Short Communication

Low cited articles in operations research / management science☆

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Highly cited scientific articles are well-known in their fields and attract most of the researchers' attention (e.g., see [8,14]). Less is known about the opposite end of the spectrum, i.e., those articles that have very few citations, if cited at all. A relatively old and highly debated article in *Science* [5] estimated that a surprisingly high number of articles have no citations. More recently, a news feature article in *Nature* [13] observed that the number of uncited articles is not as high as estimated and varies much across scientific areas. Similarly, focusing on the Business/Management area, Baruch et al. [2] also challenged the view that uncitedness ratios (i.e., the fraction of articles not cited) are very high.

This topic has attracted increased interest, given the debates on the use of citations as a proxy for the quality of publications and the availability of increasingly large citation databases. Over a hundred articles concerning uncited publications can now be found in the Web of Science™ (WoS) database by Clarivate Analytics. Some recent studies (e.g., [9,10]) address possible explanatory variables (such as field, document type, or impact factor of a journal) for the probability of being uncited. Most of these studies make a high-level aggregation of scientific fields (e.g., arts and humanities, social sciences, engineering, etc.), whereas other studies have focused on specific areas (e.g., [1,2,11]). The area of Operations Research/Management Science (OR/MS), however, does not seem to have been previously addressed.

This editorial examines the issue more closely within the context of the OR/MS field of research by focusing solely on a specific set of journals listed in the Operations Research & Management Science category in the Journal Citation Reports™ (JCR) by Clari-

vate Analytics. With some degree of arbitrariness, we selected 12 journals among the 100 listed in this category, but this concept study can easily be extended to any number of journals. The selected journals have high impact factors (Q1 or almost Q1 according to JCR) and are focused on core OR/MS topics while having a wide scope (excluding for instance journals narrowly focused on transportation or safety). The following 12 journals were selected:

- Annals of Operations Research
- Computers and Operations Research
- Decision Support Systems
- European Journal of Operational Research
- Expert Systems with Applications
- International Journal of Production Economics
- International Journal of Production Research
- Journal of Operations Management
- Management Science
- OMEGA – International Journal of Management Science
- Operations Research
- Production Planning and Control

The above list contains some of the most well-known journals that cover a broad spectrum of OR/MS topics, with a long tradition in the field.

Records from the articles in these 12 journals from 2001 to 2017 with document type "article" or "review" were obtained from WoS. More recent years were not included to allow for at least a 5-year window from the date of publication for being cited. A total of 46,154 articles meet all the criteria in these 12 journals. This represents 37.34% of the total 123,604 Article/Review documents in this WoS category during 2001–2017. Citations were obtained from WoS citation reports, and do not exclude self-citations. These data were collected in the first week of October 2022.


Table 1

Distribution of WoS citations in different journals, highlighting uncited articles.

		Number of citations in WoS		
	Articles in 2001–17	0 citations	1–5 citations	>5 citations
Annals of Operations Research	2781	4.0%	25.2%	70.8%
Computers and Operations Research	3518	1.0%	11.1%	87.8%
Decision Support Systems	2139	0.5%	8.4%	91.2%
European Journal of Operational Research	9863	1.2%	10.7%	88.1%
Expert Systems with Applications	10,315	0.8%	11.0%	88.2%
Int. Journal of Production Economics	4405	0.8%	7.0%	92.2%
Int. Journal of Production Research	5879	1.0%	13.7%	85.3%
Journal of Operations Management	686	0.0%	0.3%	99.7%
Management Science	2508	0.1%	4.2%	95.7%
OMEGA-International Journal of Management Science	1251	0.6%	5.9%	93.4%
Operations Research	1607	0.6%	7.3%	92.1%
Production Planning and Control	1202	1.2%	17.6%	81.3%
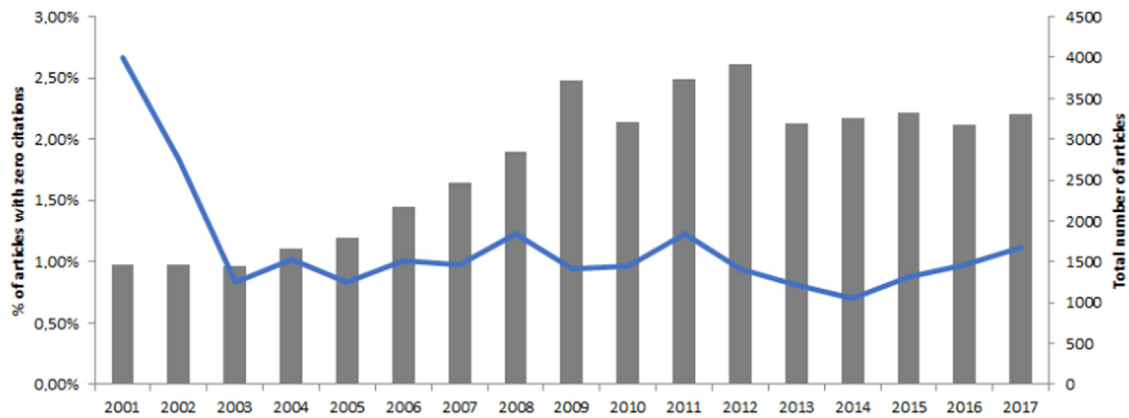
Fig. 1. Number of articles per publication year (columns) and percentage of these that remain uncited 2022 (line).
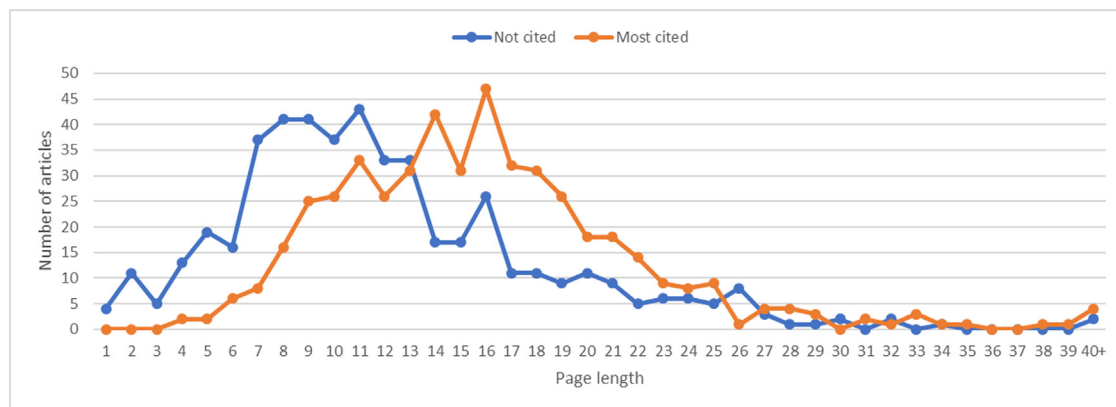
Fig. 2. Distribution of page length for the two groups.

Among the 46,154 articles in the selected list of journals, 486 (i.e., 1.05%) have zero citations in WoS. This represents a small percentage. Indeed, considering a broader set, 3.67% of the 123,604 articles and reviews in the OR&MS category have no citations. Moreover, if we consider all 221,150 documents in this category in the same period, including all book chapters, proceeding papers, etc., then the percentage of uncited papers is even larger, reaching 8.85%. Table 1 presents the proportion of uncited 2001–2017 articles by journal. With only one exception, the proportion of articles that have no citations is well below the figure of 3.67% observed for the articles and reviews in the OR&MS category.

We can also examine the trend of uncited articles by year of publication (Fig. 1). The total number of articles published in the selected journals increased markedly from 2001 to 2009 (a trend also observed in OMEGA [7,15]) and has remained stable since then. The percentage of those articles without any citations is quite stable from 2003 to 2017, having been higher in 2001–2002. Of course, some of these articles, especially the most recent ones, may soon start being cited.

One can wonder what might be general differences between articles with zero citations and the most cited articles. To find some elements to answer this question, we compared two groups of equal size:

- Group N (not cited) contains all the 486 articles from 2001 to 2017 that have not been cited.
- Group M (most cited) contains the 486 articles from 2001 to 2017 with the highest number of citations (ranging between
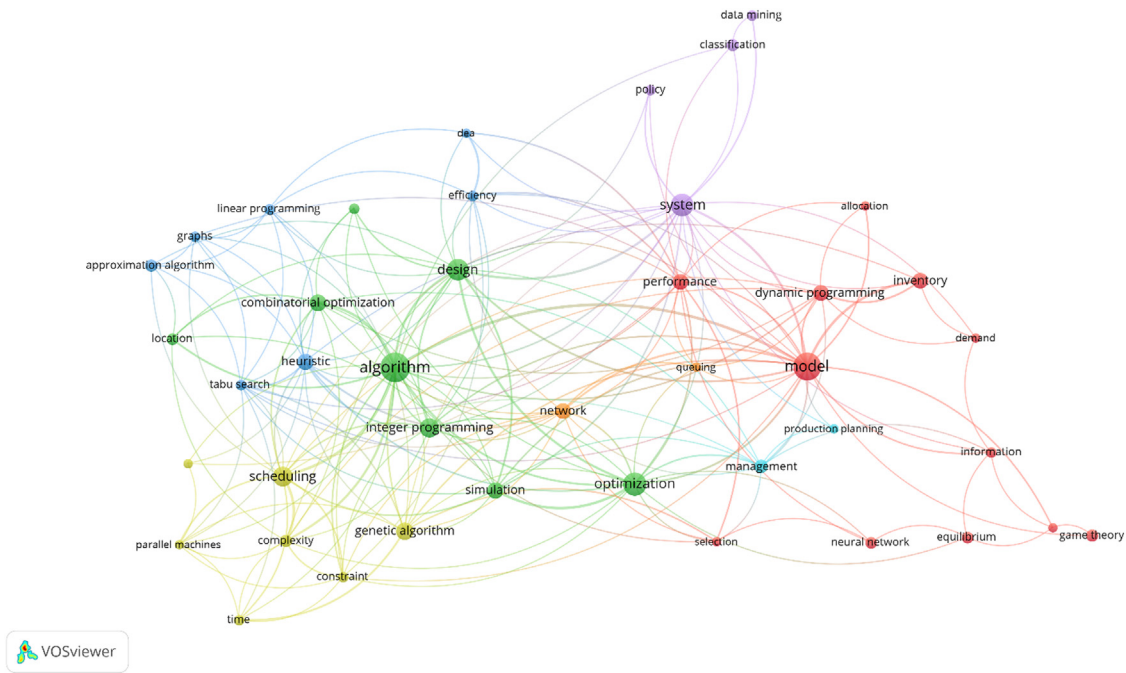
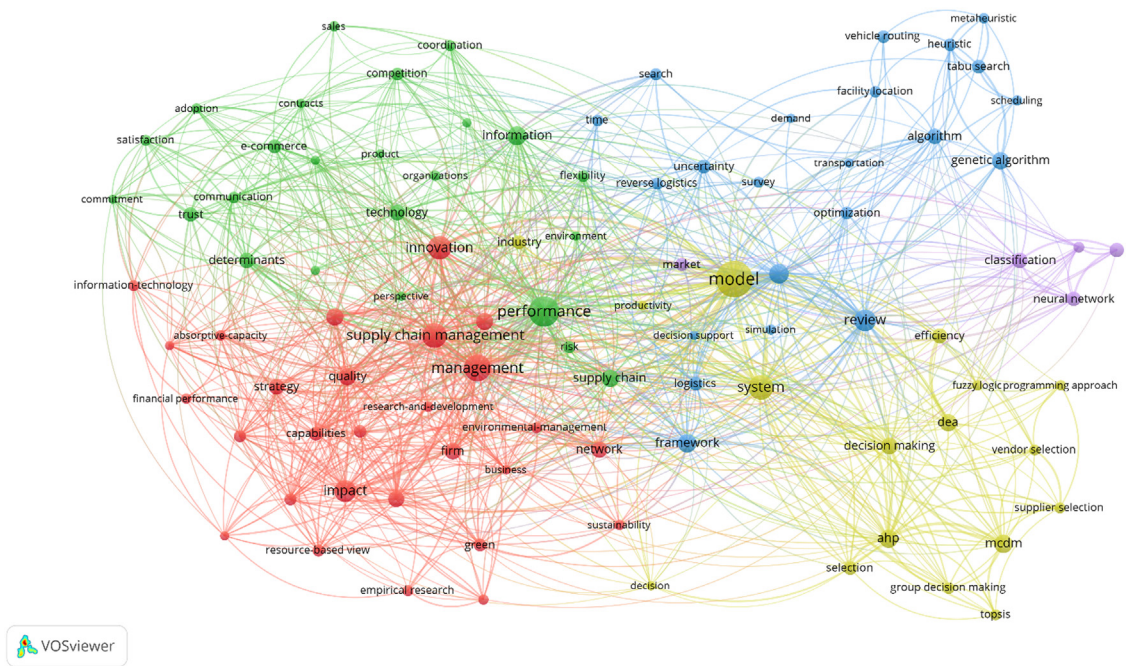**Fig. 3.** Most common keywords in the group of uncited articles.

Fig. 4. Most common keywords in the group of the most cited articles.

344 and 2366 citations, with an average of 576.2 citations per article).

Fig. 2 compares the two groups in terms of page length. Articles in group N tend to be shorter in length, averaging 12.16 pages, while an average of 15.90 pages is seen for articles in group M. Interestingly, articles with more than 26 pages are few, and no differences between uncited and much cited papers can be observed in the range of about over 27 page-long papers.

In terms of open access, a difference is found between the two groups: 20.8% of the 486 most cited papers (group M) are available in open access, versus 12.6% of the 486 papers without citations

(group N). Open access articles are more accessible to readers and, therefore, might have an advantage in terms of citations. Yet, a recent article by Basson et al. [3] found that articles in open access journals experience a citation advantage (versus subscription journals) only in very few subject areas, which do not include OR/MS. Moreover, an earlier article [4] found that open access OR/MS articles were actually less cited. The latter results, however, concern average number of citations, whereas here we are looking at the two extremes represented by groups M and N.

Finally, we compared the keywords of the two groups, checking for the most common ones in each group. This comparison was based on the WoS fields "Author Keywords" and "Keywords Plus,"
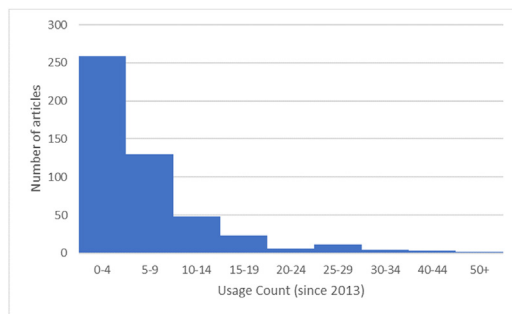
Fig. 5. Distribution of the usage count among uncited articles.

after a minor preprocessing stage to consolidate plural and singular designations (e.g., "model" and "models"), acronyms (e.g., "DEA" and "data envelopment analysis"), and hyphenization (e.g., "supply chain" and "supply-chain").

Figs. 3 and 4, produced using the VOS Viewer software [12], present and cluster the most common keywords within each group. Even though some elements are common (e.g., the pervasive "model" and "system"), the two pictures are markedly distinct. In group N, we find mostly traditional OR problems, techniques, and algorithms, together with game theory. In group M, we find many more business/management keywords, including supply chain/logistics but also strategy, quality, e-commerce, etc. We also find a group of common keywords associated with DEA, multicriteria decision and group decision. Optimization and algorithms also appear, now more strongly connected with heuristic methods. The keywords "model", "optimization", "algorithm", "supply chain" and "DEA" also appeared frequently in OMEGA during 2016–2020 [16].

As a final note, we should acknowledge that not being cited does not mean the papers are not read and considered useful by other scholars [6]. In fact, according to the Usage Count indicator available in WoS,[1] only 36 of the articles without citations were not used. However, the distribution of the usage count of the uncited articles is highly skewed (Fig. 5), with a low Usage Count for most of these articles. The average Usage Count for the articles without citations is 6.5, much lower than the average Usage Count of 301.1 for the 486 articles with highest number of citations. In addition, a self-reinforcement effect might be present here, as websites such as WoS, Scopus, and others, include options to show the results of literature searches sorted by number of citations. Normally, the user will select to sort by decreasing order of citations and will therefore use, and cite, articles which already have several citations. In this short analysis we looked at the opposite side of this ranking.

We can conclude that uncitedness does not seem to be a problem in the OR/MS area: the proportion of uncited articles in these mainstream OR/MS journals is rather small, and has remained so in the past two decades. Researchers in this field can be reassured that their publications will be read and cited by other researchers. Additionally, if some articles are uncited, this does not mean they are not used. Moreover, uncitedness might be explained by a number of factors, such as being an article closing off an unproductive avenue of research or addressing a topic that has become obsolete [13]. As we have observed, having a shorter length and a focus on traditional OR problems, techniques, and algorithms, and possibly addressing a very specific problem that is "solved" without encouraging future research, are more frequent among uncited articles. When comparing their keywords with those of highly cited articles, we can conjecture that uncitedness can also in part reflect the OR/MS's movement from theory and techniques to real-world applications and managerial impact, which is perfectly aligned with OMEGA's aims and scope.

Data availability

Data will be made available on request.

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[1] «The Usage Count is a measure of the level of interest in a specific item on the Web of Science platform. The count reflects the number of times the article has met a user's information needs as demonstrated by clicking links to the full-length article at the publisher's website (via direct link or Open-Url) or by saving the article for use in a bibliographic management tool (via direct export or in a format to be imported later). The Usage Count is a record of all activity performed by all Web of Science users. not just activity performed by users at your institution. Usage Counts for different versions of the same item on the Web of Science platform are unified. Usage Counts are updated daily.» https://images.webofknowledge.com/WOKRS524B8/help/WOS/hp_usage_score.html.