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Scholarly Communication on Web 3.0: An Analysis Based on Web of Science

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Abstract

For investigating the structure and process of academic communication, bibliometrics provides an excellent set of methodologies and measures. Web 3.0 is a concept that incorporates artificial intelligence and other advanced technologies and brings forth new opportunities and challenges to information scientists. The present study provides an evaluation of the scientific productivity related to Web 3.0 technologies in Web of Science (WoS) during the period of 2007 to 2020. The country-wise distribution of the literature revealed that the majorities (22.330%) of the documents were published from the USA, followed by Spain, and scholarly output of Web 3.0 literature received a total of 2145 citations. More than Ninety percentage of scholarly communication is through the English language. The study also provided a list of the top 10 publications based on the number of citations.

Keywords: Web 3.0, Web 2.0, Semantic Web, Bibliometrics, Scientometrics, Web of Science, Scholarly Communication

1. Introduction

The World Wide Web is widely acknowledged as the world's fastest-growing publication medium. The education sector is undergoing significant change, and web technologies are playing a key role in this evolution. Bibliometric studies are becoming common in several fields of science because of the number and accessibility of electronic databases as well as the development of conceptual frameworks in which bibliometric measures are indicative of social processes such as the evolution of scientific specialities and the diffusion of innovations (Paisle, 1989). For investigating the structure and process of academic communication, bibliometrics provides an excellent set of methodologies and measures. Citation analysis, the best known of

bibliometric approaches, has become more sophisticated, and the advent of networked information technologies has led to quantitative and qualitative advances in other bibliometric methods (Borgman and Furner, 2006). The term scientometrics (meaning the study of the evolution of science through the measurement of scientific information) was introduced by the Russian mathematician Vasilii Nalimov (Nalimov and Mulchenko, 1969).

2. Web 3.0

Web 2.0 is an umbrella term that encompasses a variety of user-generated content, content sharing and collaborative effort, together with the use of various kinds of social networking software and advanced with interacting web-based applications, and the use of the Web as a platform for generating, re-purposing and consuming content. The next phase of Web evolution, Web 3.0, is already in the progressing stage. Web 3.0 demanded an integrated Web experience, where the machine will be able to recognize and interpret data in a manner similar to humans. Initially, there were the static informative characteristics of the early Web, referred to as Web 1.0, which progressed into the more interactive experience of Web 2.0. The next phase of Web development, Web 3.0, brings forth new opportunities and challenges (Rudman and Bruwer, 2016). Although Web 3.0 applications are hard to define, the contours of new applications have emerged over the past years. Web 3.0 has many implications in the profession of library and information science. Adoption of the semantic web provides tools for exchange and interprets information. In the era of Web 3.0, computers will be able to answer most queries using artificial intelligence or fuzzy logic. The artificial intelligence would answer the queries of researchers using books, journal articles, dissertations and encyclopedias (Ahmed, 2015).

3. Web of Science

Large scale bibliometric research was made possible by the establishment and development of the Science Citation Index (SCI) in 1963, which is now part of Web of Science (WoS) alongside two other citation indexes, the Social Science Citation Index (SSCI) and the Arts and Humanities Citation Index (A&HCI) (Wouters 2006). WoS, formerly Web of Knowledge, is an online scientific citation indexing service created by the Institute for Scientific Information and now operated by Clarivate Analytics. WoS is considered to be the world's leading scientific citation search and analytical information platform for the scientific, scholarly community across the globe, which provides a subscription-based comprehensive citation search

to researchers and other information seekers. And it is the world's oldest, most widely used and authoritative database of research publications and citations. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialised sub-fields within an academic or scientific discipline. WoS is one of the significant sources of citation data. It is a selective, structured, and balanced database with complete citation linkages and enhanced metadata that supports a wide range of information purposes.

4. Literature Review

A study by Lopez Belmonte and others (2020) analysed the scientific production and performance of the Machine Learning and Big Data concepts. A bibliometric methodology of scientific mapping based on the processes of estimation, quantification, analytical tracking, and evaluation of scientific research has been used as the method of the research.. A total of 4240 scientific publications from the Web of Science has been analyzed. The study revealed a constant and ascending progression of the scientific communication on that topic, and 2018 and 2019 were the most productive years. In a research study, Batcha (2017) analyzed the volume of research on robotic technology carried out by scientists all over the world. WoS was used as the source of the literature for the study. The paper also assessed the extent of international collaboration. The researcher found that, during the period 1990 to 2016, a major portion of the literature on robotics was published from USA, and the number of citations appears to be high in 2015, with 11,000 citations reported.

With the intention of identifying the research gaps and possibilities for improvement in the context of e-government research in developing countries, Pedro and others (2016) critically analyzed the scholarly contributions in the field of e-government and tried to identify the future areas of interest and potentially valuable methodologies. Diverse scientometric approaches were employed in this analysis of published papers by the international journals listed in the SSCI index in the fields of Public Administration and Information Science & Library Science. The findings of the study revealed the existence of different research gap and highlighted the areas that should be addressed in future research. Mongeon and Paul-Hus (2015) conducted a study to compare the journal coverage of the WoS and Scopus. The main objective of their study was to describe the journal coverage of those two databases with Ulrich extensive Periodicals directory. The researchers downloaded the WoS master journal list from the Thomson Reuters Website.

The results of the study implied that, in the context of comparative research evaluation, their coverage differs substantially, especially when comparing different fields, institutions, countries or languages.

5. Methodology

The bibliographic details of the published literature for a period of 2007 to 2020 were collected using the general search option of WoS. The data were retrieved from WoS on 2nd May 2021. Bibliographic information such as author(s), title of the document, source with year of publication, volume, issue and page, author affiliation, language, and document form were downloaded from the online version of WoS, in Excel format by giving “Web 3.0” as a topic in the search field. The search retrieved the documents in WoS which is closely related to the topic Web 3.0.

While searching the WoS simple search by giving Web 3.0 as the topic, the results showed more than 1200 published documents, which included the terms “web” and “3.0”. But on further checking of the retrieved documents, it was found that most of them were not related to the Web 3.0 concept. In order to exclude these non-relevant documents, the search was done with “Web 3.0” (within quotes, as a single phrase) as the search term. When we use quote marks around our search terms, we're informing the database that the words must appear as a phrase, hence the search provided the documents, which includes “Web 3.0” as a phrase.

6. Objectives of the Study

The general objective of the study is to give a picture of the scientific productivity related to Web 3.0 technology in WoS, during the period of 2007 to 2020. The specific objectives of the study are

1. To analyze Year-wise distribution of papers related to Web 3.0 Technology.
2. To analyze Country-wise contribution of publications.
3. To analyze Document-wise distribution of the papers.
4. To analyze Language-wide distribution of the publications.
5. To identify the co-occurrence of keywords.
6. To identify the most cited publication and the Prolific Author.

7. Analysis and interpretations

A total of 103 scholarly publications were identified from WoS, as on 2nd May 2021, by giving “Web 3.0” as a topic in the search field. The analysis found that among the scholarly documents on Web 3.0 in WoS, 35 of them are available as open access.

7.1 Year-wise Contribution of the publications

The year-wise distribution of the publication shows that from 2007 to 2020, the publication density is more significant in the year 2012 (11.650%), followed by 2013 (10.680%). The details are given in Table 1.

Table 1
Year-wise Distribution of Publications

Sl No	Publication Year	Number of Documents	Percentage
1	2007	3	2.913
2	2008	6	5.825
3	2009	7	6.796
4	2010	9	8.738
5	2011	4	3.883
6	2012	12	11.650
7	2013	11	10.680
8	2014	6	5.825
9	2015	9	8.738
10	2016	10	9.709
11	2017	6	5.825
12	2018	6	5.825
13	2019	8	7.767
14	2020	6	5.825
	Total	103	100

The year-wise analysis of the literature found that there is a growth in the quantity of literature from 2007 onwards and after 2012; the publication density is gradually decreasing. In 2013 there is a decrease of 0.97%. Among the studied years, the quantity of output is very less (2.913%) in the year 2007, it is because, the concept of Web 3.0 is emerging during that period. The growth and reduction of the quantity of publications through years is displayed in Figure 1.

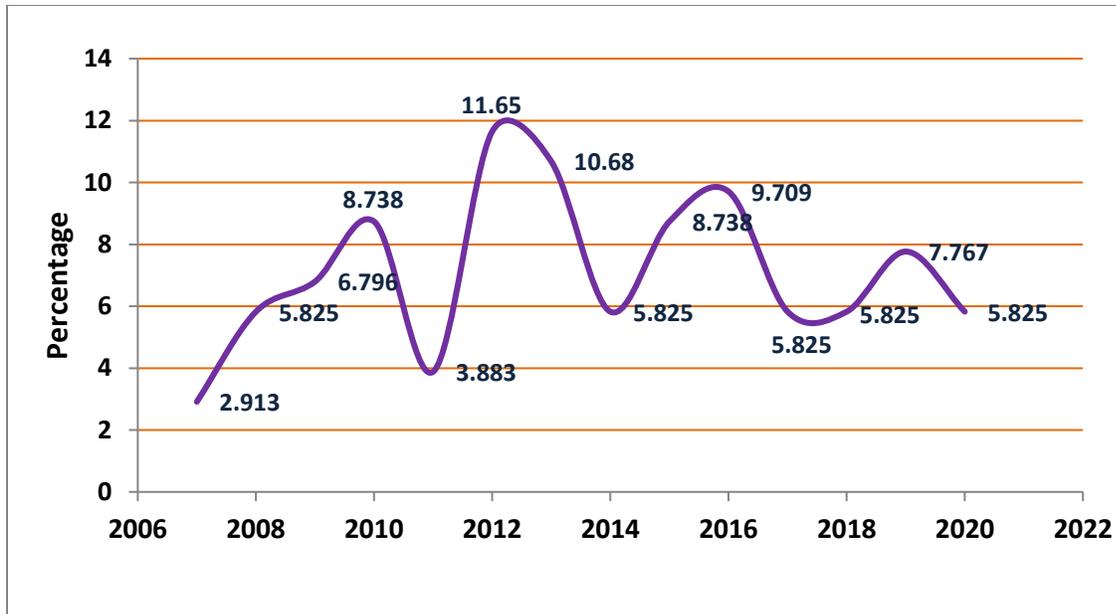


Figure 1
Year-wise Scattering of Publications

7.2 Classification of the Publications Based on Document Type

In the scientific and technical literature, there are different types of documents that contain distinct kinds of information. In the case of scholarly documents in WoS, the study found that articles are the major form of documents, followed by Editorial Materials. The details are given in Table 2.

Table 2
Document Type Classification of Publications

Sl.No	Document Type	Total	Percentage
1	Article	83	80.583
2	Editorial Material	13	12.621
3	Review	4	3.883
4	Meeting Abstract	2	1.942
5	Proceedings Paper	1	0.971
	Total	103	100

While checking the type of the documents, it was found that the majority of the scholarly communication related to Web 3.0 is journal articles. Among the total papers, 80.583 % of them belonged to this category. 12.621 % of the papers are editorial materials. The literature on Web 3.0 is comparatively less in other forms such as meeting abstracts and proceedings papers.

7.3 Country Wise Contribution of Publications

The country-wise distribution of the scholarly communication on Web 3.0 found that the majority (22.330%) of the documents were published from USA, followed by Spain with 14.563% of the publications. Table 3 described more details.

Table 3
Country-wise distribution of Publications

Sl.No	Country	Total	Percentage
1	USA	23	22.330
2	Spain	15	14.563
3	England	10	9.709
4	China	7	6.796
5	South Korea	7	6.796
6	Canada	6	5.825
7	Australia	5	4.854
8	Turkey	4	3.883
9	Iran	3	2.913
10	Mexico	3	2.913
11	Egypt	2	1.942
12	Germany	2	1.942
13	Greece	2	1.942
14	India	2	1.942
15	Others	9	11.65
	Total	103	100

England contributes 9.709 % of the publications, and 6.796 % of them were from China. South Korea also contributed 6.796 % of the total publications.

The major part of the remaining publications is from Canada (5.825%), Australia (4.854%) and Turkey (3.883%). Iran and Mexico contributed 2.913 % each. Egypt, Germany, Greece, and India contributed 1.942 % each. The other countries included Ireland, Italy, Saudi Arabia, Slovenia, South Africa and UAE.

7.4 Publication Performance in Languages

More than Ninety percentage of scholarly communication related to Web 3.0, is in the English language. Only 3.883% of the publications were through Spanish. French, German, Russian and Slovenian are the other languages in which the publications appeared. Table 4 described more details on that.

Table 4
Language-wise distribution of Publications

Sl.No	Language	Total	Percentage
1	English	95	92.233
2	Spanish	4	3.883
3	French	1	0.971
4	German	1	0.971
5	Russian	1	0.971
6	Slovenian	1	0.971
	Total	103	100

7.5 Subject Categories of Publications

Web 3.0 is a term closely related to Computer Science and hence the major part of the scholarly publications on Web 3.0 is belonged to the subject area of Computer Science and Technology. As per the classification of the WoS subject categories, a major part of the literature belongs to the Artificial Intelligence area of Computer Science.

The details of scholarly literature on Web 3.0 belonged to the various WoS subject category as described in Table 5.

Table 5
Subject Categories of Publications

Sl. No.	Subject category	Numbers of publications	Percentage
1	Computer Science- Artificial Intelligence	18	17.476
2	Computer Science- Information Systems	17	16.505
3	Computer Science -Software Engineering	15	14.563
4	Information Science- Library Science	14	13.592
5	Computer Science- Theory Methods	13	12.621
6	Engineering- Electrical Electronic	12	11.650
7	Communication	5	4.854
8	Telecommunications	5	4.854
9	Business	4	3.883
10	Computer Science- Hardware Architecture	4	3.883
11	Computer Science Interdisciplinary Applications	4	3.883
12	Education/ Educational Research	4	3.883
13	Engineering Multidisciplinary	4	3.883

Most of the features of the Web 3.0 concept are related to Artificial Intelligence; thus, the majority (17.476%) of the scholarly publications of Web 3.0 belonged to the category of Artificial Intelligence, a subcategory of Computer Science. 13.592 percentage of the publications are related to Library and Information Science, and 3.883 percentage of the published papers were related to Business. 12.621 percentage of the literature closely related to the theoretical methods of Computer Science, 11.650 percentage of the documents are related to the field of Electrical and Electronic Engineering. Communication and Telecommunication holds 4.854 percentage each. The remaining documents belonged to the subject categories such as Hardware Architecture, Interdisciplinary Applications, Education and Engineering.

7.6 Occurrence of Keywords in Publications

Co-occurrence is a technique for identifying the significant and highly frequent terms and keywords used in a document (Laengle and others. 2018). The total numbers of keywords identified from these scholarly publications are 535(Five hundred and thirty-five). The most frequent keywords are “Web 3.0”and “Semantic Web”. The most used ten keywords and their occurrences are listed in Table 6.

Table 6
Occurrence of Keywords

Sl.No	Keyword	Occurrences
1	Web 3.0	30
2	Semantic Web	24
3	Web 2.0	10
4	Ontology	10
5	Web	6
6	Technology	5
7	Information	6
8	Model	6
9	Systems	5
10	Social Media	6

Figure 2 displayed the network of co-occurrence of keywords, which is visualized by using the VOS viewer keyword map.

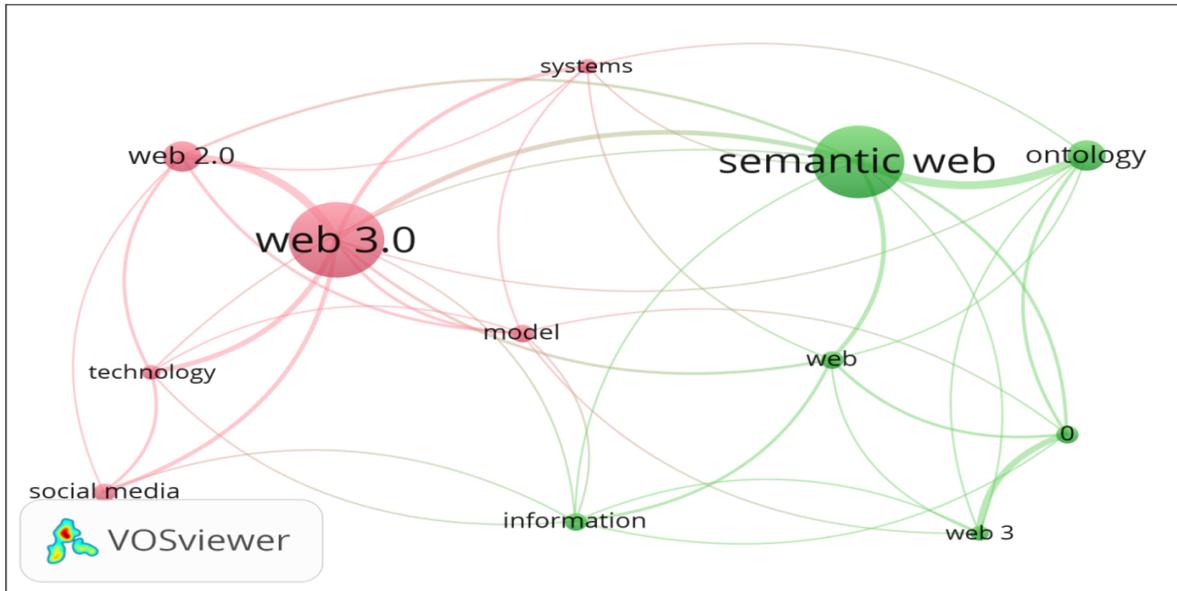


Figure 2
Network Analysis of Keywords

7.7 Citation analysis of Web 3.0 literature from Web of Science

The scholarly output of Web 3.0 literature on WoS received a total of 2145 citations during the period from 2007 to 2020. These papers received 2101 citations while avoiding the self-citations. The average citations per paper are 20.83, and the h-index of the total publications is 21. The year-wise distribution of literature and its citations is displayed in Figure 3.

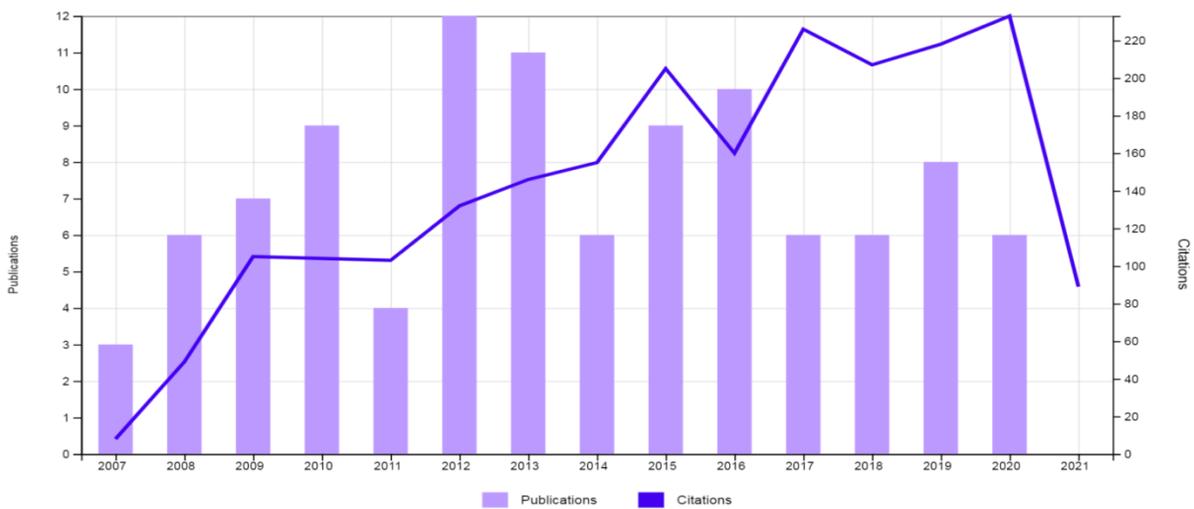


Figure 3
Year-wise distribution of papers and citations

The paper by Boulos and Wheeler (2007) entitled “The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education” is found the most cited article with 463 citations. The study put a glimpse of future software forwards, touching on Web 3.0 and the Semantic Web and how it could be combined with Web 2.0 to produce the ultimate architecture of participation. The publication got an average of 30.8 citations per year, and the paper was downloaded 241 times through WoS. The article by Gruber (2008), with 241 citations, is the second most cited paper. The paper entitled “Data, information and analytics as service” by Delen and Demirkan (2013) with 137 citations come in the third position. Among the total publications, Jim Hendler is the most productive author.

The top cited ten publications are described in Table 7

Table 7
Top Cited Ten Publications

Sl.No	Bibliographic Details of Documents	Total Citations	Average Citations/ Year
1	The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education Authors : Boulos, Maged N. Kamel; Wheeler, Steve Source : Health Information and Libraries Journal Volume: 24 Issue: 1 Pages: 2-23 Year : 2007	463	30.87
2	Collective knowledge systems: Where the Social Web meets the Semantic Web Author : Gruber, Tom Source : Journal Of Web Semantics Volume: 6 Issue: 1 Pages: 4-13 Year : 2008	241	17.21
3	Data, information and analytics as services Authors : Delen, Dursun; Demirkan, Haluk Source : Decision Support Systems Volume: 55 Issue: 1 Pages: 359-363 Year : 2013	137	15.22
4	Web 3.0 Emerging Author : Hendler, Jim Source : Computer Volume: 42 Issue: 1 Pages: 111-113 Year : JAN 2009	85	6.54
5	Embracing " web 3.0" Authors : Lassila, Ora; Hendler, James Source : IEEE Internet Computing Volume: 11 Issue: 3 Pages: 90-93 Year : 2007	82	5.47

6	Social networks and Web 3.0: their impact on the management and marketing of organisations Authors : Garrigos-Simon, Fernando J.; Lapiedra Alcami, Rafael; Barbera Ribera, Teresa Source : Management Decision Volume: 50 Issue: 10 Pages: 1880-1890 Year : 2012	74	7.40
7	Web 3.0-Based personalisation of learning objects in virtual learning environments Authors : Kurilovas, Eugenijus; Kubilinskiene, Svetlana; Dagiene, Valentina Source :computers In Human Behavior Volume: 30 Pages: 654-662 Year : 2014	70	8.75
8	Does Web 3.0 come after Web 2.0? Deconstructing theoretical assumptions through practice Authors : Barassi, Veronica; Trere, Emiliano Source : New Media & Society Volume: 14 Issue: 8 Pages: 1269-1285 Year : 2012	67	6.70
9	HCLS 2.0/3.0: Health care and life sciences data mashup using Web 2.0/3.0 Authors : Cheung, Kei-Hoi; Yip, Kevin Y. Source :Journal Of Biomedical Informatics Volume: 41 Issue: 5 Pages: 694-705 Year : 2008	56	4.0
10	Interoperability of Security-Enabled Internet of Things Authors :Alam, Sarfraz; Chowdhury, Mohammad M. R.; Noll, Josef Source : Wireless Personal Communications Volume: 61 Issue: 3 Pages: 567-586 Year : 2011	40	3.64

8. Major Findings

- The publication density of the scholarly literature on Web 3.0 is greater in the years 2012 (11.650%), and 2013 (10.680%), and the majority of the scholarly communication related to Web 3.0 are journal articles.
- It is found that the majority (22.330%) of the documents was published from the USA, followed by Spain, and more than Ninety percentage of the scholarly communication is through the English language.
- A major part (17.476%) of the scholarly publications belonged to the category of Artificial intelligence, a subcategory of Computer Science.
- The most frequent keywords used in the scholarly communication are “Web 3.0” and “Semantic Web”.

- The scholarly output of Web 3.0 literature in WoS received a total of 2145 citations during the period from 2007 to 2020.
- Out of the total scholarly literature on “Web 3.0” in WoS, Nine of them have received more than 50 citations and 23 of them have more than 20 citations.

9. Conclusion

Research on scholarly communication is attracting significant interest because of the issues and costs of conveying information to scientists, practitioners, and policymakers. With its focus on informal and formal communication processes, this research obviously comes under the realm of communication research. Citation count is a common bibliometric tool used to determine the long term impact and performance of journal papers; the higher the number of citations, the greater the perception of quality for that article (Renjith and Pradeep Kumar, 2021). The present study provided a state of the art report of the scholarly publications on Web 3.0 indexed in WoS. The years 2012 and 2013 are the most productive period. The study of scholarly communication provides an opportunity for communication researchers and information scientists to collaborate in an area of collective cooperation.

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