

Bibliometric Analysis and Visualization of the Journal of Artificial Societies and Social Simulation (JASSS) between 2000 and 2018

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Abstract

All scientific journals need to be regularly monitored and evaluated from a bibliometric perspective. The *Journal of Artificial Societies and Social Simulation (JASSS)* founded in 1998 is dedicated to the topics related to artificial societies and social simulation. It is a pioneering journal with the global audience and international authors. Bibliometric analysis of this journal can be helpful in evaluating its scientific performance and research quality. In this study, the number of *JASSS* papers, highly-cited papers, the most prolific authors, the most active research institutions and countries were identified and their keyword and term co-occurrences and journal and author co-citation maps were visualized in the period 2000–2018 by using various bibliometric indicators in VOSviewer bibliometric software package. The results showed that with a high contribution to the field and a scientific collaboration with other related journals, *JASSS* had found its way in the field of social simulation and achieved an academic level. This

study provides a reference for future studies by exploring the knowledge structures and publishing trends of *JASSS*. The bibliometrics analysis and visualization of *JASSS* can be a useful for either library and information science (LIS) scholars or the people interested in bibliometric studies; therefore, they can use it as a pattern to review other journals.

Keywords

Bibliometrics; Citation Analysis; Co-citation; Co-occurrences; Journal of Artificial Societies and Social Simulation; VOSviewer

Introduction

Scientific journals are the main channels of scholarly communication, dissemination of research-based information, knowledge transfer, and certification of the research results. Journals should be evaluated from a research perspective. This can be done by applying bibliometric methods. Bibliometrics is a research field that quantitatively studies the publications of a journal, research institute, a research field, a country, etc. (Pritchard, 1969; Broadus, 1987). Bibliometrics can be used for measuring the scientific influence of journals, authors, research institutions as well as determining hot topics, newly-emerged subjects, highly-cited items, scientific collaboration patterns, interdisciplinary models, etc. (Laengle et al, 2018).

In 1969, Pritchard coined the term bibliometrics as a statistical method to quantitatively analyze the cross-science of all knowledge domains (Hood & Wilson, 2001). Bibliometrics has been interested by many researchers and has been applied in various scientific fields (Merigo & Yang, 2017). The use of bibliometric techniques for the analysis the knowledge structure and scientific features of a particular journal's publications provides a good guide for its potential authors and some reference guides concerned with the future development of the journal. It also can reveal a specific journal's current status and development trend, and provide a basis for further improvement of its quality (Xu, Yu & Wang, 2018).

Many bibliometric studies have been conducted on scientific journals. Recently, Laengle et al. (2017) performed a bibliometric overview of all of the papers published in *European Journal of Operational Research* between 1977 and 2016 and identified the main countries, institutions, authors and the leading trends of the journal. Merigo et al. (2017) studied *International Journal of Intelligent Systems*, with a bibliometric overview of all of its papers published in this journal between 1986 and 2015 to identify its developmental trend. In their study, using a bibliometric overview, Tang, Liao and Su (2018) identified the conceptual evolution and the development situation of *the International Journal of Fuzzy Systems (IJFS)*. Xu, Yu and Wang (2018) studied some bibliometric features of the *International Journal of Machine Learning and Cybernetics (IJMLC)* to improve its academic level and scientific quality.

As noted in its website (<http://jasss.soc.surrey.ac.uk/admin/about.html>), *the Journal of Artificial Societies and Social Simulation (JASSS)* is an interdisciplinary journal for the exploration and understanding of social processes by means of computer simulation. Since its first issue in 1998, it has been a world-wide leading reference for readers interested in social simulation and the application of computer simulation in the social science. As a pioneering international journal in the field, it is an inter-disciplinary journal serving a global audience and it publishes original research papers and critical reviews on all aspects of social simulation and agent societies. In addition, the online nature of the journal guarantees a large audience and the inclusion of multi-media content enriches the readability and usability of its papers. Since its establishment, *JASSS* has made important contributions to social science, especially in the field of computer simulation. It has many academic publications in this field. According to *Journal Citation Reports*, the *JASSS* has a 2017 impact factor of 1.640 and according to *SCOPUS*, 2017 CiteScore was 1.91, ranking it 23rd out of 213 journals in the category of "Social Science-General" journals.

It should be noted that some limited bibliometric overviews of *JASSS* have already been performed. To explore the interdisciplinary nature of social simulation, Meyer, Lorscheid and Troitzsch (2009) studied all of the papers of the journal published in the first ten-year period (1998-2007) from a bibliometric perspective. Saberi, Isfandyari-moghaddam and Mohammedsmaeil (2011) used a citation analysis (as one approach to the bibliometrics) to study the accessibility and decay of web citations (URLs) used in the cited articles published in *JASSS* during 1998-2007. Squazzonia and Casnicib (2013) conducted a study to investigate the bibliometric impact of *JASSS* on other ISI-indexed and Scopus-indexed sources by examining inward and outward citations and their inter-relations. In another study, Hauke, Lorscheid and Meyer (2017) investigated the recent development of social simulation as reflected in *JASSS* publications from 2008 to 2014. However, a wide range of influences of the journal's scientific output has not yet been investigated

Considering the journal's scope and its wide influence on the field, this study aimed to conduct a bibliometric analysis of the journal to discover the frequencies and trends of published papers and received citations, visualize active authors and map contributing countries, determine highly-frequent affiliations, highly-cited papers, highly-frequent concepts included in its paper titles, abstracts and keywords, etc. in the period of 2000-2018.

Materials and Methods

This bibliometric study focused on a specific scientific journal. The method was widely used by several scientific journals, including *International Journal of Hospitality Management* (Cunill et al, 2019); *Journal of Business-to-Business Marketing* (Valenzuela-Fernandez et al, 2019); *Journal of Travel & Tourism Marketing* (Mulet-Forteza et al, 2019); *Journal of Knowledge*

Management (Gaviria-Marin, Merigo and Popa, 2018); and *D-Lib Magazine* (Agrahari, Chaudhary and Singh, 2018).

Data were collected using Scopus database. As one of the credible and comprehensive abstract and citation databases in the world, Scopus is maintained by a Netherlands' institute, named Elsevier. It includes peer-reviewed literature, such as scientific journals, books and conference proceedings. Its content is indexed and organized by 5000 publishers in main subject fields, such as science, technology, medicine, social sciences, and arts and humanities. Currently (2019/04/25), this database contains about 22,000 serial titles, 15,000 books, 69,000,000 items, 70,000 main institutional profiles, and 12,000,000 author profiles (Scopus, 2019). This rich content can be potentially used for various types of bibliometric studies.

The time span of this study was a 19-years period, 2000-2018, as *JASSS* published papers started to be indexed in Scopus from 2000. The following formula was used for data extraction in Scopus in January 2019:

ISSN (1460-7425) AND DOCTYPE (ar) AND PUBYEAR > 1999 AND PUBYEAR < 2019

By searching in Scopus (2019/04/25), 712 papers were identified and their bibliographic information was analyzed by applying bibliometric techniques in VOSviewer that is software tool used to visualizes the results through a wide range of bibliometric indicators (Van Eck & Waltman, 2010). These techniques included citation analysis, bibliographic coupling, co-occurrence and co-citation (Zupic & Čater, 2015).

We used the citation analysis and bibliographic coupling (see Boyack & Klavans (2010) for more details on these approaches) to determine the trend of papers in *JASSS*, that of their received citations and cited references, top highly-cited papers and identify the most influential and highly-productive authors, institutions and countries.

Co-occurrence is a technique for identifying the significant and highly-frequent terms and keywords used in a document (Laengle et al, 2018). In this study, it was used for mapping the keyword co-occurrence of the published papers and clustering the terms extracted from the papers' titles. Co-citation appears when two documents receive a citation from the same third document (Small, 1973). In this study, co-citation was used to identify the authors and references cited by *JASSS* papers.

Results

The trend of published papers in *JASSS*

The trend of published papers (especially number of papers) is a main and direct indicator used to measure the state and influence of a journal. Figure 1 shows the general trend of papers published in *JASSS* in the period 2000-2018. A total of 712 papers indexed in the Scopus were

studied. The publication trends showed an increased volume for the period 2000-2018 from 16 published papers in 2000 to 46 ones in 2018 ($R^2=0.6217$). The fewest and highest paper numbers belonged to the years 2000 and 2015, respectively.

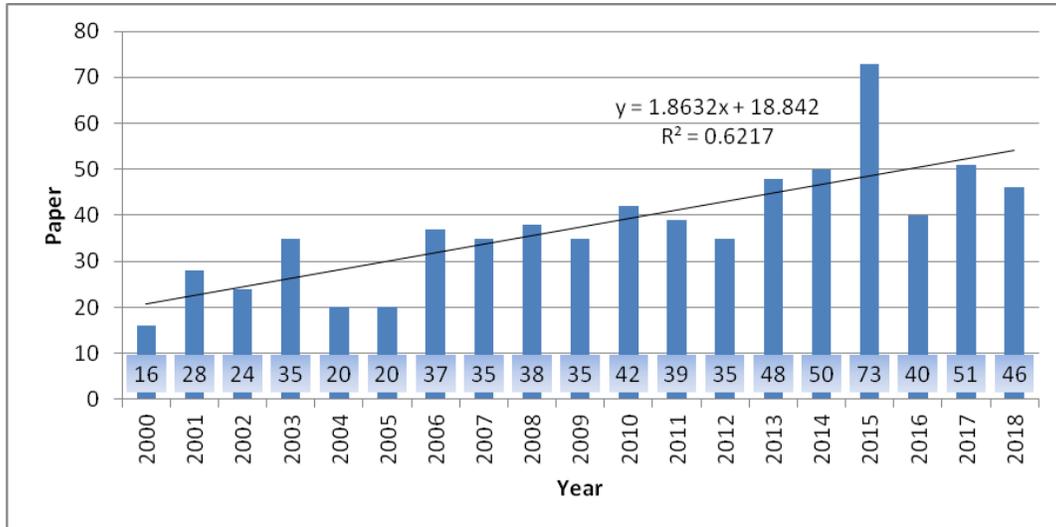


Figure 1. The frequencies of JASSSS published papers indexed in Scopus

The trend of citations received by JASSS papers

Citations can reflect the influence of papers published by a journal and its role in the scientific communication. Figure 2 shows the trend of received citations. 712 studied papers had received 11749 citations from 2000 to 2018. The trend showed an increased pattern ($R^2=0.9587$). The number of received citations had been increased from 1 citation in 2000 to 1287 in 2018. This shows that *JASSS* has attracted more attention year-by-year in the field.

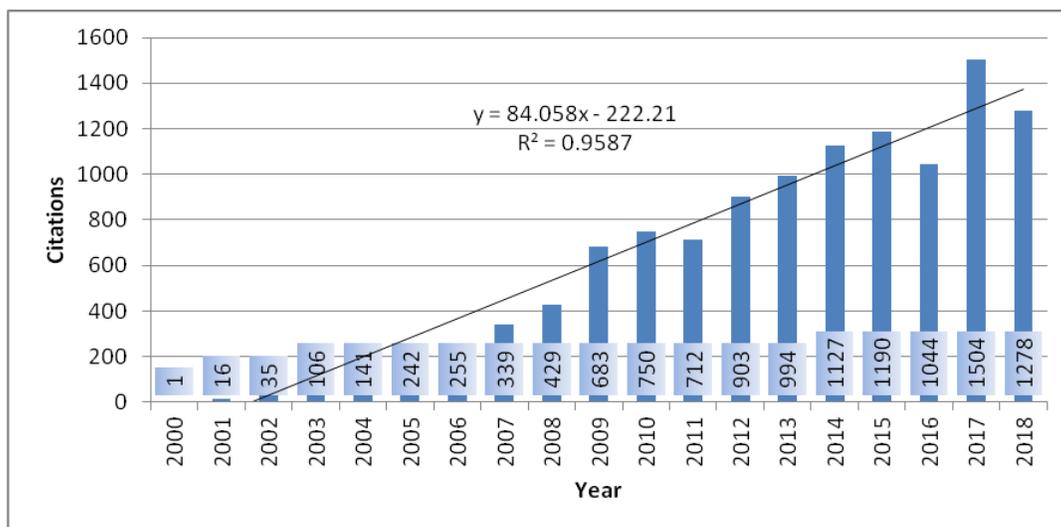


Figure 2. The frequencies of citations received by JASSSS published papers indexed in Scopus

The highly-cited papers in JASSS

The top 20 most cited papers in *JASSS*, the rank of each paper, its total citations, its title and first author, publication year, and the rate of citations per year are listed in Table 1.

Table1. 20 highly-cited papers in JASSS

Rank	Total citations	First Author	Title	Pub. Year	Citations per year
1	1117	Hegselmann R.	Opinion dynamics and bounded confidence: Models, analysis and simulation	2002	69.81
2	318	Deffuant G.	How can extremism prevail? A study based on the relative agreement interaction model	2002	19.88
3	250	Epstein J.M.	Why model?	2008	25.00
4	246	Windrum P.	Empirical validation of agent-based models: Alternatives and prospects	2007	22.36
5	171	Heath B.	A survey of agent-based modeling practices (January 1998 to July 2008)	2009	19.00
6	170	Barreteau O.	Role-playing games for opening the black box of multi-agent systems: Method and lessons of its application to Senegal River Valley ...	2001	10.00
7	151	Davidsson P.	Agent based social simulation: A computer science view	2002	9.44
8	149	Nikolai C.	Tools of the trade: A survey of various agent based modeling platforms	2009	16.56
9	124	Edmonds B.	Replication, replication and replication: Some hard lessons from model alignment	2003	8.27
10	120	Boero R.	Does empirical embeddedness matter? Methodological issues on agent-based models for analytical social science	2005	9.23
11	118	Tobias R.	Evaluation of free Java-libraries for social-scientific agent based simulation	2004	8.43
12	108	D'Aquino P.	Using self-designed Role-Playing Games and a Multi-Agent System to empower a local decision-making process ...	2003	7.20
13	106	Wilensky U.	Making models match: Replicating an agent-based model	2007	9.64
14	105	Moss S.	Alternative approaches to the empirical validation of agent-based models	2008	10.50
15	98	Filatova T.	Agent-based urban land markets: Agent's pricing behavior, land prices and urban land use change	2009	10.89
16	97	Sabater J.	Repage: REPutation and ImAGE among limited autonomous partners	2006	8.08
17	95	Galán J.M.	Errors and artefacts in agent-based modelling	2009	10.56
18	90	Deffuant G.,	Comparing extremism propagation patterns in continuous opinion models	2006	7.50
19	89	Flache A.	Do irregular grids make a difference? Relaxing the spatial regularity assumption in cellular models of social dynamics	2001	5.24
20	87	Bandini S.	Agent based modeling and simulation: An informatics perspective	2009	9.67

The most highly-cited paper was authored by Hegselmann, R. and Kruse, U. in 2002 entitled "Opinion dynamics and bounded confidence: Models, analysis and simulation" with 1,117 received citations. A paper was authored by Deffuant, G., Amblard, F., Weisbuch, G. and Faure, T. in 2002 entitled "How can extremism prevail? A study based on the relative agreement

interaction model" with 318 received citations ranked second. The third most highly-cited paper belonged to Epstein, J.M. published in 2008 with 250 received citations titled "What model?"

As illustrated in mapping these highly-cited papers with VOSviewer, 638 (89.60%) out of 712 papers, received citations. Of them, 49 papers received >50 citations. Figure 3 shows these papers with only their first authors' names. The color and size of circles show the magnitude of the number of citations. For example, yellow circles show papers with >140 received citations, amounted to 8 papers.

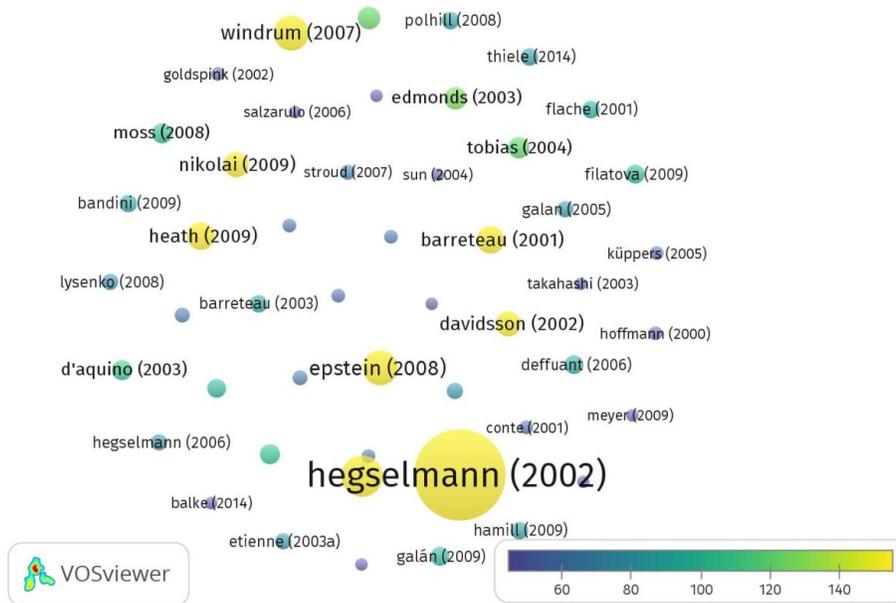


Figure 3. The map of highly-cited papers (with >50 received citation) in JASSS

Most influential and highly-productive authors

Many authors in the world published their papers in *JASSS*. Table 2 shows some bibliometric features (such as h-indices, affiliated countries, and total received citations) for authors who had published 5 or more papers in *JASSS*. As shown in Table 2, the first rank of the most productive authors belonged to Edmonds, B. from Manchester Metropolitan University, Centre for Policy Modelling, with 12 published papers. The second rank belonged to Deffuant, G. from Irstea, Antony, with 11 published papers. Izquierdo, L.R., Jager, W. and Polhill, J.G, each with 9 published papers were ranked as the third most productive authors. As can be seen in Table 2, the most productive authors were from the tree countries: Germany (with 8 authors), United Kingdom (with 7 authors) and France (with 6 authors). In other words, among 29 highly-productive authors with ≥ 5 published papers in *JASSS*, 21 authors were from these three countries and other 8 authors were from Spain, Netherlands, Italy and Poland. All highly-productive authors showed high performances and influences with respect to their total received citations and h-indices.

Table 2. Most influential and highly productive authors (with ≥ 5 published papers) in JASSS

Author's Name	Affiliation	Country	Articles in JASSS	H-index	Total publications	Total Citations	Rank
Edmonds, B.	Manchester Metropolitan University, Centre for Policy Modelling	UK	12	20	119	1522	1
Deffuant, G.	IRSTEA, Antony	France	11	18	80	1681	2
Izquierdo, L.R.	Universidad de Burgos	Spain	9	14	37	528	3
Jager, W.	University of Groningen,	Netherlands	9	24	57	1748	3
Polhill, J.G.	The James Hutton Institute, Information and Computational Sciences, Aberdeen	UK	9	18	78	1706	3
Gilbert, N.	University of Surrey, Department of Sociology, Guildford	UK	8	27	131	2820	4
Gotts, N.M.	Edinburgh, Edinburgh	UK	7	18	48	364	5
Hegselmann, R.	Frankfurt School of Finance and Management, Department of Philosophy and Law	Germany	7	8	11	1421	5
Huet, S.	Irstea, Antony	France	7	11	27	364	6
Ahrweiler, P.	Johannes Gutenberg Universität Mainz, Institute of Sociology, Mainz	Germany	6	11	33	797	7
Barreteau, O.	Université de Montpellier, Montpellier	France	6	17	62	258	7
Flache, A.	University of Groningen, Groningen	Netherlands	6	20	61	1391	7
Hales, D.	Manchester Metropolitan University, Centre for Policy Modelling	UK	6	15	56	259	7
Meyer, M.	Hamburg University of Technology, Hamburg	Germany	6	9	30	285	7
Moss, S.	Derbyshire and Koblenz University, Mainz	Germany	6	12	32	678	7
Nikolic, I.	Delft University of Technology, Faculty of Technology, Delft	Netherlands	6	9	42	316	7
Rouchier, J.	Laboratoire d'Analyse et Modélisation de Systèmes pour l'Aide à la Décision, Paris	France	6	9	36	259	7
Squazzoni, F.,	Università degli Studi di Milano, Department of Social and Political Sciences, Milan	Italy	6	13	73	1186	7
Cioffi-Revilla, C.,	George Mason University, Fairfax Campus, Department of Computational and Data Sciences, Fairfax	U.S.	5	14	50	1267	8
Conte, R.,	Istituto Di Scienze E Tecnologie Della Cognizione, Rome, LABSS, Rome	Italy	5	21	103	284	8
Elsenbroich, C., "5"	University of Surrey, Guildford	UK	5	6	17	114	8
Grimm, V., "5"	Universität Potsdam, Department of Plant Ecology and Nature Conservation, Potsdam	Germany	5	45	190	72	8
Izquierdo, S.S.,	Universidad de Valladolid, Department of Industrial Organization, Valladolid	Spain	5	7	23	284	8
Le Page, C.,	CIRAD, Paris	France	5	20	33	1300	8
Neumann, M.,	Jacobs University Bremen, Bremen	Germany	5	5	24	72	8
Pyka, A.,	Universität Hohenheim, Stuttgart	Germany	5	21	125	180	8
Sobkowicz, P.	KEN 94/140, Warsaw	Poland	5	14	38	664	8
Troitzsch, K.G.	Universität Koblenz-Landau, Koblenz am Rhein	Germany	5	7	36	180	8
Weisbuch, G.	École Normale Supérieure, Paris	France	5	26	71	2698	8

Most influential and highly-productive research institutions/universities

As depicted in Figure 4, Delft University of Technology with 13 papers which had made a contribution to *JASSS* was ranked first. The reason might be that Nikolic I., as one of highly-productive authors in *JASSS* with 6 published papers affiliated to this university. University of Groningen was ranked second with 10 papers. Nine of these papers were authored by Jager, W. The third rank belonged to the University of Surrey, as a result of attempts made by Gilbert, N., the former *JASSS* editor-in-chief affiliated by the latter university.

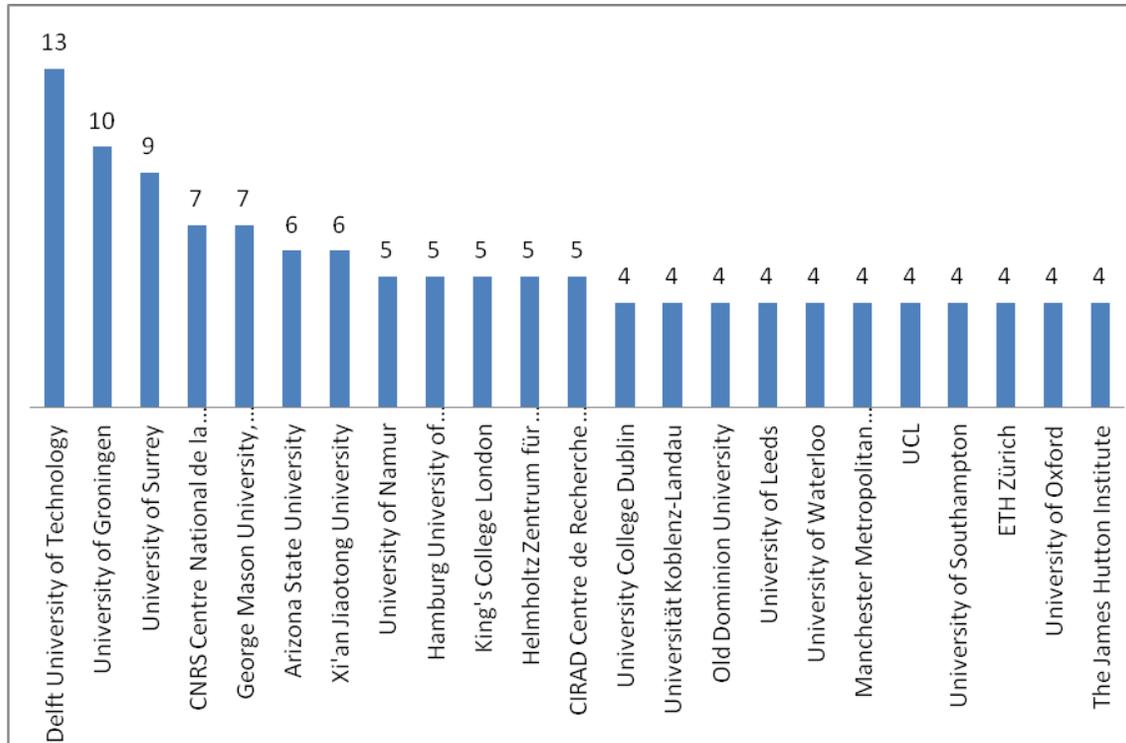


Figure 4. Most influential and highly-productive research institutions/universities contributing to *JASSS*

Most influential and highly-productive countries in *JASSS*

As a journal with an international scope in the field of social simulation and artificial science, *JASSS* has attracted the interest of many researchers worldwide. Authors from 52 countries made some contributions to *JASSS*. However, about 50 percent of contributions belonged to the nine countries, including the United States, the United Kingdom, Germany, Netherlands, France, China, Italy, Australia, and Canada. Figure 5 illustrates the bibliographic coupling map of the most active countries contributing to *JASSS* (with a threshold of 5 published papers).

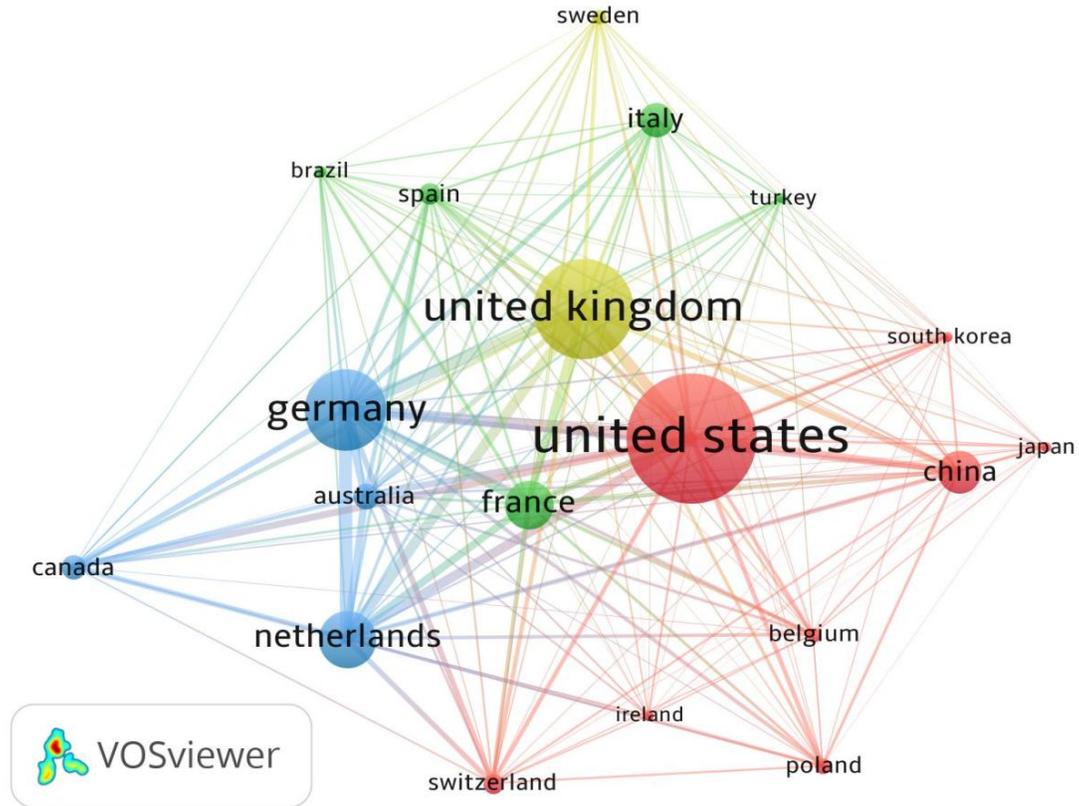


Figure 5. Bibliographic coupling network of highly-productive countries contributing to JASSS

As depicted in the figure above, 19 countries published 5 or more papers in *JASSS*. The size of circles indicated the magnitude of the share or contribution of the countries. The most productive countries were the United States (with 85 papers, 11.93% contribution), the United Kingdom (with 65 papers, 9.12% contribution) and Germany (with 54 papers, 7.58% contribution), respectively.

Lines between circles (countries) demonstrated links between an individual country and other countries contributing *JASSS*. As can be seen, six countries, including the United States, the United Kingdom, Germany, Netherlands, France and China had most links with other countries. Table 3 includes additional information on the 24 top productive countries, having about 65.87 percent contribution to the journal.

Table 3. Additional information on countries contributing to JASSS

Country/Territory	Published Papers	% out of 712 papers	Rank
United States	85	11.94	1
United Kingdom	65	9.13	2
Germany	54	7.58	3
Netherlands	37	5.20	4
France	32	4.50	5
China	28	3.93	6
Italy	23	3.23	7
Australia	17	2.39	8
Canada	16	2.25	9
Spain	14	1.97	10
Switzerland	13	1.83	11
Poland	11	1.54	12
Belgium	10	1.40	13
Sweden	10	1.40	13
Brazil	8	1.12	14
Japan	7	0.98	15
South Korea	7	0.98	15
Turkey	7	0.98	15
Ireland	5	0.70	16
Austria	4	0.56	17
Portugal	4	0.56	17
Iran	3	0.42	18
Israel	3	0.42	18
Taiwan	3	0.42	18
United Arab Emirates	3	0.42	18
Other Country	243	34.13	-
Total	712	100	-

Co-occurrence map of keywords of papers published in JASSS

As one of most applicable items of papers, keywords are effective vocabularies in searching for their subjects in abstracting and indexing databases. Studying the keywords used in *JASSS* papers is beneficial for its wide-range audience. Its highly-frequent frequent keywords can depict active and top research fields. Figure 6 visualizes the co-occurrence map of highly-frequent keywords in *JASSS*, with the threshold of 10 frequently-used keywords.

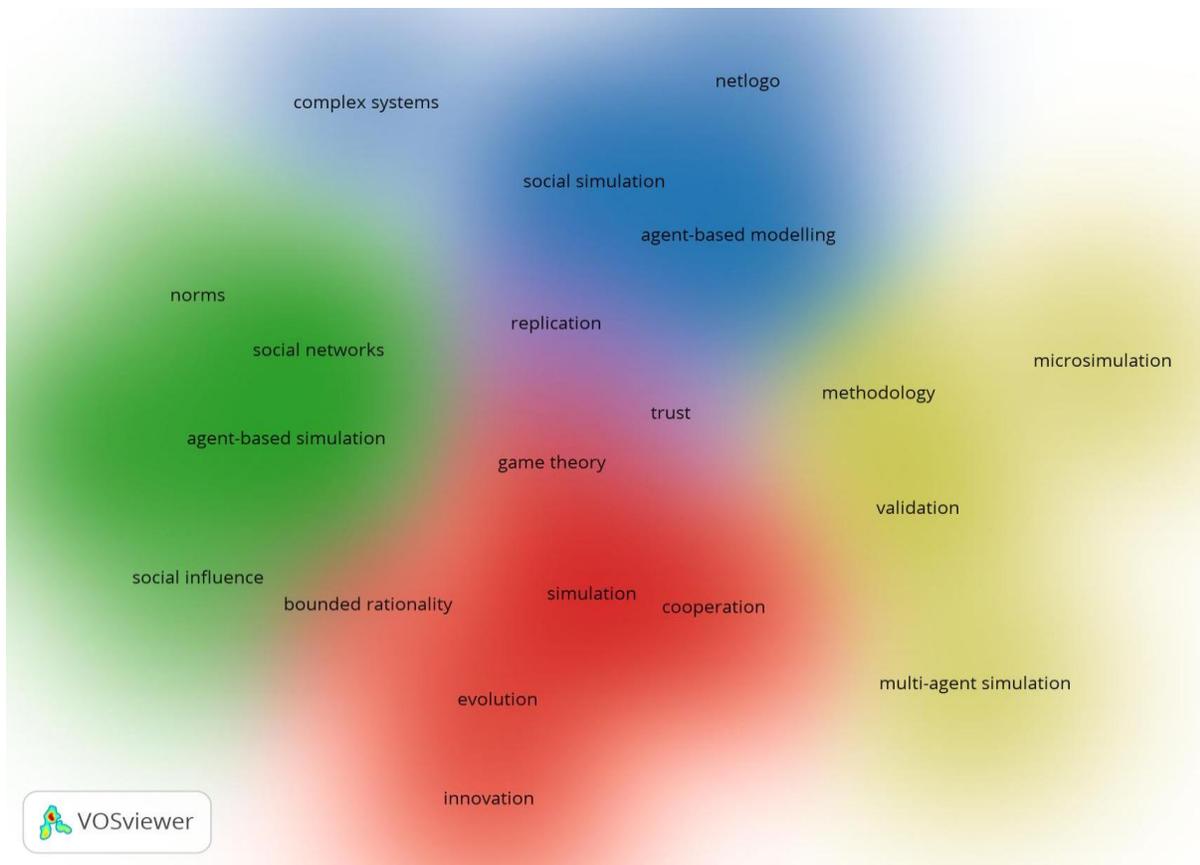


Figure 6. Co-occurrence density map of most highly-frequent keywords used in JASSS papers

As depicted in figure above, the co-occurrence map of the most frequent used keywords in *JASSS* was composed of 20 keywords in 5 clusters. The first cluster in red included the keywords "innovation", "evolution", "simulation", "cooperation", "bounded rationality", and "game theory". The second cluster with green color contained the keywords "social network", "agent-based simulation", "norms" and "social influence". The third cluster in blue consisted of the keywords "agent-based modeling", "social simulation", "net logo", and "complex system". The fourth cluster in yellow showed 4 keywords, including "multi-agent simulation", "validation", "methodology" and "micro simulation". The smallest cluster in violet had two keywords: "trust" and "replication". It was noted that in co-occurrence maps, close keywords or ones in the same cluster appeared together in papers.

Co-occurrence map of the terms extracted from the titles of published papers

Terms used in the titles of papers are the most important retrieving / access points. In addition, highly-frequent terms demonstrate the development trend of a scientific journal. A total of 1,826 terms were extracted from the titles of 712 studied papers. With threshold of 5, the terms with at least 5 frequencies in titles were studied and their co-occurrences were depicted based on 26 highly-frequent terms.

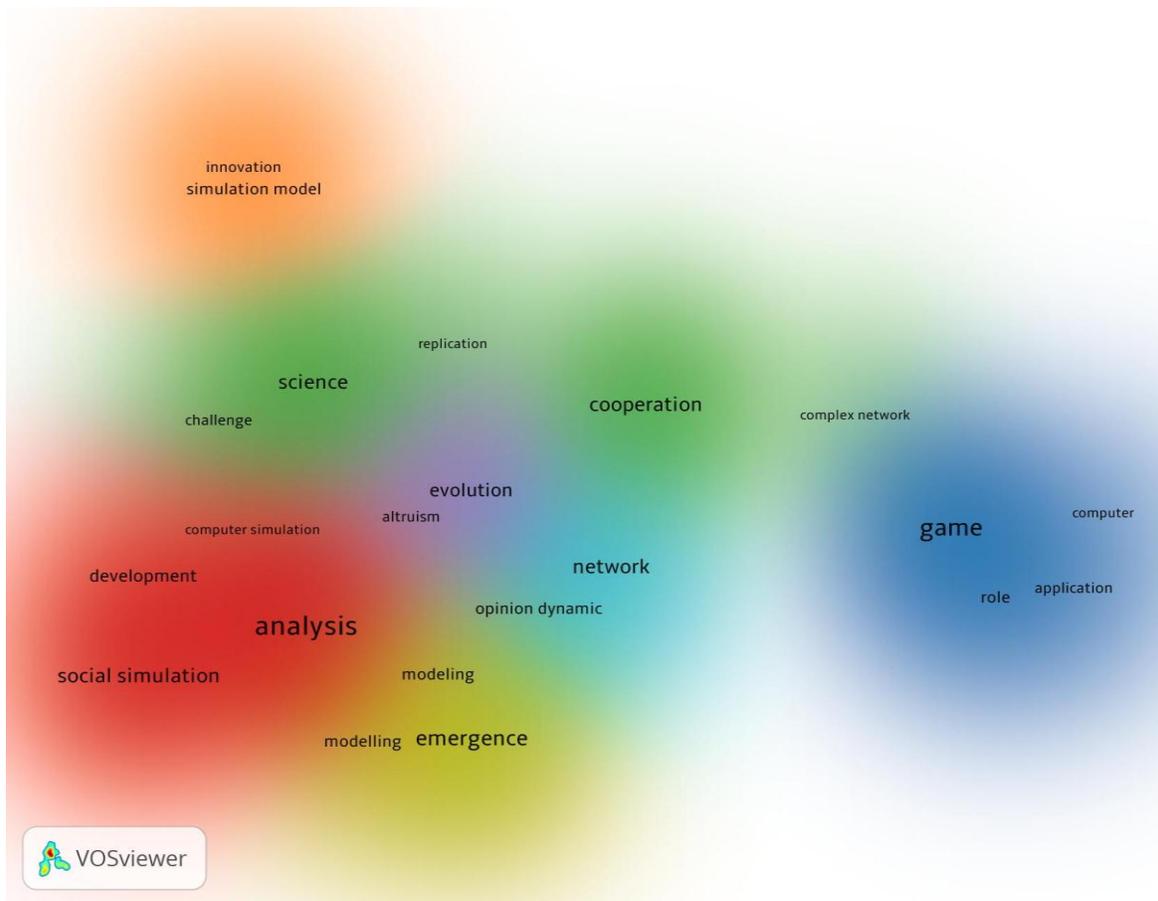


Figure 7. Co-occurrence density map of extracted terms of paper titles

As shown in Figure 7, the co-occurrence map of highly-frequent terms used in the titles of published papers consisted of seven clusters: Named as "social simulation analysis and development", the first cluster in red included the terms "analysis", "social simulation", "computer simulation" and "development". "Science" and "cooperation" were the main terms of the second cluster in red, named as "scientific cooperation". Labeled as "computer games", the third cluster in blue included terms, such as "game", "computer" and "application". The words "modeling" and "emergence" were observed in the fourth cluster with the assigned name of "modeling". The terms, including "altruism" and "evolution" in the fifth cluster (in violet) would be named as "human factors". Two terms such as "network" and "opinion dynamic" were observed in the sixth cluster (in turquoise), with name of "dynamic networks. In the last cluster, entitled "innovation in simulation models", two terms including "simulation model" and "innovation" were observed.

Cited References

As the base of a paper, references (bibliography) contain main information for the authors, audience and editorial teams of a specific journal. A total of 1,253 cited references were included

in *JASSS* papers. Seventeen of these items had been cited more than 100 times. These journals (and their citation numbers) were: *Journal of Artificial Societies and Social Simulation* (1441), *Nature* (325), *Science* (288), *American Journal of Sociology* (197), *Ecological Modeling* (194), *American Economic Review* (141), *American Sociological Review* (131), *Physical Review E* (129), *Journal of Theoretical Biology* (127), *Physica A* (124), *Journal of Personality and Social Psychology* (118), *Journal of Conflict Resolution* (116), *Environmental Modeling and Software* (112), *Management Science* (108), *Journal of Mathematical Sociology* (105), *Advances in Complex Systems* (104), and *Plos One* (103), respectively.

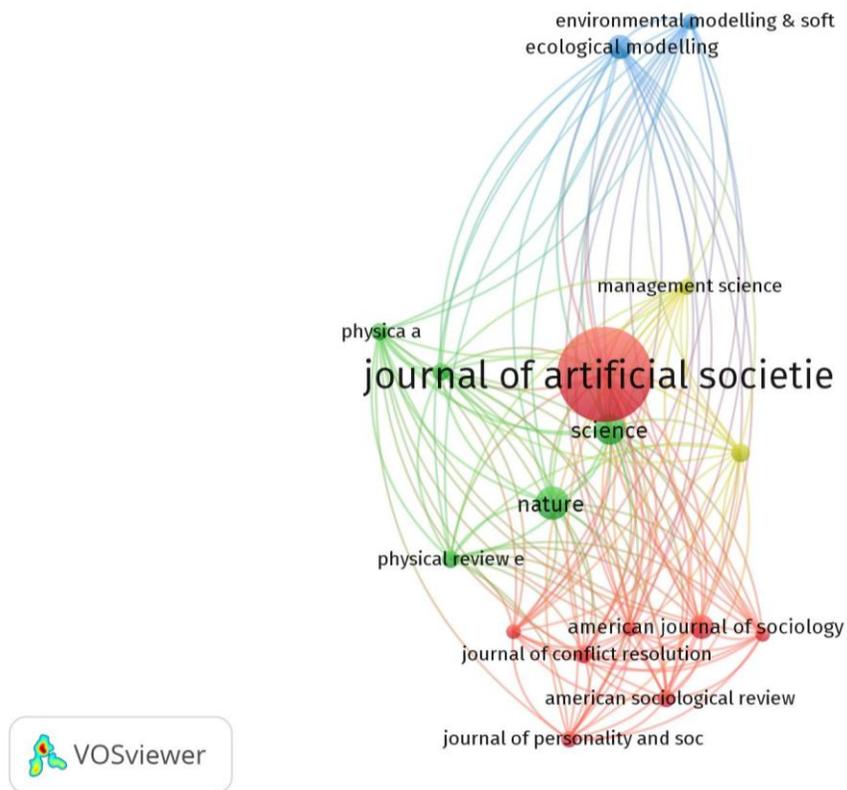


Figure 8. Journal co-citation network map of journals cited in *JASSS* papers

The co-citation map of cited journals in *JASSS* papers (Figure 8) showed that the *Journal of Artificial Science and Societies (JASSS)*, *the Science* and *the Nature* were three main cited journals in *JASSS*. The circle size or font size in the map indicated the density of citation numbers. The larger a circle size or font size, the more a cited item will be. As shown in the figure above, given the prestige of *JASSS* and their influential publication in in the field of social simulation, it was the most highly-cited resource for its. Other 17 highly-cited journals were main resource with high impact factors, too.

Considering the color of the circles included in the map, 4 co-citation clusters could be seen. Resources in each cluster were more or less citing each other. The first cluster in red consisted of

8 cited resources: Journal of Artificial Societies and Social Simulation (1441), Advances in Complex Systems (104), American Journal of Sociology (197), American Sociological Review (131), Journal of Conflict Resolution (116), Journal of Mathematical Sociology (105), Plos One (103), Journal of Personality and Social Psychology (118). The second cluster in green includes 5 resources: Journal of Theoretical Biology (127), Nature (325), Physica A (124), Physical Review E (129), and Science (288). The third cluster in blue consists of two resources: Ecological Modeling (194) and Environmental Modeling and Software (112). The fourth cluster in yellow includes American Economic Review (141) and Management Science (108).

Cited authors

The analysis the references used in a journal showed that cited authors whose papers cited by authors in a specific journal used in authoring their works. In papers of *JASSS*, 25,225 authors were cited. 26 top highly-cited authors (with ≥ 100 received citations) were as follows: Axelrod, R. (294), Gilbert, N. (267), Grimm, V. (229), Deffuant, G. (211), Epstein J. M. (210), Edmonds, B. (193), Wilensky, U. (186), Polhill, J. G. (177), Amblard, F. (166), Conte, R. (146), Weisbuch, G. (143), Bousquet, F. (142), Flache, A. (142), Nowak, M. A. (142), Moss, S. (137), Hegselmann, R. (136), Jager, W. (131), Berger, U. (112), Axtell, R. (110), Le Page, C. (105), Barreteau, O. (103), Hales, D. (103), Railsback, S. F. (102), Gotts, N. M. (101), Troitzsch, K. G. (101), Janssen, M. A. (100), respectively. Based on the authors' co-citation map (Figure 9), the top 5 highly-cited authors in *JASSS* were Axelrod, R., Gilbert, N., Grimm, V., Deffuant, G. and Epstein J. M., respectively.

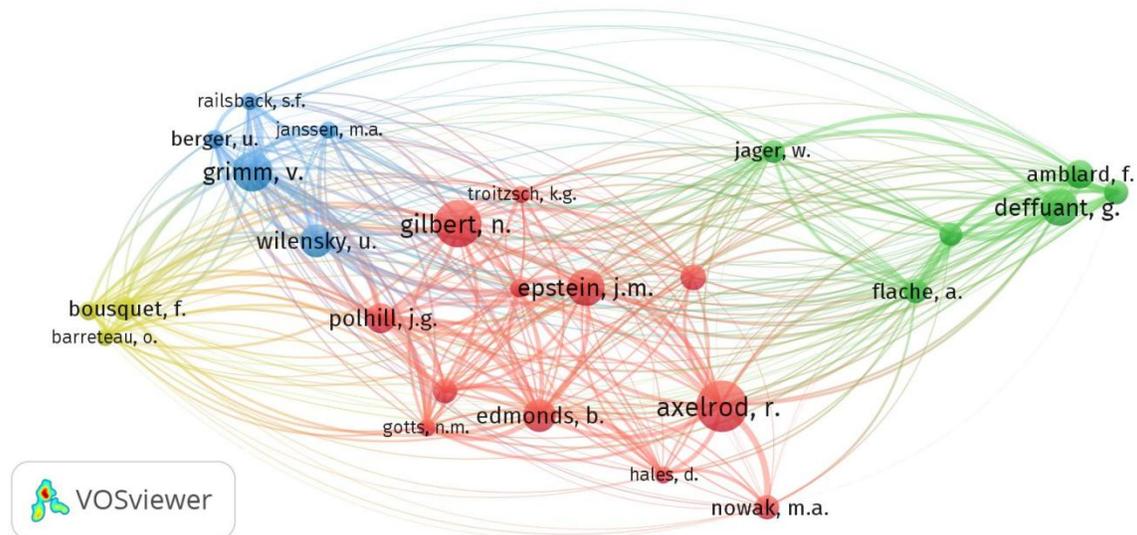


Figure 9. Co-citation network map of authors cited in JASSS papers

As visualized in figure above, the authors' co-citation map consisted of 4 clusters. Authors in the same cluster were cited together. The most influential authors in the first cluster were Axelrod,

R., Gilbert, N., and Epstein J. M. The most influential authors in the second cluster are Grimm, V., Wilensky, U. and Berger, U. In the third cluster are Deffuant, G., Amblard, F. and Flache, A. The fourth cluster consisted of two authors: Bousquet, F. and Barreteau, O.

Conclusion

As main tools for disseminating scientific information and research findings, journals need to be evaluated from a bibliometric perspective. *JASSS* is not an exception. Based on the scientific map and knowledge structure of this journal illustrated by using bibliometric techniques in this study, it was revealed that there were significant achievements in the field for the journal. There was an increasing trend in its published paper number, total number of citations received, and number of contributing authors, countries and research institutions in the studied time span (2000-2018).

The gradual increase in the number of published papers and their received citations showed that *JASSS* achieved the target of attracting the attention of researchers worldwide. Year-by-year increase in received citations of the journal indicated its promise and deep influence on research development. Highly-productive authors in the journal were well-known in their fields as the bibliometric indicators such as their h-indexes and total received citations showed.

The wide geographical distribution of contributing countries clearly shows *JASSS* international scope and authors. This can be a sign of its worldwide development, scientific quality and academic prestige. However, developing countries and their research institutions have less contribution to *JASSS* publications. Considering the term and keyword co-occurrences and clustering maps, *JASSS* focused mainly on the topics related to social simulation, its analysis, methodologies, scientific modeling, networking, cooperation, etc. These topics can potentially widen *JASSS* in scope and attract interdisciplinary authors from different disciplines and consequent development in its scientific quality.

JASSS papers had made high contribution to the field as citation analysis of its published papers showed. Co-citation network of journals cited in *JASSS* papers indicated that *JASSS* had logical relations with other related journals in its field and other similar fields. These journals are from different disciplines, reflecting the interdisciplinary nature of *JASSS*. They are mostly high prestige and have scientific quality. It can be said that *JASSS* is at the core of social simulation and strongly connects with many other journals publishing papers in related fields.

In general, *JASSS* has found its way in the field of social simulation and achieved an academic level. However, potential gaps in the journal in comparison with other related journals can be detected in further research and by conducting a detailed item-based bibliometric analysis. Our bibliometric study of this important leading journal can encourage researchers to carry out further studies.

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