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A Bibliometric Analysis of Operations Research and Management Science

José M. Merigó^{1,2*}, Jian-Bo Yang¹

¹*Alliance Manchester Business School, University of Manchester
Booth Street East, M13 9SS Manchester, UK*

²*Department of Management Control and Information Systems, University of Chile
Av. Diagonal Paraguay 257, 8330015 Santiago, Chile*

Abstract

Bibliometric analysis is the quantitative study of bibliographic material. It provides a general picture of a research field that can be classified by papers, authors and journals. This paper presents a bibliometric overview of research published in operations research & management science in recent decades. The main objective of this study is to identify some of the most relevant research in this field and some of the newest trends according to the information found in the Web of Science database. Several classifications are made, including an analysis of the most influential journals, the two hundred most cited papers of all time and the most productive and influential authors. The results obtained are in accordance with the common wisdom, although some variations are found.

Keywords: History of OR; bibliometrics; operations research; management science; Web of Science.

* Corresponding author: Telf: +44 (0)161 3063495. Email: jmerigo@fen.uchile.cl

1. Introduction

In recent decades, the practice of operations research and management science (OR-MS) has seen a substantial increase in the scientific community. Since the official establishment of the Operations Research Society of America (ORSA) in 1952, the Operational Research Society (ORS) of the United Kingdom in 1953 and The Institute of Management Sciences (TIMS) in 1953, many important developments have consolidated a research area that today encompasses thousands of researchers. These associations have promoted some classical journals in the field that have become the key instruments to disseminate new research contributions. The Operational Research Quarterly, founded in 1950, later became the Journal of the Operational Research Society (JORS), Operations Research (1952) and Management Science (1954).

These and other operations research associations have cooperated together through joint international conferences and associations [13]. First, the creation of the International Federation of Operational Research Societies (IFORS) in 1959 between ORSA, ORS and the French Operational Research Society (SOFRO) constituted a world entity focused on operations research which grew rapidly with the incorporation of operational research societies from a wide range of countries. Today the IFORS includes more than 30,000 individual members from 48 national societies. Another important integration process was the constitution of regional associations that encompassed a whole continent, such as the Association of European Operational Research Societies (EURO) in 1975. Similar regional associations have also been formed in other continents, including the Association of North American Operations Research Societies (NORAM), the Latin American Ibero Association on Operations Research (ALIO) and the Association of Asian-Pacific Operational Research Societies (APORS). Finally, a further key integration event occurred when the American school became a strong unified entity with the merger between ORSA and TIMS in 1995, which created the Institute for Operations Research and Management Sciences (INFORMS). INFORMS currently has approximately 10,000 individual members and sponsors thirteen leading journals in OR-MS, including the flagship journals in the field: Management Science and Operations Research.

In the literature, several papers provide general overviews regarding different fundamental topics of OR-MS. A remarkable example is the collection of papers gathered for the 50th anniversary of the Operations Research journal in 2002 and Management Science in 2004. Hopp [18] gave a general overview of key authors and topics that appeared in

1 Management Science during this time. Some key overviews were given in a wide range of
2 fundamental research fields of OR-MS [7,38]. Similar general overviews have also appeared
3 in JORS [4] and in many other journals [6,34].
4

5 However, although there are many papers providing general overviews on different
6 aspects of OR-MS, there are few papers that have analysed the state of the art from a
7 bibliometric perspective. Some papers have partially addressed this issue, including the
8 general overview on multiple criteria decision making [45], OR-MS in Asia [5], OR-MS in
9 developing countries [46], production and operations management [17,35], data envelopment
10 analysis [22,26] and the list of 10 and 50 most influential papers published in Management
11 Science [19] that are currently available on the webpage of Management Science. Moreover,
12 several studies have focused on more specific issues, including the analysis of citation
13 behaviour in OR-MS [30-33], institutions in INFORMS practice literature [14], the
14 evaluation of OR-MS journals [8-10] and country analyses [21,37]. However, to the best of
15 our knowledge, none of the papers has provided a general picture of the current state and
16 evolution of OR-MS using bibliometric indicators.
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18 Bibliometric analysis is a research field that is receiving increasing attention by the
19 scientific community, and it is especially motivated by the fast development of computers
20 and the internet [1]. Bibliometric analysis is becoming a fundamental methodology for
21 analysing research, and it originated from the field of library and information science. In the
22 literature, there are several papers providing complete bibliometric overviews in many
23 research areas, including management [36], economics [3], health economics [44], fuzzy
24 research [28], innovation [11,27], entrepreneurship [23], international business [12] and
25 pricing research [24].
26

27 The aim of this paper is to provide a general overview of research performed in OR-MS
28 over the last decades using bibliometric methods. We use the Web of Science (WoS) as the
29 database for collecting information. The objective is to be able to identify the most
30 productive and influential research in OR-MS and see the current evolution of the field by
31 taking into account the most influential papers and authors. Most of the results are in
32 accordance with common wisdom, although we find some particular situations that show how
33 the field of OR-MS is growing, with some topics becoming very popular and highly cited,
34 whereas some other topics do not receive an equivalent number of citations.
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36 The paper is organized as follows. Section 2 describes the methodology used for the
37 bibliometric analysis and the most influential journals. Section 3 analyses the most cited
38 papers of all time in OR-MS according to WoS. Section 4 and 5 present the most productive
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and influential authors and institutions. Section 6 develops a general analysis by countries. Finally, Section 7 summarizes the main results and conclusions of the paper.

2. Bibliometric methods

To analyse the bibliographic information, it is necessary to select the journals that are going to be used. To be as objective as possible in this selection process, we have used the information available in the WoS database that is currently owned by Thomson & Reuters [42]. The database includes material from a wide range of research areas. Currently, it contains more than 15,000 journals and 50,000,000 papers classified in 251 subject categories and 151 subject areas. OR-MS appears in both subject category and research area as a single research field and includes a total number of 228,399 publications as of October 2012. However, this number includes 15 different types of publications, including journal articles, proceedings, notes, reviews and short communications. Therefore, to focus on the most representative pieces of research available in WoS, we only selected “journal articles” and “reviews” in the analysis, thus reducing the number of publications to 133,741. Sometimes, reviews are not considered important scientific contributions, but we have included them because they represent a strong point of view of a research topic that usually conditions future research. Most of the publications have been published in the last decade (2001-2011), representing 51.5% of the total number of publications. If we filter this information by “articles” and “reviews”, the number of papers is 59,231, that is, 44.29% of the total are from the last decade.

Because WoS has a specific research category dedicated to OR-MS, it is reasonable to select all of the journals from this category. The main limitation of this approach is the differences in journal quality because some of them may have lower quality but publish more papers. As such, when making the publication count, this issue cannot be avoided, which significantly affects the authors’ analysis. Therefore, we divide the latter into two parts: the most productive authors and those that are highly cited and have a minimum level of productivity in OR-MS. In general terms, however, the results generated from this study are in accordance with the perception that the leading journals and authors are mentioned by the scientific community in a wide range of places, such as at conferences, and are placed in the top positions of journal rankings, such as ABS Academic Journal Guide 2015 [41], although some exceptional variation may occur. The alternative approach was to select a lower number of journals from the category, which is usually regarded by many indicators as the leading

1 journals, such as the Journal Citation Reports (JCR) of WoS. The main advantage of this
2 method is that the information found is very selective because it is limited to only
3 publications from high-quality journals. However, the limitation is that some key research is
4 not considered. To take into account this second approach, some additional results are
5 provided with a special focus on specific journals.
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9 WoS currently contains 79 journals in the OR-MS category. Some journals close to the
10 field are not included, such as Decision Sciences, which is included in the Management
11 category, or some INFORMS journals, such as Marketing Science and Organization Science,
12 which are included in the categories of Business and Management, respectively. In this
13 context, it is interesting to see the paper recently published by Tüselmann et al. [43], where it
14 is possible to see the rankings of the main journals in business and management from a
15 comparison perspective with OR-MS journals. To be objective, the study follows the WoS
16 selection of journals in the OR-MS category, which is commonly regarded as one of the most
17 influential [25]. In Table 1, we present the complete list of journals included in the OR-MS
18 category of WoS.
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33 Some of the journals have a general research perspective in OR-MS, although some of
34 them are strictly focused on a specialized aspect, such as Transportation Science or the
35 Journal of Operations Management. WoS has a special section dedicated to the analysis of
36 journals, the JCR which analyses journals based on several criteria, although the main focus
37 is on the last 3 years, to form the impact factor. The impact factor of a journal in year X is
38 obtained by dividing the number of citations received by articles published in years X – 1 and
39 X – 2 from papers published in year X, by the number of articles published in years X – 1 and
40 X – 2. In recent years, there have been many criticisms of the impact factor. For example, it is
41 easy to manipulate it by using self-citations or similar techniques [15,39]. WoS has tried to
42 solve this problem by penalizing those journals that make excessive manipulations to the
43 impact factor, but it is clear that many other issues have to be considered when analysing the
44 quality of a journal, including the editorial board members and the peer-review process [2].
45 WoS has recently introduced an alternative measure, the 5-year impact factor, which
46 considers a period of six years in the analysis. This approach gives a more general picture by
47 considering more years. The 5-year impact factor is similar to the classical impact factor. The
48 difference is that the 5-year impact factor considers citations to articles published between
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1 years $X - 1$ and $X - 5$ instead of $X - 1$ and $X - 2$. However, there are still important
2 weaknesses similar to those mentioned before [15].

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4 Recently, a wide range of new methods has been suggested for evaluating the research
5 quality of a set of papers from authors, institutions and journals [29]. The most popular one is
6 the H-index [16] which evaluates a set of publications by considering the “x” number of
7 papers that have received at least “x” citations. Therefore, if an institution or a journal has an
8 H-index of 40, it means that it has 40 papers that **have each received** 40 citations or more.
9 This measure is useful because it considers both the quality and the quantity of a set of
10 publications. When analysing authors, institutions and countries, the H-index is extremely
11 useful, although we may find some differences depending on the quality of journals where
12 the papers have been published. However, it is not as easy to strike a balance between the
13 number of publications and citations for journals because if a journal publishes a high number
14 of papers, it may not always indicate that the journal is of a higher quality. By publishing
15 more papers, a journal tends to become more influential, but an excessive number of papers
16 may reduce the quality of the **journal. Sometimes**, a journal may decide to increase the
17 acceptance rate to change the quality of the papers published or because it is receiving many
18 high-quality papers. In some other situations, the journal may prefer to decrease the
19 acceptance rate to publish only papers with high-quality **[40]**.

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21 As explained by Podsakoff et al. [36], in the publication and citation count, WoS gives
22 one unit for each author of a paper. Moreover, it gives one unit for each different institution
23 or country of a paper. However, if more than one author is from the same institution or
24 country, it only gives one unit for the institution or country. Therefore, in this context, we
25 find a degree of asymmetry in the publication and citation count that **benefits co-authorship.**
26 **Nevertheless**, by looking at the **different results of the analysis**, it is possible to analyse and
27 classify the profile of all of the researchers to obtain a complete view of the leading authors
28 in the field. Note that this study follows the methodology of WoS.

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3. Leading journals in operations research & management science

To provide a general overview of the most influential journals, in Table 2, we present the
thirty OR-MS journals with the highest H-index. Although the H-index cannot strictly reflect
the quality of a journal because a high number of publications may influence the H-index, it
gives an approximation that is closer to the quality as perceived by the scientific community
[6,26,41] than the results found with the impact factor.

Insert Table 2 about here

By ranking the journals according to the H-index, Management Science and Operations Research obtain the first two positions in the ranking, as we would expect from other studies [34] and journal rankings [41]. However, by looking to the impact factor, several other journals are ranked more highly. We find that the ranking found with the H-index gets results similar to other ranking lists [43]. The Journal of Operations Management and Omega have the highest impact factor. The main reason is that these journals do not publish many papers but receive a large number of citations. By looking at the total number of citations, we find that Management Science, European Journal of Operational Research (EJOR) and Operations Research are the most cited journals. It is worth noting the increase of EJOR during the last decade. Although its average number of citations per paper over the last decade is approximately half that of Management Science, it has twice the number of total citations received for all the articles published over the same period.

4. Most cited articles in operations research & management science journals

The information found in WoS can be classified in different ways. One way is to order a set of articles by the number of citations received. Thus, we can identify those articles that have received more attention by the scientific community. In Table 3, a list of the 200 most cited articles of all time in OR-MS is presented. Instead of ranking the papers from the most cited to the 200th most cited, we have grouped the articles by journal so it is possible to see all of the papers of the same journal that are included in the list. For each article, we present the journal name, the global rank in the list, the number of citations, the title of the paper, the name of the first author, the year published and the average number of citations per year. Note that the journals are arranged in the table according to the number of papers they have in the ranking. In the case of tie, according to the sum of citations of the papers that appear in the table.

Insert Table 3 about here

The most cited paper is the classical article on data envelopment analysis published by Charnes and Cooper in 1978 in EJOR, which has received almost 4,000 citations. Next, we

1 find three papers with more than 2,000 citations and 12 additional ones with over 1,000
2 citations. In general, it is clear that the journals Management Science and Operations
3 Research dominate this list, with seventy seven and thirty six papers, respectively.
4

5 These 200 papers have also been classified into subareas. Each paper has been assigned
6 to a subarea, as shown in the last column of Table 3, although it could be argued that some
7 papers could be classified differently because they partially fit in different subareas. Table 4
8 analyses these subareas, indicating the number of the top 200 papers in each subarea.
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18 Mathematical Programming is the most common subarea. Operations and Production
19 Management and Information Systems and Technology appear in second and third place,
20 respectively. Many of the papers could be assigned to more than one subarea. However, in
21 this study, each paper has been assigned to one subarea to maintain the same weight for each
22 of the papers.
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29 **5. Most productive and influential authors**

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31 Since the beginning of OR-MS, many authors have made fundamental contributions to the
32 development of this field. In this section, the objective is to present some of these authors
33 according to the information found in WoS in terms of the number of papers published and
34 the number of citations received. These results include some of the most popular researchers
35 in OR-MS. However, some other very well-known authors do not appear due to the particular
36 nature of the ranking. For example, it is difficult to include older authors who published their
37 research several decades ago because at that time, the number of publications included in
38 WoS was very low. Thus, with this ranking, it is possible to identify some key researchers in
39 OR-MS, but it is important to note that many other authors could also have appeared
40 according to other parameters.
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50 Regarding the method used for the ranking, it is possible to rank authors by number of
51 publications and by number of citations. In the literature, both methods have been used in
52 previous studies. For example, Hsieh and Chang [20] decided to rank authors by publication
53 number. To avoid the limitations of this approach regarding the quality of journals, they
54 added an additional list focusing only on five selected journals. Other authors, such as
55 Podsakoff et al. [36], ranked authors by citations. In this paper, a combined method is used.
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1 First, a list is presented that includes the twenty five authors with the highest number of
2 publications in OR-MS journals. Next, an additional list with twenty five authors is included
3 who are ranked by the number of citations of papers published in OR-MS journals and who
4 has at least ten papers published in these journals. Thus, the results are flexible because they
5 present authors who have published several articles, classical authors with many citations in
6 OR-MS or influential authors in the nucleus of OR-MS. The results are shown in Table 5.
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16 Because there is no method that clearly identifies the value of a journal, another approach
17 may be used to identify influential and productive authors according to the perceived
18 reputation of journals. By focusing on the authors of Table 5, Table 6 classifies their
19 publications according to eight selected journals that are usually perceived among the most
20 reputable journals in the rankings of OR-MS [43]. The aims and scope of these journals
21 permits defining them as general journals in OR-MS. The selection process of these journals
22 excludes journals that are specialized in a particular area of OR-MS because the objective is
23 to view OR-MS from a general perspective.
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33 Insert Table 6 about here
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36 To obtain a better picture regarding the authors with the highest number of papers in
37 these selected journals, in Table 7, the analysis is focused on presenting the 30 authors with
38 the highest number of papers in these eight selected journals. Thus, it is possible to see the
39 most influential authors in each journal, thus allowing the reader to identify key authors for
40 each journal. Because there is no agreement regarding the value and ranking of a journal,
41 each reader may evaluate this list in a different way. Moreover, the list can be useful for those
42 who are interested in a particular journal. If there is a tie, we rank the authors alphabetically.
43 And if the tie appears in the 30th position, the column is expanded until all the tied authors
44 are mentioned.
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6. Conclusions

A general bibliometric overview of OR-MS was presented. Most of the results are in accordance with the perception of the academic community, although some interesting differences were found when looking to the numerical results obtained by the journals, the articles and the authors of the analysis. First, the American school is the most dominant in OR-MS. The USA leads the two most influential journals in the field: Management Science and Operations Research. The most popular authors come from America, such as Cooper and Charnes, and Americans have published most of the leading articles of all time. Canada has also shown very productive and influential results in this field. Second, Continental Europe has been increasing its influence with the publication of EJOR. Third, the Chinese school is much younger but already has a strong position with several leading researchers. Finally, the British school also has a strong influence with the publication of JORS.

From the results of this study, it is possible to identify some of the most productive and influential research in OR-MS in terms of journals, papers and authors. However, an important limitation is that they only provide a general orientation, and there is a lot of good research in OR-MS that has not been included in this paper. Furthermore, there are many discussions on how to evaluate publications because the values of different journals are not equal, and the consideration of this issue may lead to significant changes in the rankings generated from this study.

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References

- [1] Bar-Ilan J. Informetrics at the beginning of the 21st century – A review. *Journal of Informetrics* 2008;2(1):1–52.
- [2] Besancenot, D, Huynh KV, Faria JR. Search and research: the influence of editorial boards on journals' quality. *Theory and Decision* 2012;73(4):687–702.
- [3] Bonilla C, Merigó JM, Torres-Abad C, Economics in Latin America: A bibliometric analysis. *Scientometrics* 2015;105(2):1239–1252.

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- [4] Brailsford S, Harper P, Shaw D. Milestones in OR. *J Operational Research Society* 2009;60(S):S1–S4.
- [5] Chang, PL, Hsieh PN. Bibliometric overview of operations research / management science research in Asia. *Asia-Pacific J Operations Research* 2008;25(2):217–41.
- [6] Cheang B, Chu SKW, Li C, Lim A. OR/MS journals evaluation based on a refined PageRank method: an updated and more comprehensive review. *Scientometrics* 2014;100(2):339–361.
- [7] Chopra S, Lovejoy W, Yano C. Five decades of operations management and the prospects ahead. *Management Science* 2004;50(1):8–14.
- [8] Donohue JM, Fox JB. A multi-method evaluation of journals in the decision and management sciences by US academics. *Omega – Int J Management Science* 2000;28(1):17–36.
- [9] Eto H. Authorship and citation patterns in operational research journals in relation to competition and reform. *Scientometrics* 2000;47(1):25–42.
- [10] Eto H. Authorship and citation patterns in management science in comparison with operational research. *Scientometrics* 2002;53(3):337–49.
- [11] Fagerberg J, Fosaas M, Sapraser K. Innovation: Exploring the knowledge base. *Research Policy* 2012;41(7):1132–53.
- [12] Ferreira MP, Pinto CF, Serra FR. The transaction costs theory in international business research: A bibliometric study over three decades. *Scientometrics* 2014;98(3):1899–922.
- [13] Fores S, Krarup J. On the origins of OR and its institutions. *Central European J Operations Research* 2013;21(2):265–75.
- [14] Fricker RD. Editorial: The ninth Rothkopf ranking of universities’ contributions to the INFORMS practice literature. *Interfaces* 2011;41(6):590–8.
- [15] Glänzel W, Moed HF. Journal impact measures in bibliometric research. *Scientometrics* 2002;53(2):171–93.
- [16] Hirsch JE. An index to quantify an individual’s scientific research output. *Proc National Academy of Sciences* 2005;102(46):16569–72.
- [17] Holsapple CW, Lee-Post A. Behavior-based analysis of knowledge dissemination channels in operations management. *Omega – Int J Management Science* 2010;38(3-4):167–78.
- [18] Hopp WJ. Fifty years of *Management Science*. *Management Science* 2004;50(1):1–7.
- [19] Hopp WJ. Ten most influential papers of Management Science’s first fifty years. *Management Science* 2004;50(12):1763.
- [20] Hsieh PN, Chang PL. An assessment of world-wide research productivity in production and operations management. *Int J Production Economics* 2009;120(2):540–51.
- [21] Kao C. The authorship and country spread of operations research journals. *Scientometrics* 2009;78(3):397–407.
- [22] Lampe HW, Hilgers D. Trajectories of efficiency measurement: A bibliometric analysis of DEA and SFA. *European Journal of Operational Research* 2015; 240:1–21.

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- [23] Landström H, Harirchi G, Aström F. Entrepreneurship: Exploring the knowledge base. *Research Policy* 2012;41(7):1154–81.
- [24] Leone RP, Robinson LM, Bragge J, Somervuori O. A citation and profiling analysis of pricing research from 1980 to 2010. *J Business Research* 2012;65(7):1010–24.
- [25] Leydesdorff L, Carley S, Rafols I. Global maps of science based on the new Web of Science categories. *Scientometrics* 2013;94(2):589–93.
- [26] Liu JS, Lu LYY, Lu WM, Lin BJJ. Data envelopment analysis 1978-2010: A citation-based literature survey. *Omega – Int J Management Science* 2013;41(1):3–15.
- [27] Merigó JM, Cancino C, Coronado F, Urbano D. Academic research in innovation: A country analysis. *Scientometrics* 2016;108(2):559–593.
- [28] Merigó JM, Gil-Lafuente AM, Yager RR. An overview of fuzzy research with bibliometric indicators. *Applied Soft Computing* 2015;27:420–33.
- [29] Merigó JM, Mas-Tur A, Tierno-Roig N, Ribeiro-Soriano D. A bibliometric overview of the Journal of Business Research between 1973 and 2014. *Journal of Business Research* 2015;68(12):2645–2653.
- [30] Mingers J. Exploring the dynamics of journal citations: Modelling with s-curves. *J Operational Research Society* 2008;59(8):1013–25.
- [31] Mingers J, Burrell QL. Modeling citation behavior in management science journals. *Information Processing and Management* 2006;42(6):1451–64.
- [32] Mingers J, Leydesdorff L. A review of theory and practice in scientometrics. *European Journal of Operational Research* 2015;246:1–19.
- [33] Mingers J, Xu F. The drivers of citations in management science journals. *European J Operational Research* 2010;205(2):422–30.
- [34] Ormerod R, Kiossis I. OR/MS publications: Extension of the analysis of U.S. flagship journals to the United Kingdom. *Operations Research* 1997;45(2):178–87.
- [35] Pilkington A, Meredith J. The evolution of the intellectual structure of operations management – 1980–2006: A citation/co-citation analysis. *J Operations Management* 2009;27(3):185–202.
- [36] Podsakoff PM, MacKenzie SB, Podsakoff NP, Bachrach DG. Scholarly influence in the field of management: A bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century. *J Management* 2008;34(4):641–720.
- [37] Reisman A, Kirschnick F. The devolution of OR/MS: Implications from a statistical content analysis of papers in flagship journals. *Operations Research* 1994;42(4):577–88.
- [38] Smith JE, von Winterfeldt D. Decision analysis in *Management Science*. *Management Science* 2004;50(5):561–574.
- [39] Stonebraker JS, Gil E, Kirkwood CW, Handfield RB. Impact factor as a metric to assess journals where OM research is published. *J Operations Management* 2012;30(1):24–43.

- 1 [40] Sugimoto CR, Larivière V, Ni C, Cronin B. Journal acceptance rates: A cross-disciplinary
2 analysis of variability and relationships with journal measures. *Journal of Informetrics* 2013;7:897–
3 906.
- 4 [41] The ABS editorial board, “Academic Journal Guide 2015”, the Association of Business
5 Schools, 2015, <https://steffenroth.files.wordpress.com/2015/06/abs-2015-steffen-roth-ch.pdf>.
- 6 [42] Thomson Reuters: Web of Science, <http://wokinfo.com/> [accessed October 2012].
- 7 [43] Tüselmann H, Sinkovics RR, Pishchulov G. Towards a consolidation of worldwide journal
8 rankings: A classification using random forests and aggregate rating via data envelopment analysis.
9 *Omega – Int J Management Science* 2015;51:11–23.
- 10 [44] Wagstaff A, Culyer AJ. Four decades of health economics through a bibliometric lens. *J*
11 *Health Economics* 2012;31(2):406–39.
- 12 [45] Wallenius J, Dyer JS, Fishburn PC, Steuer RE, Zionts S, Deb K. Multiple criteria decision
13 making, multiattribute utility theory: Recent accomplishments and what lies ahead. *Management*
14 *Science* 2008;54(7):1336–49.
- 15 [46] White L, Smith H, Currie C. OR in developing countries: A review. *European J Operational*
16 *Research* 2011;208(1):1–11.
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Tables

Table 1. List of journals in the OR-MS category of WoS

4OR – A Quarterly J. of Operations Research	J. of the Operations Research Society of Japan
Annals of Operations Research	M&SOM – Manufacturing & Service Operations Managem.
Applied Stochastic Models in Business and Industry	Management Science
Asia-Pacific J. of Operational Research	Mathematical Methods of Operations Research
Central European J. of Operations Research	Mathematical Programming
Computational Optimization and Applications	Mathematics of Operations Research
Computers & Operations Research	Military Operations Research
Concurrent Engineering – Research and Applications	Naval Research Logistics
Decision Support Systems	Networks
Discrete Event Dynamic Syst. – Theory & Applications	Networks & Spatial Economics
Discrete Optimization	Omega – Int. J. of Management Science
Engineering Economist	Operations Research
Engineering Optimization	Operations Research Letters
European J. of Industrial Engineering	Optimal Control Applications & Methods
European J. of Operational Research	Optimization
Expert Systems with Applications	Optimization and Engineering
Flexible Services and Manufacturing Journal	Optimization Letters
Fuzzy Optimization and Decision Making	Optimization Methods & Software
IEEE Systems Journal	OR Spectrum
IIE Transactions	Pacific J. of Optimization
INFOR	Probability in the Engineering and Informational Sciences
INFORMS Journal on Computing	Proc. of the Institute of Mechanical Engineers. Part O – J. of Risk and Reliability
Interfaces	Production and Operations Management
Int. J. of Computer Integrated Manufacturing	Production Planning & Control
Int. J. of Information Technology and Decision Making	Quality and Reliability Engineering International
Int. J. of Production Economics	Quality Technology and Quantitative Management
Int. J. of Production Research	Queueing Systems
Int. J. of Systems Science	RAIRO – Operations Research
Int. J. of Technology Management	Reliability Engineering & Systems Safety
Int. Transactions in Operational Research	Safety Science
J. of Global Optimization	SORT – Statistics and Operations Research Transactions
J. of Industrial and Management Optimization	Studies in Informatics and Control
J. of Manufacturing Systems	Systems & Control Letters
J. of Operations Management	Systems Engineering
J. of Optimization Theory and Applications	Technovation
J. of Quality Technology	TOP
J. of Scheduling	Transportation Research Part B – Methodological
J. of Systems Engineering and Electronics	Transp. Res. Part E – Logistics and Transportation Review
J. of Systems Science and Systems Engineering	Transportation Science
J. of the Operational Research Society	

Table 2. Journal ranking according to the H-index

R	Name	TC	TP	C/P	TC11	TP11	C/P11	IF	5-IF	T200	H
1	Management Science	216817	5760	38	33819	1432	24	1.859	3.057	77	191
2	Operations Research	123068	4529	27	12346	1018	12	1.786	2.484	36	136
3	European J. Operational Research	170335	11881	14	70004	6089	11	2.038	2.524	15	125
4	Mathematical Programming	64031	2749	23	12858	910	14	2.090	2.351	9	100
5	Systems & Control Letters	53097	3398	16	14055	1273	11	1.667	2.054	15	89
6	Int. J. Production Research	72449	6558	11	21647	3177	7	1.460	1.733	3	78
7	Mathematics of Operations Research	30642	1646	19	4631	557	8	0.899	1.264	7	75
18	J. of the Operational Research Society	53763	5139	10	10919	1684	6	0.989	1.282	4	74
19	J. Optimization Theory and Applications	44956	4637	10	9703	1500	6	1.423	1.475	3	72
110	Transportation Research Part B: Methodological	26824	1439	19	9737	653	15	2.944	3.520	2	69
113	J. Operations Management	15395	534	29	13191	469	28	4.400	7.130	1	67
114	J. Quality Technology	20763	1116	19	3710	330	11	1.520	1.650	3	67
113	Computers & Operations Research	42647	3708	12	21701	2009	11	1.909	2.374	3	66
114	Transportation Science	20706	897	23	5119	370	14	1.814	2.623	2	65
115	Networks	20597	1561	13	3083	575	5	0.645	0.949	2	61
116	Int. J. Production Economics	42116	3953	11	26305	2421	11	2.081	2.594	1	60
117	IIE Transactions	27839	2150	13	7639	931	8	1.287	1.647	0	60
118	Omega – Int. J. Management Science	24866	2198	11	9773	646	15	3.024	3.474	4	59
119	Naval Research Logistics	23458	2315	10	3668	621	6	0.692	1.240	1	55
120	Expert Systems with Applications	39298	7376	5	34099	5474	6	1.854	2.339	0	55
121	Decision Support Systems	21566	1870	12	12848	1198	11	2.201	3.037	1	54
122	Reliability Engineering & System Safety	28650	3227	9	14962	1567	10	1.901	2.441	0	53
123	Interfaces	18428	2144	9	2726	450	6	0.845	1.016	1	52
124	Operations Research Letters	18808	2202	9	5125	1026	5	0.519	0.821	0	51
125	Annals of Operations Research	16599	2259	7	8004	1341	6	1.029	1.243	0	49
126	J. Global Optimization	16796	1558	11	7558	1084	7	1.307	1.665	3	47
127	Production and Operations Management	7621	545	14	6504	451	14	1.315	2.316	0	44
128	Int. J. of Systems Science	22744	5149	4	5156	1191	4	1.305	1.504	1	44
129	Technovation	13890	1590	9	8862	868	10	3.177	3.449	0	40
130	Safety Science	10491	1621	6	5457	946	6	1.359	1.785	0	38

Abbreviations: R = Rank; TC = Total number of citations; TP = Total number of publications (articles + reviews); C/P = Average number of citations per paper; TC11 = Total number of citations between 2001-2011; TP11 = Total number of publications between 2001-2011; IF = Impact factor; 5-IF = 5-year impact factor; T200 = Number of papers included in the list of 200 most cited papers; H = H-index.

Table 3. The two hundred most cited papers in operations research and management science

	J	R	TC	Title	First Author	Year	C/Y	SA
1								
2	J							
3	MS	2	2311	User acceptance of computer-technology – A comparison of 2 theoretical models	F.D. Davis	1989	100	IST
4								
5	MS	4	2139	Some models for estimating technical and scale inefficiencies in data envelopment analysis	R.D. Banker	1984	76	DEA
6								
7	MS	6	1879	Games with incomplete information played by “Bayesian” players, I-III. Part I. The basic model	J.C. Harsanyi	1967	41	DMA
8								
9	MS	8	1716	Organizational information requirements, media richness and structural design	R.L. Daft	1986	66	IST
10								
11	MS	9	1680	Asset stock accumulation and sustainability of competitive advantage	I. Dierickx	1989	73	FIN
12								
13	MS	11	1427	New product growth for model consumer durables	F.M. Bass	1969	33	OPM
14	MS	12	1398	A theoretical extension of the Technology Acceptance Model	V. Venkatesh	2000	116	IST
15								
16	MS	14	1094	Information distortion in a supply chain	H.L. Lee	1997	72	OPM
17	MS	17	965	Dynamic version of the economic lot size model	H.M. Wagner	1958	17	OPM
18	MS	23	838	The Lagrangian-relaxation method for solving integer programming-problems	M.L. Fisher	1981	27	MP
19								
20	MS	28	705	Chance-constrained programming	A. Charnes	1959	13	MP
21	MS	30	687	Patterns in strategy formation	H. Mintzberg	1978	20	SO
22	MS	32	674	Sticky information and the locus of problem solving – implications for innovation	E. von Hippel	1994	37	IST
23								
24	MS	33	658	Modeling managerial behaviour – misperceptions of feedback in a dynamic decision making experiment	J.D. Sterman	1989	28	DMA
25								
26	MS	34	649	A foundation for the study of group decision support systems	G. De Sanctis	1987	25	DMA
27								
28	MS	35	645	Conceptual-framework for the design of organizational control mechanisms	W.G. Ouchi	1979	19	SO
29								
30	MS	39	615	Reducing social context cues – electronic mail in organizational communication	L. Sproull	1986	23	IST
31								
32	MS	40	612	Lead users – A source of novel product concepts	E. von Hippel	1986	23	OPM
33	MS	43	606	Central problems in the management of innovation	A.H. van Deven	1986	23	EIK
34	MS	46	584	Development of a tool for measuring and analysing computer user satisfaction	J.E. Bailey	1983	20	IST
35								
36	MS	47	575	Managerial perspectives on risk and risk-taking	J.G. March	1987	23	DMA
37	MS	48	571	A procedure for ranking efficient units in data envelopment analysis	P. Andersen	1993	30	DEA
38								
39	MS	54	535	Information technology implementation research – A technological diffusion approach	R.B. Cooper	1990	24	IST
40								
41	MS	55	530	The shifting bottleneck procedure for job shop scheduling	J. Adams	1988	22	OPM
42								
43	MS	57	522	The correlates of entrepreneurship in 3 types of firms	D. Miller	1983	18	EIK
44	MS	58	521	A simplified model for portfolio analysis	W.F. Sharpe	1963	10	FIN
45	MS	59	519	Quantifying the bullwhip effect in a simple supply chain: The impact of forecasting, lead times and information	F. Chen	2000	43	OPM
46								
47	MS	61	516	An experimental application of the Delphi method to the use of experts	N. Dalkey	1963	10	DMA
48								
49	MS	62	514	Optimal policies for a multi-echelon inventory problem	A.J. Clark	1960	9	OPM
50	MS	67	497	The value of information sharing in a two-level supply chain	H.L. Lee	2000	41	OPM
51								
52	MS	70	478	Frictionless commerce? A comparison of Internet and conventional retailers	E. Brynjolfsson	2000	39	IST
53								
54	MS	72	474	Location of knowledge and the mobility of engineers in regional networks	P. Almeida	1999	36	EIK
55								
56	MS	76	463	Jobshop-like queuing systems	J.R. Jackson	1963	9	QT
57	MS	77	461	The adoption of radical and incremental innovations – An empirical analysis	R.D. Dewar	1986	17	EIK
58								
59	MS	78	454	A spatial model of effectiveness criteria – Towards a	R.E. Quinn	1983	15	SO
60								
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1	MS	79	447	competing values approach to organizational analysis	C.E. Lemke	1965	9	MP
2				Bimatrix equilibrium points and mathematical programming				
3	MS	83	439	User involvement and mis success – A review of research	B. Ives	1984	15	IST
4								
5	MS	85	437	Supply chain inventory management and the value of a shared information	G.P. Cachon	2000	36	OPM
6								
7	MS	88	429	Paradox lost? Firm-level evidence on the returns to information systems spending	E. Brynjolfsson	1996	26	IST
8								
9	MS	90	427	Timid choices and bold forecasts – A cognitive perspective on risk-taking	D. Kahneman	1993	22	DMA
10								
11	MS	98	418	Reducing buyer search costs: Implications for electronic marketplaces	J.Y. Bakos	1997	27	IST
12								
13	MS	101	417	Information technology and organizational change – Causal-structure in theory and research	M.L. Markus	1988	17	IST
14								
15	MS	103	412	Control – Organizational and economic approaches	K.M. Eisenhardt	1985	15	SO
16	MS	106	408	Gambling with the house money and trying to break even – The effects of prior outcomes on risky choice	R.H. Thaler	1990	18	DMA
17								
18	MS	111	400	Decision-making in a fuzzy environment	R.E. Bellman	1970	9	DMA
19	MS	113	398	Linear programming under uncertainty	G.B. Dantzig	1955	6	MP
20	MS	114	397	Interactive approach for multi-criterion optimization, with an application to operation of an academic departm.	A.M. Geoffrio	1972	9	DMA
21								
22	MS	116	393	Management misinformation systems	R.L. Ackoff	1967	8	IST
23	MS	125	384	Multicommodity distribution system-design by benders decomposition	A.M. Geoffrio	1974	10	OPM
24								
25	MS	126	382	Strategic orientation of business enterprises – The construct, dimensionality and measurement	N. Venkatraman	1989	16	SO
26								
27	MS	129	380	Evaluating program and managerial efficiency – An application of DEA analysis to program follow through	A. Charnes	1981	12	DEA
28								
29	MS	136	365	Managerial applications of neural networks – The case of bank failure predictions	K.Y. Tam	1992	18	FIN
30								
31	MS	137	363	The impact of environmental management on firm performance	R.D. Klassen	1996	22	SO
32								
33	MS	138	363	Location of bank accounts to optimize float – Analytic study of exact and approximate algorithms	G. Cornuejols	1977	10	FIN
34								
35	MS	142	355	A tabu search heuristic for the vehicle-routing problem	M. Gendreau	1994	19	OPM
36	MS	145	354	Joint ventures and the option to expand and acquire	B. Kogut	1991	16	SO
37	MS	146	353	Supply chain coordination with revenue-sharing contracts: Strengths and limitations	G. P. Cachon	2005	50	OPM
38								
39	MS	147	353	General systems theory – The skeleton of science	K.E. Boulding	1956	6	STT
40	MS	150	350	Explaining the role of user participation in information system use	J. Hartwick	1994	19	IST
41								
42	MS	153	348	Organization strategy and structural differences for radical versus incremental innovation	J.E. Ettlie	1984	12	EIK
43								
44	MS	155	346	Strategic decision processes in high velocity environments – 4 cases in the microcomputer industry	L.J. Bourgeois	1988	14	DMA
45								
46	MS	159	344	Manufacturing flexibility – A strategic perspective	D. Gerwin	1993	18	OPM
47	MS	160	343	Adaptation on rugged landscapes	D.A. Levinthal	1997	22	SO
48	MS	161	342	Optimal dynamic pricing of inventories with stochastic demand over finite horizons	G. Gallego	1994	19	BA
49								
50								
51	MS	162	339	The digitization of word of mouth: Promise and challenges of online feedback mechanisms	C. Dellarocas	2003	37	IST
52								
53	MS	167	335	Manufacturing strategy, environmental uncertainty and performance – A path analytic model	P.M. Swamidass	1987	13	OPM
54								
55	MS	168	334	A heuristic program for locating warehouses	A.A. Kuehn	1963	6	OPM
56	MS	169	333	Empirical evaluation of the revised technology acceptance model	B. Szajna	1996	20	IST
57								
58	MS	177	323	Product development decisions: A review of the literature	V. Krishnan	2001	29	OPM
59								
60	MS	179	322	Finding K shortest loopless paths in a network	J.Y. Yen	1971	7	GRT
61								
62								
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	MS	180	321	A fast taboo search algorithm for the job shop problem	E. Nowicki	1996	20	BA
1	MS	184	318	Value of information in capacitated supply chains	S. Gavirneni	1999	24	IST
2	MS	189	315	Interactive programming method for solving multiple criteria problem	S. Zions	1976	8	DMA
3								
4	MS	190	315	Program for research on management information systems	R.O. Mason	1973	8	IST
5								
6	MS	192	313	The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer	D.Z. Levin	2004	39	EIK
7								
8	MS	193	313	Patents and innovation – An empirical study	E. Mansfield	1986	12	EIK
9	MS	200	310	The truck dispatching problem	G.B. Dantzig	1959	5	MP
10	OR	15	1091	Effective heuristic algorithm for travelling-salesman problem	S. Lin	1973	27	MP
11								
12	OR	20	889	A proof for the queuing formula – $L = \text{Lambda} \cdot W$	J.D.C. Little	1961	17	QT
13	OR	26	774	Scheduling of vehicles from central depot to number of delivery points	G. Clarke	1964	16	TR
14								
15	OR	29	694	Shock-waves on the highway	P.I. Richards	1956	12	TR
16	OR	31	678	Regret in decision-making under uncertainty	D.E. Bell	1982	22	DMA
17	OR	36	630	Optimum locations of switching centers + absolute centers + medians of graph	S.L. Hakimi	1964	13	GRT
18								
19	OR	37	625	Algorithms for the vehicle-routing and scheduling problems with the time window constraints	M.M. Solomon	1987	25	TR
20								
21	OR	38	620	Decomposition principles for linear-programs	G.B. Dantzig	1960	11	MP
22	OR	50	564	A linear-programming approach to the cutting-stock problem	P.C. Gilmore	1961	11	MP
23								
24	OR	63	512	Optimization by simulated annealing – An experimental evaluation 1: Graph partitioning	D.S. Johnson	1989	22	MP
25								
26	OR	64	512	Generalized Lagrange multiplier method for solving problems of optimum allocation of resources	H. Everett	1963	10	MP
27								
28	OR	65	509	Sequencing with earliness and tardiness penalties – A review	K.R. Baker	1990	23	OPM
29								
30	OR	73	474	Optimum preventive maintenance policies	R. Barlow	1960	9	OPM
31	OR	89	429	Dual-based procedure for uncapacitated facility location	D. Erlenkotter	1978	12	OPM
32	OR	93	424	Traveling-salesman problem and minimum spanning trees	M. Held	1970	10	MP
33								
34	OR	94	423	Branch-and-price: Column generation for solving huge integer programs	C. Barnhart	1998	30	MP
35								
36	OR	96	420	Survey of scheduling rules	S.S. Panwalkar	1977	12	SCH
37	OR	99	418	Poisson arrivals see time averages	R.W. Wolff	1982	13	QT
38	OR	104	412	Minimizing a submodular function on a lattice	D.M. Topkis	1978	12	MP
39	OR	110	401	Branch and bound methods – A survey	E.L. Lawler	1966	8	MP
40	OR	118	390	Deterministic equivalents for optimizing and satisficing under chance constraints	A. Charnes	1963	7	MP
41								
42	OR	119	390	A linear programming approach to the cutting stock problem 2	P.C. Gilmore	1963	7	MP
43								
44	OR	123	385	Networks of waiting lines	J.R. Jackson	1957	7	MP
45	OR	130	379	Optimal lot sizing, process quality improvement and setup cost reduction	E.L. Porteus	1986	14	OPM
46								
47	OR	135	366	Evaluating influence diagrams	R.D. Shachter	1986	14	STT
48	OR	140	361	Robust optimization of large scale systems	J.M. Mulvey	1995	21	MP
49	OR	143	355	An additive algorithm for solving linear programs with 0-1 variables	E. Balas	1965	7	MP
50								
51	OR	149	351	Pricing and the newsvendor problem: A review with extensions	N.C. Petruzzi	1999	27	BA
52								
53	OR	157	346	Location of emergency service facilities	C. Toregas	1971	8	BA
54	OR	172	329	Parallel sequencing and assembly line problems	T.C. Hu	1961	6	SCH
55	OR	175	326	Metric – A multi-echelon technique for recoverable IETM control	C.C. Sherbro	1968	7	OPM
56								
57	OR	181	320	Job shop scheduling by simulated annealing	P.J.M. van Laarhoven	1992	16	SCH
58								
59	OR	183	319	Closed queuing systems with exponential servers	W.J. Gordon	1967	7	QT
60								
61								
62								
63								
64								
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OR	185	317	Multistage cutting stock problems of 2 and more dimensions	P.C. Gilmore	1965	6	MP	
1								
2	OR	187	316	Solving large-scale zero-one linear-programming problems	H. Crowder	1983	10	MP
3								
4	OR	198	311	Optimum distribution of switching centers in a communication network and some related graph theoretic problem	S.L. Hakimi	1965	6	GRT
5								
6								
7	EJOR	1	3947	Measuring efficiency of decision-making units	A. Charnes	1978	116	DEA
8	EJOR	49	567	How to make a decision – The analytic hierarchy process	T.L. Saaty	1990	25	DMA
9	EJOR	66	501	Benchmarks for basic scheduling problems	E. Taillard	1993	26	SCH
10	EJOR	80	445	Quantitative models for reverse logistics: A review	M. Fleischmann	1997	29	OPM
11	EJOR	81	443	Efficiency of financial institutions: International survey and directions for future research	A.N. Berger	1997	29	FIN
12								
13	EJOR	92	426	Vendor selection criteria and methods	C.A. Weber	1991	20	DMA
14	EJOR	102	415	Variable neighbourhood search: Principles and applications	P. Hansen	2001	37	GM
15								
16	EJOR	105	408	Applications of the extent analysis method on fuzzy AHP	D.Y. Chang	1996	25	DMA
17								
18	EJOR	121	387	Resource constrained project scheduling: Notation, classification, models and methods	P. Brucker	1999	29	SCH
19								
20	EJOR	133	374	How to select and how to rank projects – The PROMETHEE method	J.P. Brans	1986	14	DMA
21								
22	EJOR	139	362	Coordinated supply chain management	D.J. Thomas	1996	22	OPM
23	EJOR	163	337	Rough sets theory for multicriteria decision analysis	S. Greco	2001	30	DMA
24	EJOR	165	337	A typology of cutting and packing problems	H. Dyckhoff	1990	15	GM
25	EJOR	196	311	Scheduling with batching: A review	C.N. Potts	2000	25	SCH
26	EJOR	197	311	The vehicle routing problem – An overview of exact and approximate algorithms	G. Laporte	1992	15	TR
27								
28	SCL	41	612	Linearization by output injection and non-linear observers	A.J. Krener	1983	21	STT
29								
30	SCL	52	546	A stabilization algorithm for a class of uncertain linear-systems	I.R. Petersen	1987	21	STT
31								
32	SCL	71	476	Adapted solution of a backward stochastic differential equation	E. Pardoux	1990	21	GM
33								
34	SCL	74	468	State-space formulas for all stabilizing controllers that satisfy an H infinity-norm bound and relations to risk sensitivity	K. Glover	1988	19	STT
35								
36								
37	SCL	82	439	A new discrete-time robust stability conditions	M.C. de Oliveira	1999	33	STT
38								
39	SCL	107	407	On characterizations of the input-to-space stability property	E.D. Sontag	1995	23	STT
40								
41	SCL	112	399	Robust control of a class of uncertain nonlinear systems	Y.Y. Wang	1992	19	STT
42	SCL	115	393	Gain scheduling via linear fractional transformations	A. Packard	1994	21	SCH
43	SCL	132	375	Fast linear iterations for distributed averaging	L. Xiao	2004	46	STT
44	SCL	144	354	Delay-dependent robust stability criteria for uncertain neutral systems with mixed delays	Y. He	2004	44	STT
45								
46	SCL	151	349	A universal construction of artstein theorem on nonlinear stabilization	E.D. Sontag	1989	15	STT
47								
48	SCL	152	348	New Lyapunov-Krasovskii functionals for stability of linear retarded and neutral type systems	E. Fridman	2001	31	STT
49								
50								
51	SCL	174	326	Control problems of grey systems	J.L. Deng	1982	10	STT
52	SCL	176	324	Sliding mode control of a discrete system	K. Furuta	1990	14	STT
53	SCL	194	312	On the Kalman-Yakubovich-Popov lemma	A. Rantzer	1996	19	STT
54	MP	16	1058	On the limited memory BFGS method for large-scale optimization	D.C. Liu	1989	46	MP
55								
56	MP	21	880	Finite-dimensional variational inequality and nonlinear complimentary problems – A survey of theory	P.T. Harker	1990	40	MP
57								
58	MP	24	825	Restart procedures for conjugate gradient method	M.J.D. Powell	1977	23	MP
59	MP	51	550	A nonsmooth version of Newton method	L. Qi	1993	28	MP
60	MP	91	426	On the implementation of an interior point filter line-	A. Wachter	2006	71	MP
61								
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63								
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1	MP	122	386	search algorithm for large-scale nonlinear programming	E.D. Dolan	2002	38	MP
2				Benchmarking optimization software with performance profiles				
3	MP	141	359	An outer approximation algorithm for a class of mixed integer nonlinear programs	M.A. Duran	1986	13	MP
4								
5	MP	166	336	Some numerical experiments with variable-storage quasi-Newton algorithms	J.C. Gilbert	1989	14	MP
6								
7	MP	182	320	Optimally conditioned optimization algorithms without line searches	W.C. Davidon	1975	8	MP
8								
9	MOR	18	927	Optimal auction design	R.B. Myerson	1981	29	DMA
10	MOR	75	465	Cooling schedules for optimal annealing	B. Hajek	1988	19	SCH
11	MOR	95	421	Strongly regular generalized equations	S.M. Robinson	1980	13	MP
12	MOR	97	419	Robust convex optimization	A. Ben-Tal	1998	29	MP
13	MOR	108	407	Minimization by random search techniques	F.J. Solis	1981	13	MP
14	MOR	127	381	Convergence analysis of some algorithms for solving nonsmooth equations	L.Q. Qi	1993	20	GM
15								
16	MOR	195	312	Integer programming with a fixed number of variables	H.W. Lenstra	1983	10	MP
17	JORS	7	1720	Rate control for communication networks: shadow prices, proportional fairness and stability	F.P. Kelly	1998	122	IST
18								
19	ORQ	44	592	Combination of forecasts	J.M. Bates	1969	13	BA
20	JORS	56	529	OR library – Distributing test problems by electronic mail	J.E. Beasley	1990	24	IST
21								
22	JORS	178	323	Future of operational research is past	R.L. Ackoff	1979	9	OTH
23	Omega	42	611	A heuristic algorithm for the M-machine, N-job flowshop sequencing problem	M. Nawaz	1983	21	OPM
24								
25	Omega	68	492	Dynamic model of process and product innovation	J.M. Utterback	1975	13	EIK
26	Omega	148	351	E-commerce: The role of familiarity and trust	D. Gefen	2000	29	IST
27	Omega	186	316	A review of scheduling research involving setup considerations	A. Allahverdi	1999	24	SCH
28								
29	JGO	3	2273	Differential evolution – A simple and efficient heuristic for global optimization over continuous spaces	R. Storn	1997	151	MP
30								
31	JGO	60	517	Greedy randomized adaptive search procedures	T.A. Feo	1995	30	MP
32	JGO	69	483	Efficient global optimization of expensive black-box functions	D.R. Jones	1998	34	MP
33								
34	COR	19	894	Future paths for integer programming and links to artificial intelligence	F. Glover	1986	34	MP
35								
36	COR	45	591	Special issue – Routing and scheduling of vehicles and crews – the state of the art	L. Bodin	1983	20	TR
37								
38	COR	53	535	Variable neighbourhood search	N. Mladenovic	1997	35	MP
39	RAIRO	13	1164	Existence, uniqueness and approximation of saddle point problem arising from Lagrangian multipliers	F. Brezzi	1974	30	MP
40								
41	RAIRO	86	432	Approximation by finite element functions using local regularization	P. Clement	1975	11	GM
42								
43	RAIRO	158	345	Conforming and non-conforming finite elements methods for solving stationary stokes equations I	M. Crouzeix	1973	8	GM
44								
45	JOTA	22	861	Thermodynamical approach to the travelling salesman problem – An efficient simulation algorithm	V. Cerny	1985	31	MP
46								
47	JOTA	84	438	Globally convergent method for nonlinear programming	S.P. Han	1977	12	MP
48	JOTA	154	347	Lipschitzian optimization without the Lipschitz constant	D.R. Jones	1993	18	MP
49	JQT	25	792	Simultaneous optimization of several response variables	G. Derringer	1980	24	MP
50	JQT	87	431	Process capability indexes	V.E. Kane	1986	16	OPM
51	JQT	173	327	Off-line quality-control, parameter design, and the Taguchi method	R.N. Kacker	1985	12	OPM
52								
53	IJPR	128	381	A state of the art survey of dispatching rules for manufacturing job shop operations	J.H. Blackstone	1982	12	OPM
54								
55	IJPR	171	332	Machine component grouping in production-flow analysis – An approach using a rank order clustering-algorithm	J.R. King	1980	10	OPM
56								
57								
58								
59	IJPR	199	310	CONWIP – A pull alternative to Kanban	M.L. Spearman	1990	14	OPM
60	TR-B	100	417	The cell transmission model – A dynamic representation	C.F. Daganzo	1994	23	TR
61								
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1				of highway traffic consistent with the hydrodynamic theory					
2	TR-B	170	333	The cell transmission model 2: Network traffic	C.F. Daganzo	1995	19		TR
3	Netw.	109	404	A survey of gossiping and broadcasting in communication networks	S.M. Hedetniemi	1988	16		IST
4									
5	Netw.	156	346	Steiner problem in networks – A survey	P. Winter	1987	13		GRT
6	TS	134	368	Network design and transportation planning – Models and algorithms	T.L. Magnanti	1984	13		TR
7									
8	TS	188	315	Traffic equilibrium and variational-inequalities	S. Dafermos	1980	9		TR
9	Inter.	131	378	The analytic hierarchy process – A survey of the method and its applications	F. Zahedi	1986	14		DMA
10									
11	NRL	191	314	Survey of maintenance models – Control and surveillance of deteriorating systems	W.P. Pierskalla	1976	8		OPM
12									
13	BEJMS	5	1957	Theory of economic regulation	G.J. Stigler	1971	47		OTH
14	OMS	10	1585	Using SeDuMi 1.02, a MATLAB toolbox for optimization over symmetric cones	J.F. Sturm	1999	121		MP
15									
16	IJSS	27	708	Operations on fuzzy numbers	D. Dubois	1978	20		GM
17	IJPE	117	391	Supply chain design and analysis: Models and methods	B.M. Beamon	1998	27		OPM
18	QS	124	384	A storage model with self-similar input	I. Norros	1994	21		QT
19	DSS	120	389	A survey of trust and reputation systems for online service provision	A. Josang	2007	77		IST
20									
21	JOM	164	337	Arcs of integration: an international study of supply chain strategies	M.T. Frohlich	2001	30		OPM
22									

Abbreviations: J = Journal name; R = Rank; TC = Total number of citations; C/Y = Citations per year; SA = Subarea (the full name of the abbreviations are available in Table 4).

Journal abbreviations: BEJMS = Bell Economic J. of Management Sciences; COR = Computers & Operations Research; DSS = Decision Support Systems; EJOR = European J. of Operational Research; Inter. = Interfaces; IJPE = Int. J. of Production Economics; IJPR = Int. J. of Productions Research; IJSS = Int. J. of Systems Science; JGO = J. of Global Optimization; JOM = J. of Operations Management; JOTA = J. of Optimization Theory and Applications; JORS = J. of the Operational Research Society (ORQ = Operational Research Quarterly); JQT = J. of Quality Technology; MS = Management Science; MP = Mathematical Programming; MOR = Mathematics of Operations Research; NRL = Naval Research Logistics; Netw. = Networks; Omega = Omega – Int. J. of Management Science; OR = Operations Research; OMS = Optimization Methods & Software; QS = Queueing Systems; RAIRO = RAIRO Operations Research; SCL = Systems & Control Letters; TR-B = Transportation Research Part B – Methodological; TS = Transportation Science.

Table 4. Number of papers of Table 3 in each OR-MS subarea

Rank	Abbreviation	Subarea	Number of Papers
1	MP	Mathematical Programming	45
2	OPM	Operations and Production Management	32
3	IST	Information Systems and Technology	23
4	DMA	Decision Making and Analysis	19
5	STT	System Theory and Thinking	15
6	SCH	Scheduling	9
7	TR	Transportation Research	9
8	EIK	Entrepreneurship, Innovation and Knowledge	8
9	SO	Strategy and Organizations	8
10	GM	General Mathematics	7
11	BA	Business Analytics (Other Topics)	5
12	FIN	Finance	5
13	QT	Queuing Theory	5
14	DEA	Data Envelopment Analysis	4
15	GRT	Graph Theory	4
16	OTH	Other Topics	2

Table 5. The most productive and influential authors in OR-MS

The most productive authors according to the total number of papers in OR-MS									
R	Name	Country	TP-OR	TC-OR	TP-10	TC-10	TP	TC	H-index
1	G Laporte	Canada	279	6779	150	2000	299	7486	42
2	TCE Cheng	China	275	4338	158	2236	407	6564	33
3	HD Sherali	USA	184	2143	79	512	225	2939	25
4	O Berman	Canada	161	1506	80	558	171	1645	21
5	Z Drezner	USA	142	2213	65	563	169	2580	22
6	KL Teo	Australia	138	1012	62	527	387	2991	19
7	F Glover	USA	135	4330	42	440	183	5640	35
8	CY Lee	China	134	3312	67	546	168	3474	30
9	SK Goyal	Canada	131	2153	45	621	197	3342	26
10	SP Sethi	USA	128	1978	52	584	221	3350	23
11	W Whitt	USA	120	2821	37	430	204	5987	30
12	DC Montgomery	USA	117	2885	58	729	162	3169	26
13	M Fukushima	Japan	115	1958	52	630	170	2812	24
14	XQ Yang	China	115	1349	80	730	154	1862	22
15	PM Pardalos	USA	112	1770	71	722	188	3005	23
16	SY Wang	China	111	1082	83	834	155	1528	18
17	M Gendreau	Canada	105	3466	56	924	133	3870	31
18	A Gunasekaran	USA	105	1977	36	1192	132	2444	22
19	JC Yao	China	105	1471	86	882	312	4241	22
20	GL Nemhauser	USA	104	3215	35	390	144	3802	28
21	G Levitin	Israel	101	995	77	523	113	1559	17
22	FTS Chan	China	98	1061	70	906	194	2078	18
23	JG Shanthikumar	USA	97	1485	13	82	152	2733	22
24	JND Gupta	USA	96	2203	35	365	99	2393	25
25	WB Powell	USA	96	1676	29	284	111	1974	25
The most influential authors according to the total number of citations in OR-MS									
1	WW Cooper	USA	88	9881	10	172	169	11929	28
2	A Charnes	USA	83	9456	-	-	191	11744	24
3	HL Lee	USA	73	5438	9	345	99	7211	33
4	RD Banker	USA	35	4335	13	299	98	5716	22
5	ML Fisher	USA	35	3532	5	113	53	4354	24
6	CF Daganzo	USA	95	3184	35	545	117	3435	29
7	A Federgreen	USA	78	3011	16	432	104	3492	31
8	D Bertsimas	USA	90	2431	39	1051	125	2926	26
9	TL Saaty	USA	36	2309	10	231	139	4980	17
10	PT Harker	USA	39	2276	5	165	76	2902	22
11	GP Cachon	USA	26	2080	20	776	36	2169	17
12	GB Dantzig	USA	27	2018	-	-	84	3638	14
13	JS Dyer	USA	38	1893	6	93	112	2245	18
14	JDC Little	USA	20	1880	2	6	53	2547	15
15	GR Bitran	USA	44	1734	2	20	48	1757	25
16	HM Wagner	USA	36	1705	2	41	109	2414	17
17	E Brynjolfsson	USA	13	1676	4	16	51	3896	9
18	MJD Powell	UK	22	1619	4	133	81	8738	15
19	SC Graves	USA	37	1610	9	152	93	2194	17
20	WD Cook	Canada	93	1590	37	474	100	1706	22
21	RL Keeney	USA	47	1548	10	122	117	2880	21
22	S Zionts	USA	50	1406	6	81	76	1515	18
23	PC Fishburn	USA	52	1352	2	65	403	6581	19
24	JB Orlin	USA	70	1249	26	248	116	2117	20
25	RL Winkler	USA	35	1122	9	61	143	3669	17

Abbreviations: R = Rank; TP-OR = Total number of publications in OR-MS; TC-OR = Total number of citations to the author's work that was published on the area of OR-MS; TP-10 = Total number of publications in OR-MS between 2002-2011; TC-10 = Total number of citations to the author's publications in the area of OR-MS between 2002-2011; TP = Total publications; TC = Total citations.

Table 6. The most productive and influential authors, with publications counts in eight selected OR-MS journals

R	Name	MS	OR	EJOR	JORS	Omega	COR	MOR	MP	Other	Total
1	G Laporte	1	20	54	47	1	41	-	2	113	279
2	TCE Cheng	1	2	48	21	10	37	-	-	156	275
3	HD Serali	7	14	14	9	4	10	1	15	110	184
4	O Berman	2	5	31	14	-	19	-	-	90	161
5	Z Drezner	3	5	22	24	1	13	1	1	72	142
6	KL Teo	1	-	9	1	-	-	1	-	126	138
7	F Glover	11	17	22	3	2	10	-	10	60	135
8	CY Lee	4	5	16	2	-	13	1	-	93	134
9	SK Goyal	2	1	27	16	-	-	-	-	85	131
10	SP Sethi	7	13	13	3	-	-	5	-	87	128
11	W Whitt	25	33	-	1	-	-	11	-	51	120
12	DC Montgomery	-	-	1	-	-	-	-	-	118	119
13	M Fukushima	-	2	8	-	-	-	3	16	86	115
14	XQ Yang	1	1	16	1	-	-	4	2	90	115
15	PM Pardalos	-	-	4	-	-	12	1	5	90	112
16	SY Wang	-	-	20	1	3	4	-	-	83	111
17	M Gendreau	1	11	17	6	-	12	-	-	58	105
18	A Gunasekaran	-	-	11	3	2	-	-	-	89	105
19	JC Yao	-	-	6	-	-	-	2	1	96	105
20	GL Nemhauser	7	17	5	1	-	1	2	22	49	104
21	G Levitin	-	-	9	3	-	2	-	-	87	101
22	FTS Chan	-	-	1	-	2	-	-	-	95	98
23	JG Shanthikumar	8	16	7	-	-	3	6	1	56	97
24	JND Gupta	-	1	16	13	5	14	1	-	46	96
25	WB Powell	2	12	6	-	-	-	1	1	74	96
1	WW Cooper	30	6	20	6	4	-	-	-	23	88
2	A Charnes	31	12	10	1	2	1	1	1	25	83
3	HL Lee	20	14	3	1	-	-	-	-	35	73
4	RD Banker	14	2	13	1	-	-	-	-	5	35
5	ML Fisher	8	9	1	-	-	-	2	4	11	35
6	CF Daganzo	-	4	-	-	-	-	-	-	91	95
7	A Federgruen	19	34	-	-	-	-	6	1	19	79
8	D Bertsimas	3	28	3	-	-	1	8	12	35	90
9	TL Saaty	3	6	14	-	-	-	-	-	13	36
10	PT Harker	6	2	7	-	-	-	-	7	17	39
11	GP Cachon	19	2	-	-	-	-	-	-	5	26
12	GB Dantzig	10	6	1	1	-	-	-	3	6	27
13	JS Dyer	17	8	4	-	1	-	-	-	8	38
14	JDC Little	2	14	-	-	-	-	-	-	4	20
15	GR Bitran	13	16	3	-	1	-	-	2	9	44
16	HM Wagner	12	17	1	-	-	-	-	-	6	36
17	E Brynjolfsson	12	-	-	-	-	-	-	-	1	13
18	MJD Powell	-	-	-	-	-	-	-	17	5	22
19	SC Graves	14	5	1	-	-	1	1	-	15	37
20	WD Cook	9	6	22	15	7	5	-	-	29	93
21	RL Keeney	11	21	2	2	1	-	-	-	10	47
22	S Zionts	14	6	13	1	-	4	-	-	12	50
23	PC Fishburn	19	15	2	-	-	-	7	1	8	52
24	JB Orlin	3	17	1	-	-	2	2	16	29	70
25	RL Winkler	25	8	-	-	-	-	-	-	2	35

Abbreviations: R = Rank; Journal abbreviations are shown in Table 3.

Table 7. Authors with the highest number of papers in eight selected journals

	MS		OR		EJOR		JORS		Omega		COR		MOR		MP	
	Author	TP	Author	TP	Author	TP	Author	TP	Author	TP	Author	TP	Author	TP	Author	TP
1	A Charnes	31	A Federgruen	34	G Laporte	54	G Laporte	47	S Eilon	21	G Laporte	41	MJ Todd	15	YY Ye	31
2	WW Cooper	30	W Whitt	33	TCE Cheng	48	Z Drezner	24	WR King	16	TCE Cheng	37	YY Ye	14	JS Pang	30
3	W Whitt	25	D Bertsimas	28	J Zhu	34	AH Christer	23	TCE Cheng	10	BL Golden	31	JS Pang	13	M Kojima	28
4	RL Winkler	25	LM Wein	24	O Berman	31	TCE Cheng	21	TSH Teo	10	O Berman	19	WT Rhee	13	MJ Todd	28
5	HL Lee	20	RL Keeney	21	M Sakawa	30	LC Thomas	21	PC Nutt	9	G Moshetov	16	UG Rothblum	13	LA Wolsey	28
6	GP Cachon	19	G Laporte	20	T Sueyoshi	30	JE Beasley	19	TS Raghunathan	9	R Batta	15	A Hordijk	11	D Goldfarb	27
7	A Federgruen	19	DD Yao	20	JPC Kleijnen	29	C Eden	17	JR Doyle	8	CJ Liao	15	A Shwartz	11	RDC Monteiro	25
8	PC Fishburn	19	F Glover	17	SK Goyal	27	YD Kim	17	B Gold	8	JND Gupta	14	W Whitt	11	M Fischetti	24
9	JS Dyer	17	GL Nemhauser	17	HS Lau	25	J Mingers	17	V Grover	8	R Marti	14	RM Freund	10	P Tseng	24
10	J Eliahsberg	17	JB Orlin	17	R Dekker	24	JM Wilson	17	JC Higgins	8	Z Drezner	13	R Hassin	10	G Cornuejols	23
11	CS Tang	17	HM Wagner	17	LF Escudero	24	SK Goyal	16	K Kowalski	8	CY Lee	13	A Shapiro	10	GL Nemhauser	22
12	C Terwiesch	17	GR Bitran	16	R Lahdelma	24	RJ Paul	16	L Liang	8	JM Smith	13	EA Feinberg	9	E Balas	20
13	RK Sarin	16	JG Shanthikumar	16	R Slowinski	24	BR Sarker	16	A Mehrez	8	LX Tang	13	MS Gowda	9	R Weismantel	20
14	TE Morton	15	P Zipkin	16	LN van Wassenhove	24	E Thanassoulis	16	D Sculli	8	JF Bard	12	E Lehrer	9	PL Toint	19
15	AG Rao	15	PC Fishburn	15	WD Cook	22	WD Cook	15	J Zhu	8	H Bruneel	12	AS Lewis	9	S Mizuno	17
16	K Srinivasan	15	NG Hall	15	Z Drezner	22	JM Norman	15	V Adlakh	7	SI Gass	12	RDC Monteiro	9	MJD Powell	17
17	RD Banker	14	RL Smith	15	F Glover	22	EA Silver	15	JE Beasley	7	M Gendreau	12	RL Smith	9	M Fukushima	16
18	MA Cohen	14	HL Lee	14	MY Kovalyov	21	PC Bell	14	PD Berger	7	JP Ignizio	12	E Zemel	9	JB Orlin	16
19	SC Graves	14	JDC Little	14	KK Lai	21	O Berman	14	Y Chen	7	SH Kim	12	A Neyman	8	AR Conn	15
20	EL Porteus	14	M Queyranne	14	WW Cooper	20	FR Johnston	14	WD Cook	7	PM Pardalos	12	LQ Qi	8	RM Freund	15
21	LM Wein	14	HD Sherali	14	C Koulamas	20	M Pidd	14	BG Dale	7	MS Akturk	11	WD Sudderth	8	M Grotschel	15
22	S Zions	14	D Simchi-Levi	14	CS Tang	20	S Salhi	14	SK Gupta	7	A Allahverdi	11	M Sviridenko	8	A Nemirovski	15
23	GR Bitran	13	JS Song	14	SY Wang	20	FJ Vasko	14	M Igarria	7	YK Lin	11	M Teboulle	8	Y Nesterov	15
24	C Derman	13	E Balas	13	DJ White	20	JE Boylan	13	KH Lai	7	JY Potvin	11	P Tseng	8	A Ruszczyński	15
25	P Kouvelis	13	P Glasserman	13	JE Beasley	19	RG Dyson	13	B Lev	7	R Ruiz	11	JN Tsitsiklis	8	HD Sherali	15
26	H Levy	13	SP Sethi	13	J Blazewicz	19	JND Gupta	13	T Sueyoshi	7	KJ Chung	10	RJB Wets	8	KM Anstreicher	14
27	V Srinivasan	13	MJ Sobel	13	A Lim	19	A Mehrez	13	C Frier	6	F Glover	10	D Bertsimas	7	RH Byrd	14
28	E Brynjolfsson	12	P Toth	13	J Puerto	19	CM Molinero	13	P Goodwin	6	L Gouveia	10	M Conforti	7	OL Mangasarian	14
29	RL Keeney	12	SA Zenios	13	C Zopounidis	19	C Romero	13	K Gronhaug	6	A Mehrez	10	PC Fishburn	7	A Tamir	14
30	H Mendelson	12	RL Ackoff	12	R Batta	18	J Rosenhead	13	C Kao	6	R Nagi	10	KD Glazebrook	7	DP Bertsekas	13
31	S Shane	12	A Charnes	12	A Volgenant	18			R Ostermark	6	C Prins	10	S Hart	7	M Conforti	13
32	HM Wagner	12	M Fischetti	12					KJ Radford	6	M Schmiederjans	10	R Kannan	7	O Gunluk	13
33			PW Glynn	12					JE Samouilidis	6	HD Sherali	10	M Kojima	7	KC Kiwiel	13
34			WS Jewell	12					TJ Stewart	6	L Wang	10	A Mandelbaum	7	J Nocedal	13
35			D Klingman	12					E Wasil	10	S Mannor	10		7	MR Rao	13

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6	PM Morse	12		S Mizuno	7	UG Rothblum	13		
7	WB Powell	12		A Ruszczynski	7	A Shapiro	13		
8	MH Rothkopf	12		M Shaked	7				
9				DB Shmoys	7				
10				E Solan	7				
11				M Talagrand	7				

12Abbreviations: R = Rank; TP = Total number of publications; Journal abbreviations are shown in Table 3.

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Supplementary Material

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Highlights

- A bibliometric analysis of the state of the art in operations research and management science.
- Identification of the 200 most influential papers in the field.
- Analysis of the most influential authors and journals.