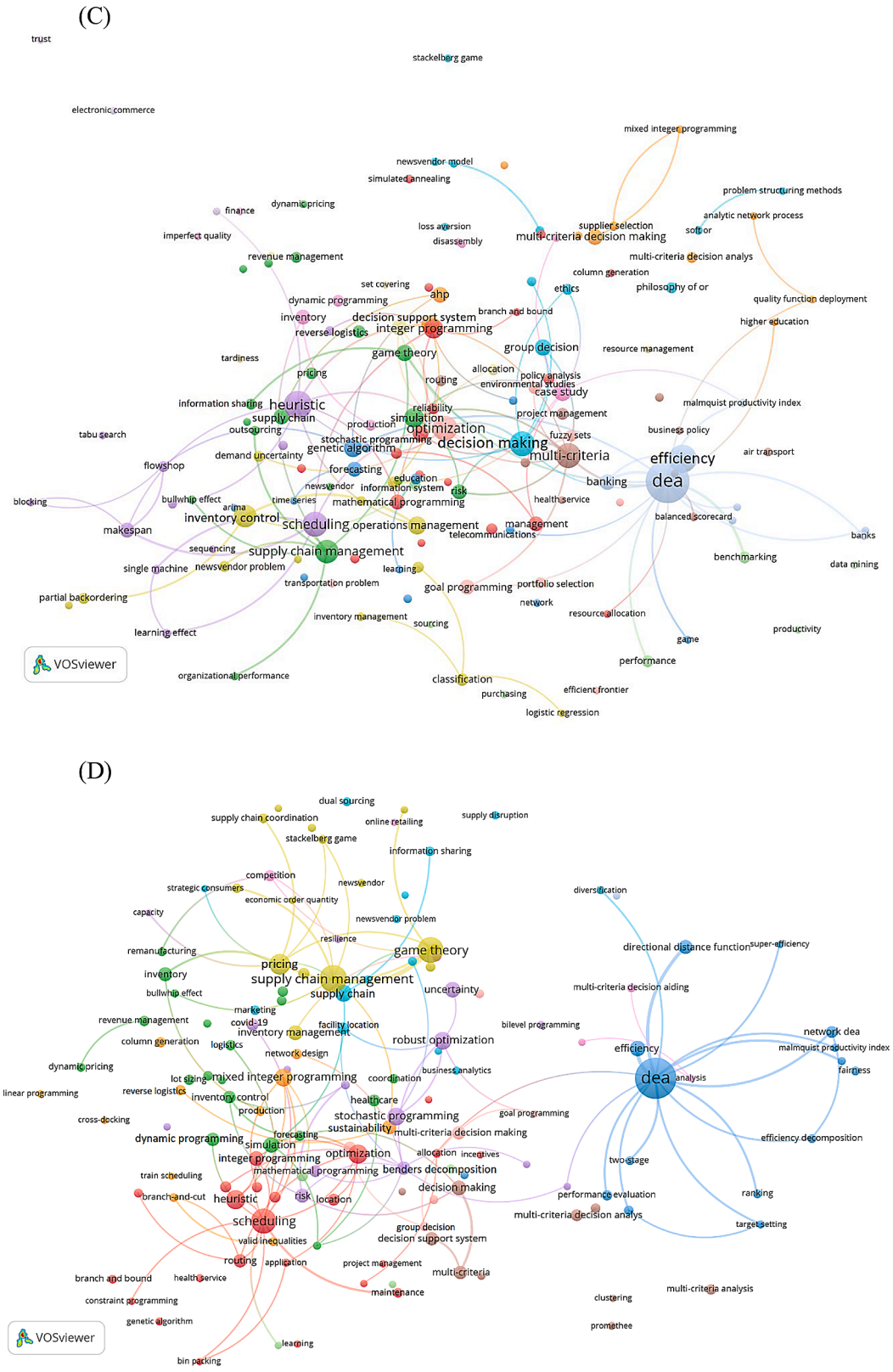


Fig. 13. (*continued*).

management. This shift is reflected in recent findings that the European Union is spearheading sustainable finance regulations to redirect capital flows toward green initiatives [75]. Additionally, the European Green Deal (EGD) has significantly influenced research trends, prioritising a transition to a circular economy and sustainable resource management. This European emphasis on structured, multi-criteria approaches is indicative of a regulatory landscape that promotes responsible and sustainable practices across industries.

In the Rest of the World, the prioritisation of keywords like "Simulation" (17), "Heuristics" (29), and "Case Study" (11) suggests a focus on

Table 15
Co-occurrence of author keywords in Omega: Global and geographical analysis.

	Global		North America		Europe		East Asia		Rest of the World	
R	Keyword	Occ	Keyword	Occ	Keyword	Occ	Keyword	Occ	Keyword	Occ
1	Data Envelopment Analysis	299	Data Envelopment Analysis	78	Data Envelopment Analysis	134	Data Envelopment Analysis	128	Data Envelopment Analysis	53
2	Scheduling	119	Scheduling	44	Scheduling	45	Supply Chain Management	52	Heuristics	29
3	Heuristics	103	Optimization	37	Heuristics	42	Game Theory	46	Simulation	17
4	Supply Chain Management	96	Decision Support Systems	36	Decision Making	41	Pricing	34	Efficiency	14
5	Simulation	81	Heuristics	36	Multi-criteria	35	Scheduling	32	Forecasting	14
6	Decision Making	78	Simulation	36	Simulation	32	Heuristics	25	Scheduling	14
7	Optimization	78	Supply Chain Management	35	Efficiency	30	Efficiency	24	Multicriteria	13
8	Efficiency	76	Inventory Control	33	Optimization	29	Supply Chain	21	Supply Chain Management	12
9	Game Theory	73	Decision Making	30	Supply Chain Management	28	Inventory	18	Case Study	11
10	Decision Support Systems	64	Game Theory	28	Decision Support Systems	27	Optimization	17	Directional Distance Function	9
11	Inventory Control	57	Efficiency	24	Forecasting	25	Analytic Hierarchy Process	13	Inventory	9
12	Multi-criteria	56	Stochastic Programming	24	Group Decisions	23	Decision Making	12	Linear Programming	9
13	Forecasting	49	Linear Programming	22	Inventory Control	22	Genetic Algorithm	11	Game Theory	8
14	Pricing	45	Integer Programming	21	Multi-Criteria Decision Making	22	Makespan	11	Location	8
15	Stochastic Programming	45	Operations Management	19	Stochastic Programming	21	Directional Distance Function	10	Mixed Integer Programming	8
16	Integer Programming	44	Pricing	18	Integer Programming	20	Information Sharing	10	Reverse Logistics	8
17	Supply Chain	41	Information Systems	18	Mixed Integer Programming	20	Multi-Criteria Decision Making	10	Risk	8
18	Case Study	39	Inventory	17	Case Study	18	Robust Optimization	10	Analytic Hierarchy Process	7
19	Operations Management	38	Case Study	16	Supply Chain	18	Dynamic Programming	9	Decision Support Systems	7
20	Risk	37	Mathematical Programming	16	Risk	16	Heuristic	9	Multi-criteria	7
21	Multi-Criteria Decision Making	36	Neural Networks	15	Game Theory	15	Stackelberg Game	9	Optimization	7
22	Group Decision	35	Risk	15	Location	15	Two-Stage	9	Robust Optimization	7
23	Inventory	35	Forecasting	14	Logistics	15	Competition	8	Sustainability	7
24	Mathematical Programming	34	Marketing	14	Uncertainty	15	Coordination	8	Information Systems	6
25	Mixed Integer Programming	33	Supply Chain	14	Management	14	Group Decision	8	Innovation	6
26	Analytic Hierarchy Process	31	Modeling	13	Mathematical Programming	14	Inventory Control	8	Integer Programming	6
27	Robust Optimization	31	Learning	12	Operations Management	14	Malmquist Productivity Index	8	Inventory Control	6
28	Uncertainty	31	Robust Optimization	12	Routing	14	Simulation	8	Mathematical Programming	6
29	Information Systems	30	Artificial Intelligence	11	Goal Programming	14	Trade Credit	8	Multi-Objective Optimization	6
30	Location	29	Implementation	11	Inventory Management	13	Column Generation	7	Revenue Management	6
31	Management	29	Genetic Algorithms	11	Banking	12	Demand Uncertainty	7	Stochastic Programming	6
32	Genetic Algorithms	28	Mixed Integer Programming	11	Classification	12	Dynamic Pricing	7	Uncertainty	6
33	Routing	27	Analytic Hierarchy Process	10	Implementation	12	E-Commerce	7	Benders Decomposition	5
34	Goal Programming	25	Classification	10	Manufacturing	12	Integer Programming	7	Decision Making	5
35	Implementation	24	Innovation	10	Project Management	12	Inventory Management	7	Dynamic Programming	5
36	Project Management	24	Manufacturing	10	Robust Optimization	12	Operations Management	7	Network DEA	5
37	Banking	23	Transportation Problem	10	Strategy	12	Risk Aversion	7	Operations Management	5
38	Dynamic Programming	23	Dynamic Programming	9	Production	11	Stochastic Programming	7	Ranking	5
39	Inventory Management	23	Inventory Management	9	Analytic Hierarchy Process	10	Supply Chain Coordination	7	Vehicle Scheduling	5
40	Manufacturing	23	Network Design	9	Bullwhip Effect	9	Uncertainty	7	Allocation	4

Abbreviations: Occ = Occurrences.

flexible, practical methods suited to the varied challenges typical in developing regions. Simulation and heuristic-based approaches provide cost-effective solutions, enabling researchers in these regions to model and optimise operations without requiring extensive infrastructure. Additionally, terms such as "Reverse Logistics" (8) and "Sustainability" (7) reflect an emerging focus on both environmental and economic sustainability, critical priorities for developing economies striving to manage limited resources effectively.

East Asia's distinctive focus on "Game Theory" demonstrates its relevance across multiple fields, particularly in energy, natural resources, and management, where competitive and cooperative strategies play a vital role [76]. Another key East Asian keyword, "Pricing," signals a strong interest in competitive strategy, potentially driven by high market competition in East Asia's diverse industries. This emphasis on pricing and strategic decision-making reflects a nuanced understanding of regional market dynamics and highlights a demand for models that support informed decisions in commerce and trade-driven sectors.

Comparatively, the distribution of co-occurring keywords across regions in *Omega* highlights a shared foundation in operational research methodologies such as DEA and heuristics, with regional variations tailored to unique economic and research priorities. North America's emphasis on decision-support systems and scheduling suggests an optimisation approach suited to resource-driven sectors. East Asia's focus on supply chain management and pricing reflects its strategic position in global manufacturing, while Europe's focus on multi-criteria decision-making aligns with its regulatory, multi-stakeholder approach. Developing regions' reliance on simulation and heuristics indicates adaptive methodologies suitable for diverse applications. This global distribution of focus areas underlines a dynamic, regionally tailored landscape in operational research, shaped by both universal methodologies and distinct, economically driven research needs.

The analysis of leading topics and topic clusters in *Omega* between 2013 and 2022, as presented in Tables 16 and 17, reveals important insights into the thematic priorities and the research impact within the journal. These tables showcase the volume of research produced in specific areas and indicate the significance of these topics through metrics such as Field-Weighted Citation Impact (FWCI) [77] and Worldwide Prominent Percentile (PP) [78]. The topics and topic clusters are available in Scopus through the SciVal platform [79].

Table 16 lists *Omega*'s top 40 leading topics based on the number of papers (TP) published between 2013 and 2022. "Decision-Making; Data Envelopment Analysis; Industry" emerges as the most prominent topic with 157 papers, indicating the centrality of efficiency and decision-making in industrial contexts. This topic also has a high FWCI of 2.33 and a near-perfect PP of 98.983, underscoring its significant influence and high citation rates relative to the global average in the field. The table also highlights the evolution of focus towards supply chain management, particularly in the context of risk management and contemporary challenges like COVID-19. The topic "Supply Chain; Risk Management; COVID-19″ reflects an adaptive response to global events and boasts an impressive FWCI of 4.99 and a PP of 99.882, signifying its cutting-edge relevance and widespread recognition in academic circles.

There is a clear emphasis on operational efficiency across various sectors, as evidenced by recurring topics related to inventory models, supply chain management, and scheduling problems. For example, the topic "Inventory Model; Trade Credit; Supply Chain Management", with 18 papers and an FWCI of 2.58, demonstrates the sustained interest in optimising supply chain processes under financial constraints. Interestingly, several topics related to sustainability and environmental impact have gained traction, such as "Greenhouse Gas Emissions; Decision Making; Supply Chain Management," which, despite having only 16 papers, has a remarkably high FWCI of 5.17 and a PP of 99.416. This indicates a growing recognition of the importance of integrating environmental considerations into supply chain management, reflecting broader global concerns about climate change.

The table also shows the diversity of research topics within *Omega*,

Table 16
Leading topics in Omega between 2013 and 2022 (Scopus).

R	Topic	TP	FWCI	PP
1	Decision-Making; Data Envelopment Analysis; Industry	157	2.33	98.983
2	Contract Law; Supply Chain; Sales	60	2.33	99.61
3	Decision Making; Multicriteria; Multiple-Criteria Decision Analysis	36	2.15	95.611
4	Supply Chain; Closed Loop; Remanufacturing	28	3.39	99.734
5	Supply Chain; Risk Management; COVID-19	25	4.99	99.882
6	China; Data Envelopment Analysis; Carbon Dioxide Emission	21	1.36	99.434
7	Inventory Model; Trade Credit; Supply Chain Management	18	2.58	98.321
8	Inventory Model; Order Quantity; Supply Chain Management	17	1.09	90.164
9	Greenhouse Gas Emissions; Decision Making; Supply Chain Management	16	5.17	99.416
10	Nurse; Scheduling Problem; Integer Programming	16	1.4	90.498
11	Lot Size; Production Control; Integer Programming	16	0.92	89.678
12	Location Problem; Genetic Algorithm; Integer Programming	15	1.43	96.032
13	Supply Chain; Genetic Algorithm; Network Design	15	2.5	92.968
14	Supply Chain; Risk Management; Finance	14	2.51	98.525
15	Health Care; Emergency Ward; Discrete Event Simulation	14	0.88	95.466
16	Single Machine; Polynomial Approximation; Parallel Machine Scheduling	14	2.21	91.983
17	Contract Law; Risk Management; Supply Chain Management	14	0.96	84.169
18	Scheduling Problem; Genetic Algorithm; Benchmarking	12	3.77	98.922
19	Vehicle Routing; Genetic Algorithm; Benchmarking	12	1.5	98.82
20	Genetic Algorithm; Light Rail Transit; Railway	12	3.35	96.246
21	Stochastics; Risk Management; Supply Chain Management	12	2.19	90.055
22	Portfolio Selection; Returns to Scale; Data Envelopment Analysis	12	1.01	61.874
23	Genetic Algorithm; Linear Programming; Packing Problem	11	1.13	92.781
24	Stochastics; Inventory Control; Supply Chain Management	11	0.6	88.95
25	Decision-Making; Preference Relation; Mathematical Operator	10	6.68	99.343
26	Revenue Management; Dynamic Pricing; Airline	10	0.79	91.677
27	Bibliology; Bibliometric Analysis; Scientometrics	9	2.14	99.415
28	Supplier Evaluation; Supply Chain; Multiple-Criteria Decision Analysis	9	2.77	99.159
29	AHP Approach; Decision Making; Multiple-Criteria Decision Analysis	9	2.81	96.88
30	Genetic Algorithm; Assembly Machines; Assembly Line Balancing	9	2.69	96.074
31	Routing Problem; Supply Chain; Integer Programming	9	2.12	94.747
32	Operating Room; Operation Duration; Integer Programming	9	1.06	94.13
33	Robust Statistics; Linear Programming; Optimization Problem	9	2.3	91.586
34	Disaster Relief; Genetic Algorithm; Supply Chain Management	8	2.49	99.358
35	Supply Chain; Bullwhip Effect; Sales	8	2.21	94.709
36	Consumer Behavior; Pricing Strategy; Commerce	8	1.74	86.525
37	Cooperatives; Optimal Control; Supply Chain Management	8	2.45	86.059
38	Benefits; Composite Indicator; Data Envelopment Analysis	8	1.29	79.376
39	Decision Making; Case Study; Multiple-Criteria Decision Analysis	7	12.36	99.248
40	Project Portfolio; Data Processing; Multiple-Criteria Decision Analysis	7	1.11	93.003

Abbreviations: *R* = Rank; TP = Total papers; FWCI = Field-weighted citation impact (data from Scopus); PP = Worldwide prominent percentile (according to Scopus and FWCI).

Table 17
Leading topic clusters in Omega between 2013 and 2022 (Scopus).

R	Topic Cluster	TP	FWCI	PP
1	Supply Chain Management; Pricing; Commerce	251	2.21	93.133
2	Data Envelopment Analysis; Industry; Regression Analysis	216	2.1	79.137
3	Integer Programming; Transport; Benchmarking	154	1.59	94.114
4	Flowshop Scheduling; Integer Programming; Benchmarking	92	1.84	82.211
5	Supply Chain Management; Industry; Airline	59	3.74	98.038
6	Multiple-Criteria Decision Analysis; Cognitive Map; Artificial Intelligence	41	2.01	24.068
7	Railway; Transport; Integer Programming	40	1.92	32.701
8	Queueing Theory; Number; Probability Distribution	33	1.21	29.431
9	Number; Multiple-Criteria Decision Analysis; Fuzzy Logic	23	4.31	89.666
10	Commerce; Machine Learning; Transport	21	1.19	89.732
11	Heat Exchanger; Energy Engineering; Natural Gas	21	2.77	55.592
12	Multiple-Criteria Decision Analysis; Analytical Hierarchy Process; Artificial Intelligence	20	6.77	83.976
13	Auction; Cooperative Game; Commerce	19	0.82	34.402
14	Public-Private Partnership; Construction Industry; Project Scheduling	16	1.46	79.398
15	Scientometrics; Biomedical Research; Social Media	11	2.02	86.92
16	Energy Engineering; Battery Charging; Electric Power	10	2.41	96.599
17	Value at Risk; Fintech; Volatility	10	1.07	50.491
18	Knee Joint; Tibia; Total Hip Arthroplasty	9	1.06	66.579
19	Carbon Dioxide Emission; Environmental Policy; Climate Change	8	2.4	95.749
20	Data Mining; Graph Neural Network; Social Network Analysis	7	0.98	94.572
21	Reliability Analysis; Engineering; Condition-Based Maintenance	7	2.53	83.322
22	Edge; Number; Mathematics	7	0.87	50.425
23	Social Media; Adoption; e-Commerce	6	0.72	98.365
24	Transport; Data Mining; Information System	6	2.23	94.702
25	Measles; Vaccine Hesitancy; Public Health	6	2	53.695
26	Air Traffic Control; Traffic Management System; Antenna	6	2.52	19.228
27	Sentiment Analysis; Natural Language Processing; Machine Learning	5	1.19	99.346
28	Particle Swarm Optimization; Mathematical Optimization; Benchmarking	5	1.17	95.683
29	Finance; Industry; Capital Structure	5	0.84	77.959
30	Metric Space; Matrix (Mathematics); Variational Inequality	4	1.14	67.626

Abbreviations are available in Table 16.

spanning from highly specialised areas like "Nurse, Scheduling Problem, and Integer Programming" to broader topics such as "Health Care, Emergency Ward, and Discrete Event Simulation." However, not all high-volume topics necessarily translate to high impact, as seen in topics like "Lot Size; Production Control; Integer Programming" and "Revenue Management; Dynamic Pricing; Airline," where the FWCI values are lower at 0.92 and 0.79, respectively. This suggests that while these topics are important within their specific niches, they may not resonate as strongly across the broader research community.

Table 17 presents the leading topic clusters, which group related topics together, providing a broader view of research trends within *Omega*. The "Supply Chain Management; Pricing; Commerce" cluster is prolific, with 251 papers and an FWCI of 2.21. This cluster encapsulates a wide array of research on optimising supply chains and pricing strategies within commercial contexts, reflecting these topics' critical role in theory and practice.

The second cluster, "Data Envelopment Analysis; Industry; Regression Analysis," with 216 papers and an FWCI of 2.1, aligns closely with the top-ranked topic from Table 16, further emphasising the field's focus on efficiency analysis and industrial applications. However, despite its volume, the PP of 79.137 suggests that while influential, this cluster may not be as universally prominent as other clusters with higher PP values. Clusters like "Integer Programming; Transport; Benchmarking" and "Flowshop Scheduling; Integer Programming; Benchmarking" highlight the technical and computational nature of research within *Omega*. These clusters are foundational to operations research, focusing on optimising complex systems, yet they have varying degrees of impact, as seen in their FWCI scores of 1.59 and 1.84, respectively. The PP values also vary, indicating that while these topics are essential, their prominence may differ based on the specific applications or methodologies they involve.

Another noteworthy cluster is "Supply Chain Management; Industry; Airline," which, although smaller with 59 papers, has an impressive FWCI of 3.74 and a PP of 98.038. This suggests that research at the intersection of supply chain management and the airline industry is particularly impactful, likely due to this sector's high stakes and complexities. The inclusion of clusters such as "Multiple-Criteria Decision Analysis; Cognitive Map; Artificial Intelligence" and "Commerce; Machine Learning; Transport" reflects the journal's engagement with emerging technologies and their applications in decision-making and commerce. While smaller in size, these clusters highlight the integration of AI and machine learning into traditional operations research topics, pointing to future directions in the field.

The analysis of these tables reveals a dynamic research landscape within *Omega*, characterised by both continuity in foundational topics and adaptability to new challenges and technologies. The prominence of supply chain management, decision-making processes, and efficiency analysis reflects the enduring relevance of these areas. At the same time, integrating AI, sustainability, and real-world crisis response demonstrates the journal's responsiveness to evolving global needs. The varying FWCI and PP values across topics and clusters further illustrate the diversity in impact and recognition within the research community, highlighting both established areas of strength and emerging fields with potential for future growth.

5. Conclusions

The concluding remarks are divided in three subsections. First, the study provides a general discussion regarding the main results and contributions of this article. Second, the work analyzes the practical implications provided by this approach. Third, the paper ends summarizing some relevant limitations and providing future research lines.

5.1. General discussion

This article provides a critical analysis of *Omega*'s evolution over five decades, highlighting significant geographic and thematic focus shifts. The bibliometric analysis reveals that early contributions were dominated by Western countries like the USA and the UK. But recent years saw a rise in Asian institutions, particularly from China, indicating a shift in global research dynamics. This change mirrored broader global trends in research and development, indicating a reconfiguration of academic networks and the growing importance of collaboration with these emerging research powerhouses.

The most productive institutions are the Chinese Academy of Sciences and the Imperial College of London. The growth of the Chinese Academy of Sciences is very impressive, having become by far the most productive institution over the last decade and having all its publications during the last twenty years. The Imperial College of London was the most productive institution in the first twenty years of *Omega*, thanks in part to Samuel Eilon, the founding editor-in-chief. Most of the institutions that publish frequently in the journal are usually ranked among the Top 500 worldwide, and several of them in the Top 100.

The North American School is the most productive in *Omega*. Twelve institutions are in the Top 50 of Table 9. However, note that Drexel University is the only institution in the Top 10. Other productive universities are the University of North Carolina and the University of Montréal. The most productive author from this region is Benjamin Lev

(Drexel University), the current editor-in-chief of the journal.

The British School is very significant in *Omega*, with eleven institutions among the fifty most productive, including the Imperial College of London, the University of Manchester, the University of Warwick and Cardiff University. Samuel Eilon is by far the most productive author from the UK.

Continental Europe also achieves very remarkable results in *Omega*, particularly, Spain that reaches the fifth position in Table 11. Eight institutions are among the Top 50, including the University of Lisbon, that ranks seventh. Seven authors are included in the Top 50. The most productive ones are Jose Rui Figueira (University of Lisbon) and Milosz Kadzinski (Poznan University of Technology).

Currently, there are fourteen Chinese institutions in the Top 50 including the Chinese Academy of Sciences, the Hong Kong Polytechnic University, and the University of Science and Technology. Some Chinese authors are already among the most productive of the journal including Tai Chiu Edwin Cheng (Hong Kong Polytechnic University) and Liang (University of Science and Technology). China shows a significant increase during the last years that it is expected to continue in the future.

Some other Asian countries and institutions perform very well in *Omega*. Particularly, it is worth noting Taiwan, and at a lower level, Turkey, India, Israel, South Korea, Singapore and Japan. Four institutions appear in the Top 50, including the National University of Singapore that is ranked fifth.

In order to understand better how the leading actors of *Omega* publish and connect between each other, this study has developed a graphical mapping of the bibliographic data by using VOS viewer software. The co-citation analysis reveals that *Omega* is mainly connected to operations research and management science journals although it has remarkable connections with journals in the fields of business, economics, computer science, and engineering. The *European Journal of Operational Research* and *Management Science* are the most influential journals in *Omega*.

The bibliographic coupling patterns emphasised the importance of international collaboration, with countries/regions like the USA, China, and the UK emerging as central hubs in the global research network. The co-occurrence analysis of author keywords demonstrated a broadening of research themes within *Omega*, transitioning from traditional operations-focused topics to contemporary areas such as data envelopment analysis, scheduling, heuristics, supply chain management, and simulation. This diversification reflected the journal's adaptability in addressing emerging academic and practical challenges, underscoring the interconnectedness of research areas in tackling complex, multidisciplinary issues.

5.2. Practical implications

Omega is a leading international journal in the field of operations research and management science. Moreover, one of its key advantages is that it is well connected to other research areas including business, economics, computer science, and engineering. During this half a century, the journal has consolidated its position in the academic community. The expectation for the future is that it will continue increasing its relevance and ranking, since the growth of research worldwide will attract more attention into the top journals. Additionally, with the creation of new journals, the journal impact factor percentile of the journals already established in the scientific community, will increase.

This study is of great usefulness for any researcher or practitioner interested in knowing the current state for the art of *Omega* and identify the leading and most popular trends occurring in the journal. Particularly, it is very practical for PhD students and newcomers in the field to obtain a quick overview of the journal without the need of spending a lot of time analysing the bibliographic data of *Omega*. Obviously, this study provides a general starting point, but anyone interested in some specific topic or question, should analyze the information in more detail.

Currently, we see how the journal has evolved from the classical position led by English-speaking countries to a more general and diversified perspective, where countries and regions from all over the world publish regularly in *Omega*. Specially, it is worth noting the huge increase of China and Continental Europe, that are achieving a leading position in the journal.

The journal has published some of the most cited papers of all-time in OR&MS [35]. One of the most recent achievements are two articles written by Jafar Rezaei [80,81] (current editor-in-chief of the *Journal of Multi-Criteria Decision Analysis*) that already have obtained more than 1000 citations, each. Note that the most cited article [80] introduces the best-worst method for multi-criteria decision-making, and it is currently the most cited document of the last decade (2014–2024) in OR&MS according to the data available in WoS Core Collection.

5.3. Limitations and future research

Finally, note that this study shows a general picture until 2023. However, the future results might vary because of the publication evolution of the journal that could include the emergence of new topics and other unexpected changes. Additionally, it is worth noting that the results of this work come from the bibliographic data available in WoS Core Collection. Therefore, the limitations of this database also apply to this analysis. Moreover, it is important to end the study mentioning that this work has identified some leading trends occurring in the journal. But different research topics may have different characteristics and therefore not always the bibliometric data may reflect or identify correctly the leading trends of a research field or a journal.

Future research in this direction could include future updates of the bibliographic data. For example, for the 60th, 70th or 75th anniversary of *Omega*. Additionally, it would be interesting to see more specific results on some key topics published in the journal [67,82,83], deeper comparative analyses at the university or country level [84], and comparative studies between journals [63].

CRediT authorship contribution statement

Walayat Hussain: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **José M. Merigó:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Iman Rahimi:** Investigation, Data curation. **Benjamin Lev:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that there is no potential conflict of interest.

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Data availability

No data was used for the research described in the article.

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