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Is Social Simulation a Social Science Outstation? A Bibliometric Analysis of the Impact of *JASSS*

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Abstract

This paper examines the bibliometric impact of *JASSS* on other ISI- and Scopus-indexed sources by examining inward and outward citations and their inter-relation. Given the prestige of *JASSS*, this analysis can measure the growth and dynamics of social simulation and give us an indication of the direction in which social simulation is moving. Results show that the impact of *JASSS* is higher in computer sciences, physics and ecology than it is in the social sciences, even though *JASSS*-indexed articles tend to be more concerned with social science-related topics. Looking at inter-journal citations revealed an interesting citation structure: *JASSS* collected its largest percentage of citations from non-social science-focused journals while directing more citations within its own articles toward works published in social science journals. On the one hand, this would confirm that social simulation is not yet recognised in the social science mainstream. On the other hand, this may indicate that the cross-disciplinary nature of *JASSS* allows it to promulgate social science theories and findings in other distant communities.

Keywords:

JASSS, Social Simulation, Bibliometric Analysis, Impact, Inter-Journal Citations

Introduction

- 1.1 Social simulation is a multi-disciplinary field now reaching a mature stage in its development, as has been attested to in a number of recent studies (e.g., Meyer, Lorscheid and Troitzsch 2009; Squazzoni 2010; Meyer, Zaggl and Carley 2011). To better understand this multi-disciplinary nature, we carried out a bibliometric analysis of *JASSS* based on the best available databases of peer-reviewed, scholarly publications, such as ISI and Scopus. Our aim was to understand the position of *JASSS* in the scholarly journal environment and to examine the structure of citations and cited sources. Since *JASSS* is considered the most prestigious social simulation publication, examining this journal can provide a realistic picture of the overall situation.
- 1.2 The rest of this paper is organised as follows. The first section presents a bibliometric analysis of the impact of *JASSS* on other ISI- and Scopus-indexed sources. We have focused on these databases because they are considered to be highly representative of the best scholarly peer-reviewed publications and complement one another both in terms of coverage and type of information. Indeed, while ISI is the most respected bibliometric index, Scopus covers a larger sample of conference proceedings, which are extremely relevant to this investigation into the impact of social simulation. Results have shown that *JASSS* has had a truly cross-disciplinary impact and that this impact was more prevalent in computer science, physics and ecology as compared with the social sciences.
- 1.3 In the second section, we looked in greater detail at the relation between social simulation and other fields by analysing the structure of inward and outward citations. We restricted our focus to the years 2009–2010, as appropriate citation data were available only for this period. As we will see, looking at citations and cited sources reveals an interesting citation structure: *JASSS* collected the largest percentage of its citations from non-social science journals, while directing more citations within its own articles toward works published in social science journals. We have also found a structure of tighter relations between a small set of journals that represent the true hub of social simulation.
- 1.4 In the third section we have reported on *JASSS* top-20 cited articles in the ISI, Scopus and Google Scholar indices. We restricted our attention to these articles, which comprise approximately one-third of all journal citations, in an effort to reveal differences and similarities between the respective indices. In the final section, we clarify certain limitations of our work and highlight potential implications germane to the further development of *JASSS*.

JASSS bibliometric impact (ISI and Scopus databases, 2002-2010)

- 2.1 From 2002 to 2010, *JASSS* published 324 articles, receiving 983 and 1283 citations, respectively, by all ISI- and Scopus-indexed sources (excluding journal self-citations). The journal achieved an increasing impact, especially in the most recent years of the period under consideration. Figure 1 illustrates the total number of citations on ISI- and Scopus-indexed sources. It is worth noting that the citation growth dynamics were similar across the two indices, although the size of the growth in the most recent years was more pronounced among ISI-indexed sources.

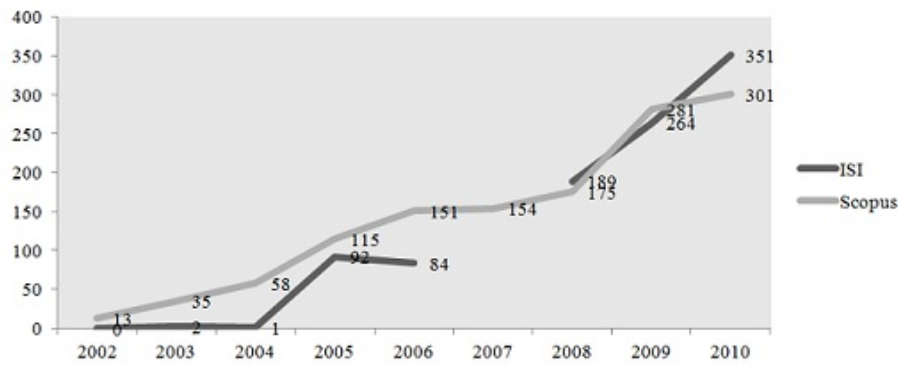


Figure 1. *JASSS* citation dynamics in ISI- and Scopus-indexed sources from 2002 to 2010. Note that *JASSS* was not covered by ISI in 2007 for technical reasons.

2.2 As shown in Figure 2, which illustrates the impact factor *JASSS* achieved in the Journal Citation Report by Thomson Reuters, the journal's impact factor increased significantly, particularly from 2008 to 2010. This allowed the journal to not only position itself as a recognised title of quality among the list of interdisciplinary social science journals—where it ranked 8th among the 84 titles listed as of 2010—but also to achieve respectable positions if included on other, related, disciplinary lists. Considering the situation as of 2010, for instance, were *JASSS* included in the list of political science-focused journals, it would have ranked 15th of 141, 16th of 132 journals in the list of sociology-focused journals, 49th of 308 if included in the list of economics-focused journals, and 21st of 78 if included in the list of environmental studies-focused journals.

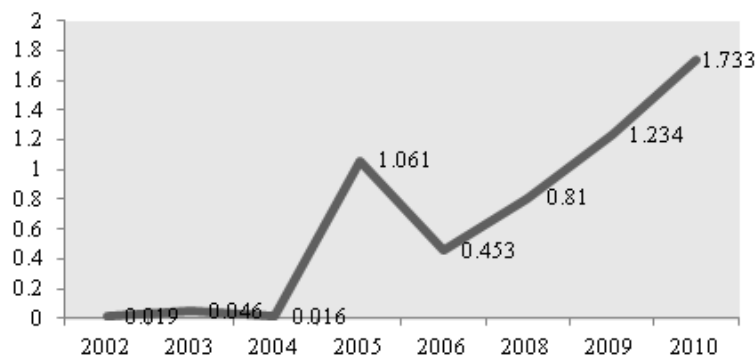


Figure 2. *JASSS* ISI impact factor from 2002 to 2010. Note that *JASSS* was not covered by ISI in 2007 for technical reasons.

- 2.3 As shown in Tables A.1 and A.2 of the appendix and as noted above, *JASSS* collected 983 citations from 178 ISI-indexed sources and 1283 citations from 468 Scopus-indexed sources (excluding self-citations), respectively. Looking at the top positions on the ISI list, it is worth noting that a significant percentage of the citations came from physics and related journals or from book series focused on complexity, simulation and artificial intelligence. Physics journals such as *International Modern Physics C* (6.6% of total citations), *Physica A* (5.9%) and *Physical Review A* (3%) topped the list, along with *Lecture Notes in Artificial Intelligence* (10% of all citations), *Lecture Notes in Computer Science* (4.7%), *Advances in Complex Systems* (3.8%) and *Computational and Mathematical Organization Theory* (2.6%). Another considerable percentage of citations came from ecology- and environmental sciences-focused journals such as *Environmental Modelling & Software* (2.6% of all citations), *Computers, Environment and Urban Systems* (1.8%), *Ecology and Society* (1.6%), *Geoforum* (1.4%) and *Ecological Modelling* (1.3%).
- 2.4 The picture is similar among Scopus-indexed sources, although in this case physics-focused journals had a less pronounced presence at the top of the list and there were more sources which only rarely cited articles published in *JASSS*. The top positions were occupied by well-known sources such as *Lecture Notes in Computer Science* (9.74% of all citations), *Advances in Complex Systems* (2.10%) and *Computational and Mathematical Organization Theory* (1.40%). As was seen among ISI-indexed sources, another significant percentage of citations came from ecology- and environment sciences-focused journals such as *Ecological Modelling* (2% of all citations), *Ecology and Society* (1.16%), *Environmental Modelling and Software* (1.40%) and *Computers, Environment and Urban Systems* (1.16%).
- 2.5 Table 1 shows the impact of *JASSS* on other ISI-indexed sources classified by discipline. This classification was carried out by hand, one-by-one, to ensure a precise allocation of journals and fields and to resolve any instances of multiple allocation. Results showed, first, that *JASSS* had an impact on a diverse range of disciplines. Second, the results showed that computer science-focused journals attracted 30% of all citations, followed by physics (21%). Figure 3 shows a comparison between ISI- and Scopus-indexed journals. Although ISI did not afford full coverage of the period considered, we can state that approximately 75% of all citations of *JASSS* articles came from the fields of computer science, physics, the natural sciences and ecology, while only approximately 20% came from social science-focused journals.
- 2.6 The picture is different if we consider sources cited by articles published in *JASSS*. It was unfortunately not possible to perform this analysis on only ISI-cited sources in 2009 and 2010. We also restricted our interest to journal citations by removing any source indicating a monograph or an edited volume (in this case, included in the ISI database). As is shown in Figure 4, our results indicate that approximately half of all citations concerned social science-focused journals, whereas computer science-focused journals accounted for 22% of all citations and physics-focused journals 8%. It is worth noting that in this case even the humanities were represented, accounting for approximately 3% of all citations.
- 2.7 Taken together, these findings reveal that the citation structure of *JASSS* was unbalanced in terms of inward and outward citations: more citations were collected from non-social science sources, while more citations were made of social science-related sources. We will examine this in more detail below.

Table 1: Percentage of ISI-indexed sources which cite *JASSS* out of the total number of citations, sorted by academic discipline.

Discipline	Percentage of citing <i>JASSS</i> sources
Computer Sciences	29.70
Physics	21.4
Environmental sciences	6.7
Complexity	6.00
Management & Business	5.8
Ecology	5.5
Economics	5.5
Engineering	4.6
Geography	2.4
Social sciences	2.3
Sociology	2.2
Agriculture	1.50
Natural sciences	1.2
Philosophy	1
Medicine	0.8
Political sciences	0.6
Neurosciences	0.6
Psychology	0.4
Cognitive sciences	0.40
Biology	0.40
Science- General	0.3
Operational Research	0.3
Archaeology	0.20

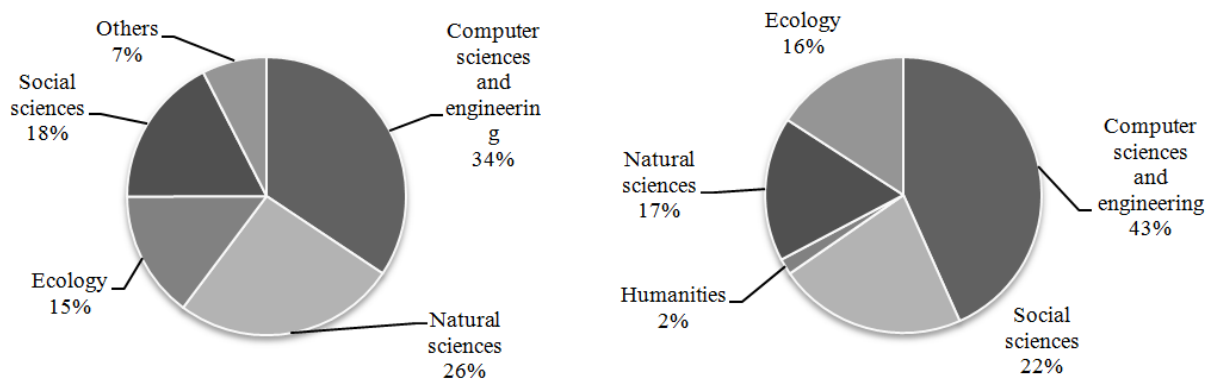


Figure 3. Percentage of ISI- (left) and Scopus-indexed (right) sources which cite *JASSS* out of the total number of citations, presented per academic discipline for the period 2002-2010. Note that, for the sake of simplicity, in the category "ecology", we have included environmental sciences and geography (as most such articles dealt with socio-ecological systems); in "natural sciences" we have included physics, mathematics, statistical mechanics, agriculture and water management; in "social sciences", we have included economics, psychology, political sciences, cognitive sciences and management and business. "Humanities", when cited, included history and philosophy.

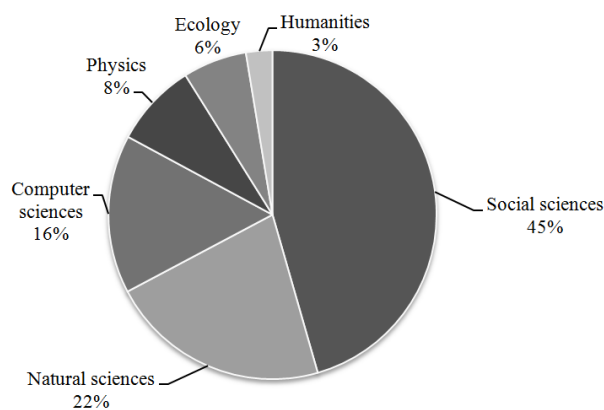


Figure 4. Percentage of ISI-indexed sources cited by *JASSS* out of the total number of citations made in 2010, sorted by academic discipline.

2.8 Although we could not control for the relative weight of the individual disciplines in terms of the number of potential citations and the number of

journals, this citation structure nevertheless did confirm the recent findings of Meyer, Lorscheid and Troitzsch (2009) relating to the multidisciplinary nature of social simulation. The impact of *JASSS* in fact touches upon a wide variety of disciplines. On the other hand, our results indicate that: (i) the influence of *JASSS* is more prominent in computer science, physics, ecology and the natural sciences; and, (ii) articles published in *JASSS* are more thoroughly embedded in social science literature than in other fields.

The inter-journal citation structure

- 3.1 Looking at inter journal co-citations allows us to better understand the relationship between social simulation and more traditional areas of study such as physics, computer science, ecology and social sciences. Doing so can also help us verify the discrepancy found in the previous analysis—i.e., the unbalanced relationship between inward and outward citations at the single-discipline level.
- 3.2 To achieve this we first ranked the inward and outward ISI citations made in 2009 and 2010, which we used to create the index Cit , which measured their inter-journal relationships, as follows:

$$Cit = \frac{(m_{i \rightarrow j} - n_{j \rightarrow i})}{(m_{i \rightarrow j} + n_{j \rightarrow i})} \quad (1)$$

where j stood for *JASSS*, i for each journal included in the list of citations, $m_{i \rightarrow j}$ the number of citations of *JASSS*-published works collected from any other journal i and $n_{j \rightarrow i}$ the number of citations of works published in any other journal i in *JASSS*. The index takes a range of possible values between 1 (= *JASSS* was cited by i at least once but *JASSS* never cited j) and -1 (= *JASSS* cited i at least once but was never cited by j), with 0 indicating a perfect balance of inward and outward citations. To control for the different dimensions of the inter-relation $j \leftrightarrow i$ as any value of Cit could be achieved by different combinations of in-outward citations, we added a second index, Cit_w , which measured the total number of inward-outward citations, as follows:

$$Cit_w = m_{i \rightarrow j} + n_{j \rightarrow i} \quad (2)$$

- 3.3 Let us suppose, for instance, that *JASSS* provided 20 citations of journal i and received 10 citations in turn. This would yield values of $Cit = 0.33$ and $Cit_w = 30$. The same $Cit = 0.33$ could be achieved had *JASSS* been cited 205 times by the journal i , which received 103 citations in turn; on the other hand, such a scenario would yield a value of $Cit_w = 308$. This allowed us to also consider differences in the size and scope of inter-journal relations.
- 3.4 Following Leydesdorff (2007) and using our inter-journal citation indices, we first mapped the total *JASSS* network for the period considered (see Figures 5 and 6). Although certain differences exist between the two years in terms of the number and type of ties and the journals included in the analysis, we again found that stronger inter-journal connections existed in the fields of natural and computer sciences.
- 3.5 To examine the data in greater detail, we remapped the network to present values of Cit within the range $-0.5 : 0.5$ —i.e., focusing only on inter-journal relations with a consistent number of exchanged citations. Figures 7 and 8 show that, were we to exclude the importance of the inter-journal relations with *CMOT* in 2010—which could be viewed as a relationship between two journals which are thematically related rather than a relation between *JASSS* and a mainstream social science journal, as well as a less consistent relationship with *JEBO* and *Sociological Research Online*—the hub of social simulation more often included computer science- and physics-focused journals.

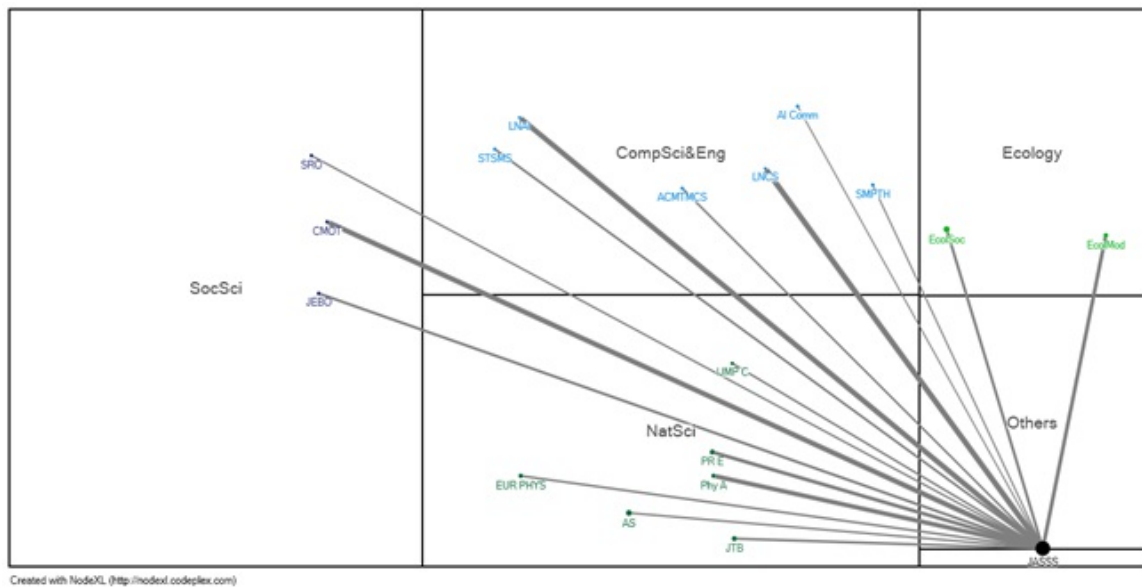


Figure 8. The *JASSS* network of citations in 2010. The colours indicate the journal fields, the size of the circles indicates the journal's impact factor (the bigger the circle, the greater the journal's impact factor) and the dimension of the tie indicates the number of citations (the thicker the tie, the greater the number of inward-outward citations).

3.6 Figures 9 and 10 show the inter-journal relation index with Cit as the x-axis and Cit_w as the y-axis. For the sake of readability and in order to focus only on existing inter-relations, we excluded all extreme cases where $Cit = 1, -1$. It is worth noting that, when $Cit > 0$, the inter-journal relationship favours *JASSS* in terms of the relative number of citations. Although interesting differences existed between 2009 and 2010, the results largely confirmed that there was a circumscribed set of journals from various fields with which *JASSS* had positive relations, such as *LNCS*, *LNAI*, *CMOT*, *Physica A* and *Advances in Complex Systems*, among others, and that none of these journals was expressly focused on social science-related topics if we exclude the case of *Technovation* in 2009 and *Sociological Research Online* in 2010, which would be an acceptable step given the minimal number of mutual citations.

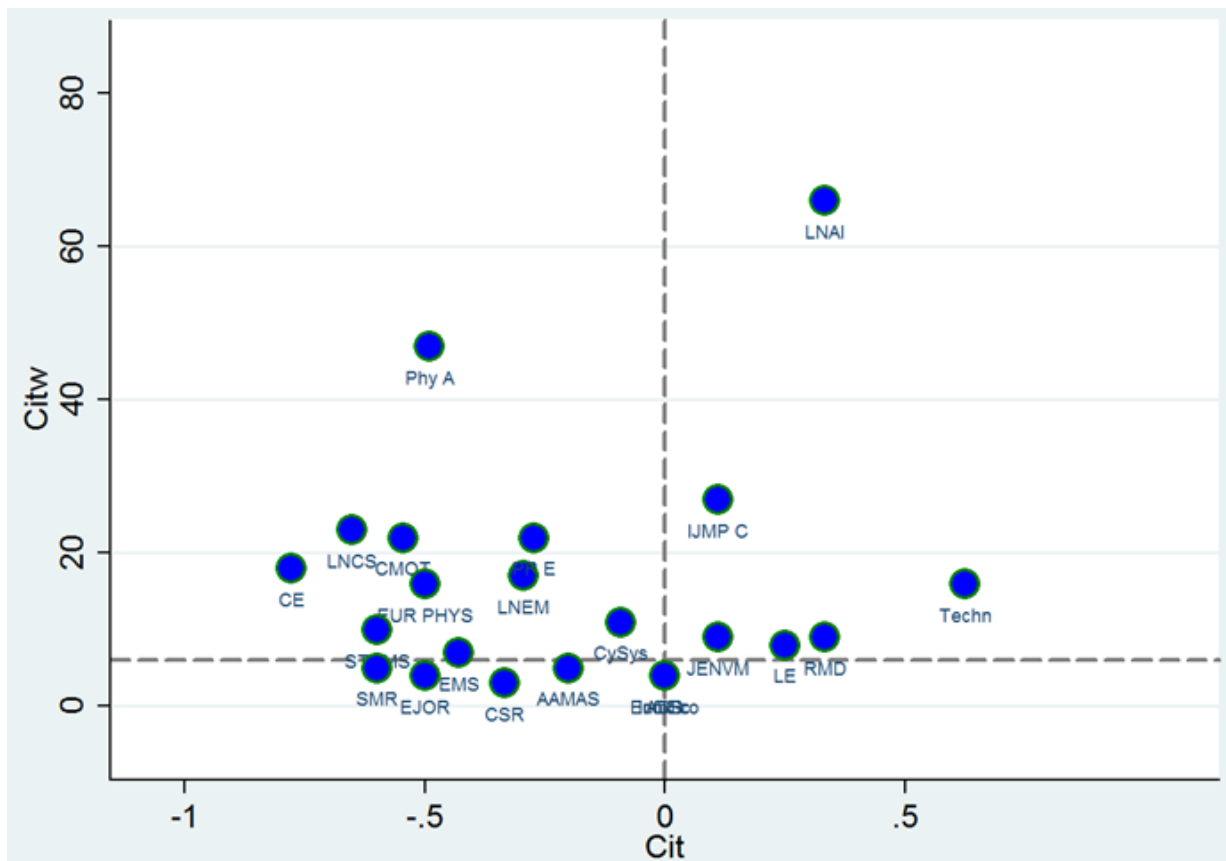


Figure 9. The inter-journal relation index in 2009 (including only higher values).

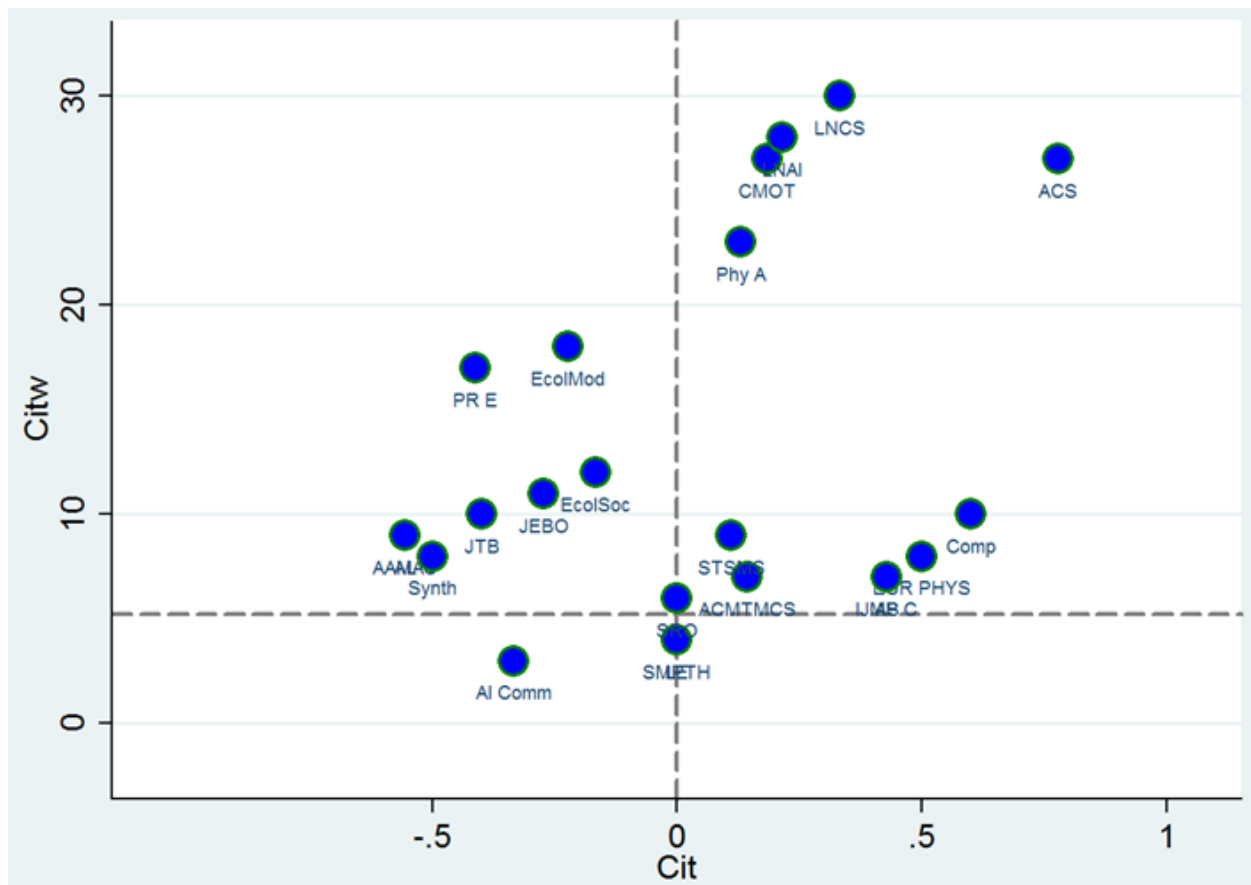


Figure 10. The inter-journal relation index in 2010 (including only higher values).

The JASSS article stars

- 4.1 As expected, the impact of JASSS was strongly dependent upon the success of a restricted number of articles. Tables 2, 3 and 4 show the top-20 cited JASSS articles from 2002 to 2012 in the ISI, Scopus and Google Scholar databases, respectively. These articles collected approximately one-third of all JASSS citations in the period considered in this analysis. First, it is interesting to note that there are significant differences between the three lists, and especially between ISI and the other lists. Epstein's 2008 article on modelling (Epstein 2008), for instance, ranked second in ISI, while it ranked 20th and 11th in Scopus and Google Scholar, respectively. Two influential articles on opinion dynamics (Hegselmann and Krause 2002; Deffuant *et al.* 2002), which accounted for approximately 10% of all JASSS citations in the Scopus and Google Scholar databases during the period considered—where they were ranked first and second, respectively—ranked relatively low in ISI. Second, it is worth noting that the top positions were frequently occupied by either methodological or epistemological articles, which accounted for approximately half of the top 20 such articles on each

list.

4.2 Figure 11 shows the percentage of un-cited articles from 2002 to 2012 retrieved from Scopus. Were we to consider the growth in the number of *JASSS* articles published in the most recent years of the study period—with an average number of 32 articles published per year during the period 2002-2005 as compared with an average of approximately 40 articles published per year in the more recent period—this figure indicates that a greater number citations were concentrated among a relatively small number of articles, which were thus responsible for the increasing impact of the journal. In 2010, for example, approximately 60% of *JASSS* articles did not receive a single citation. This would indicate that there is room for stronger selection of submissions.

Table 2: The top 20 articles in terms of the number of citations in the ISI database (note that citation figures were retrieved on 26 July 2012, and thus refer to a ten-year citation period running 2002-2012).

Rank	Article authors	Article title	Year and issue	Number of citations
1	Windrum, P., Fagiolo, G., Moneta, A.	Empirical validation of agent-based models: Alternatives and prospects	10(2) 2007	29
2	Epstein, J. M.	Why Model?	11(4) 2008	26
3	Hurbig, D.	Attitude dynamics with limited verbalisation capabilities	1(2) 2003	16
4	Moss S.	Alternative approaches to the empirical validation of agent-based models	11(5) 2008	14
5	Hegselmann, R., Krause, U	Opinion dynamics and bounded confidence: Models, analysis and simulation	5(3) 2002	11
6	Edmonds, B., Hales, D.	Replication, replication and replication: Some hard lessons from model alignment	6(4) 2003	29
7	Hoffmann A. O. I., Jager, W., Von Eije, J. H.	Social simulation of stock markets: Taking it to the next level	10(2) 2007	10
8	Deffuant, G.	Comparing extremism propagation patterns in continuous opinion models	9(3) 2006	9
9	Gonzales-Avella, J. C., Cosenza M. G., Klemm, K. and colleagues	Information feedback and mass media effects in cultural dynamics	10(3) 2007	9
10	Galán, J.M., Izquierdo, L.R., Izquierdo, S.S., Santos, J.I., del Olmo, R., López-Paredes, A., Edmonds, B.	Errors and artefacts in agent-based modelling	12(1) 2009	9
11	Health, B., Raymond, H., Frank, C.	A survey of agent-based modeling practices (January 1998 to July 2008)	12(4) 2009	9
12	Bhavnani, R., Miodownik, D. Nart J.	IREsCape: An agent-based framework for modeling resources, ethnicity, and conflict	11(2) 2008	8
13	Pawel, S.	Modelling opinion formation with physics tools: Call for closer link with reality	12(1) 2009	8
14	Nikolai, C., Madey, G.	Tools of the trade: A survey of various agent based modeling platforms	12(2) 2009	8
15	Wilensky, U., Rand, W.	Making models match: replicating an agent-based model	10(4) 2007	7
16	Lysenko, M., D'Souza Roshan, M.	A framework for megascale agent-based simulations on graphics processing units	11(4) 2008	7
17	Izquierdo, L.R., Izquierdo, S.S., Galán, J.M.,	Techniques to understand computer simulations: Markov chain analysis	11(4) 2008	7
18	Bandini, S., Manzoni, S. Vizzari, G.	Agent-based modeling and simulation: An informatics perspective	12(4) 2009	7
19	Edmonds, B., Hales, D.	Replication, replication and replication: Some hard lessons from model alignment	6(4) 2003	6
20	Filatova, T., Parker, D., van der Veen, A.	Agent-based urban land markets: Agent's pricing behavior, land prices and urban land use change	12(1) 2009	6

Table 3: The top 20 articles in terms of the number of citations in the Scopus database (note that citations were retrieved on 26 July 2012, and thus refer to a ten-year citation period running 2002-2012).

Rank	Article authors	Article title	Year and issue	Number of citations
1	Hegselmann, R., Krause, U	Opinion dynamics and bounded confidence: Models, analysis and simulation	5(3) 2002	86
2	Deffuant, G., Amblard, F., Weisbuch, G., Faure, T.	How can extremism prevail? A study based on the relative agreement interaction model	5(4) 2002	67
3	Windrum, P., Fagiolo, G., Moneta, A.	Empirical validation of agent-based models: Alternatives and prospects	10(2) 2007	42
4	D'Aquino, P., Le Page, C., Bousquet, F., Bah, A.	Using self-designed Role-Playing Games and a Multi-Agent System to empower a local decision-making process for land use management: The SelfCormas experiment in Senegal	6(3) 2003	35
5	Hales, D., Rouchier, J., Edmonds, B.	Model-to-model analysis	6(4) 2003	34

6	Edmonds, B., Hales, D.	Replication, replication and replication: Some hard lessons from model alignment	6(4) 2003	29
7	Davidsson, P.	Agent based social simulation: A computer science view	5(1) 2002	29
8	Tobias, R., Hofmann, C.	Evaluation of free Java-libraries for social-scientific agent based simulation	7(1) 2004	25
9	Etienne, M., Le Page, C., Cohen, M.	A step-by-step approach to building land management scenarios based on multiple viewpoints on multi-agent system simulations	6(2) 2003	25
10	Goldspink, C.	Methodological implications of complex systems approaches to sociality: Simulation as a foundation for knowledge	5(1) 2002	25
11	Boero R., Squazzoni F.	Does empirical embeddedness matter? Methodological issues on agent-based models for analytical social science	8(4) 2005	23
12	Vogt, P., Coumans, H.	Investigating social interaction strategies for bootstrapping lexicon development	6(1) 2003	22
13	Galán, J.M., Izquierdo, L.R., Izquierdo, S.S., Santos, J.I., del Olmo, R., López-Paredes, A., Edmonds, B.	Errors and artefacts in agent-based modelling	12(1) 2009	21
14	Guyot, P., Honiden, S.	Agent-based participatory simulations: Merging multi-agent systems and role-playing games	9(4) 2006	21
15	Barreteau, O.	The joint use of role-playing games and models regarding negotiation processes: Characterization of associations	6(2) 2003	20
16	Nikolai, C., Madey, G.	Tools of the trade: A survey of various agent based modeling platforms	12(2) 2009	19
17	Filatova, T., Parker, D., van der Veen, A.	Agent-based urban land markets: Agent's pricing behavior, land prices and urban land use change	12(1) 2009	19
18	Sabater, J., Paolucci, M., Conte, R.	Repage: REPutation and ImAGE among limited autonomous partners	9(2) 2006	19
19	Heath, B., Hill, R., Ciarallo, F.	A survey of agent-based modeling practices (January 1998 to July 2008)	12(4) 2009	18
20	Epstein, J. M.	Why Model?	11(4) 2008	18

Table 4: The top 20 articles in terms of the number of citations in the Google Scholar database (note that citations were retrieved on 26 July 2012, and thus refer to a ten-year citation period running 2002-2012).

Rank	Article authors	Article title	Year and issue	Number of citations
1	Hegselmann, R., Krause, U	Opinion dynamics and bounded confidence: Models, analysis and simulation	5(3) 2002	441
2	Deffuant, G., Amblard, F., Weisbuch, G., Faure, T.	How can extremism prevail? A study based on the relative agreement interaction model	5(4) 2002	172
3	Barreteau, O., Le Page, C. and D'Aquino, P.	Role playing games, models and negotiation processes	6(2) 2003	167
4	Tobias, R., Hofmann, C.	Evaluation of free Java-libraries for social-scientific agent based simulation	7(1) 2004	164
5	Barreteau, O. and colleagues	Our companion modelling approach	6(1) 2003	131
6	Windrum, P., Fagiolo, G., Moneta, A.	Empirical validation of agent-based models: Alternatives and prospects	10(2) 2007	130
7	Edmonds, B., Hales, D.	Replication, replication and replication: Some hard lessons from model alignment	6(4) 2003	128
8	Davidsson, P.	Agent based social simulation: A computer science view	5(1) 2002	127
9	Sabater, J., Paolucci, M., Conte, R.	Repage: REPutation and ImAGE among limited autonomous partners	9(2) 2006	120
10	D'Aquino, P., Le Page, C., Bousquet, F., Bah, A.	Using self-designed Role-Playing Games and a Multi-Agent System to empower a local decision-making process for land use management: The SelfCormas experiment in Senegal	6(3) 2003	119
11	Epstein, J. M.	Why Model?	11(4) 2008	118
12	Etienne, M., Le Page, C., Cohen, M.	A step-by-step approach to building land management scenarios based on multiple viewpoints on multi-agent system simulations	6(2) 2003	101
13	Goldspink, C.	Methodological implications of complex systems approaches to sociality: Simulation as a foundation for knowledge	5(1) 2002	86
14	Moss S.	Alternative approaches to the empirical validation of agent-based models	11(5) 2008	69
15	Boero R., Squazzoni F.	Does empirical embeddedness matter? Methodological issues on agent-based models for analytical social science	8(4) 2005	69

16	Guyot, P., Honiden, S.	Agent-based participatory simulations: Merging multi-agent systems and role-playing games	9(4) 2006	69
17	Galán, J.M., Izquierdo, L.R.,	Appearances can be deceiving: Lessons learned re-implementing Axelrod's 'Evolutionary approach to norms'	8(3) 2005	66
18	Hales, D., Rouchier, J., Edmonds, B.	Model-to-model analysis	6(4) 2003	66
19	Vogt, P., Coumans, H.	Investigating social interaction strategies for bootstrapping lexicon development	6(1) 2003	65
20	Küppers, G.	Validation of simulation: Patterns in the Social and Natural Sciences	8(4) 2005	62

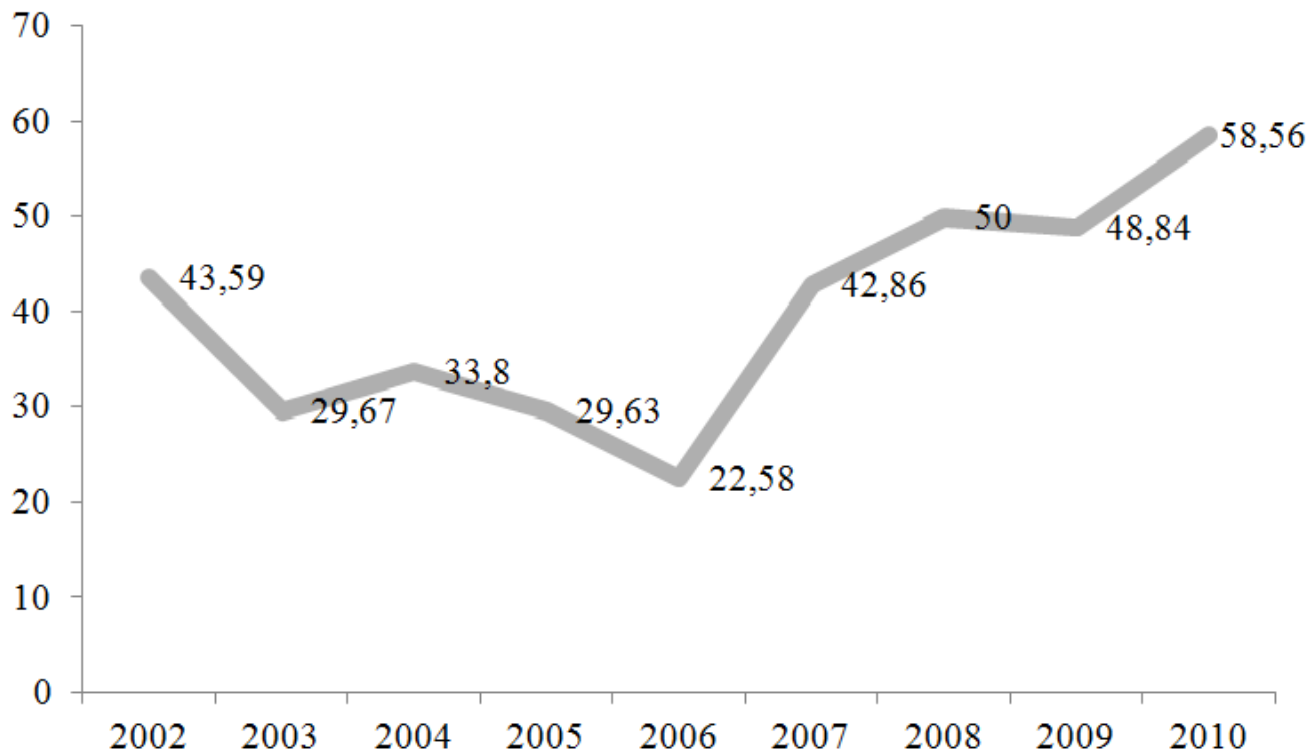


Figure 11. Percentage of un-cited *JASSS* articles, 2002-2010 (Scopus database)



Conclusions

- 5.1 Our results indicate that the impact of *JASSS* is cross-disciplinary but is consistently concentrated more among computer science, the natural sciences, physics and ecology. The impact of the journal on the social sciences is less significant. This finding could be subjected to multiple interpretations. On the one hand, this could be seen to confirm the fact that social simulation is not yet recognised as a relevant pursuit in the social sciences, as has been previously suggested by Richiardi *et al.* (2006). On the other hand, and especially if we were to consider the citation structure, we could conclude that *JASSS* serves the important function of reverberating social science concepts, theories and models in other, originally distant academic disciplines.
- 5.2 In both cases, this is a typical pattern for any cross-disciplinary, specialised journal. Such journals indeed seek to connect distant fields and bridge the gaps which exist between disciplines which lack a single, incremental, institutionalised and discipline-specific organisational field (e.g., Huutoniemi *et al.* 2010). This might also explain the relative instability of the impact factor trends and the greater variety of inter-journal connections among cross-disciplinary journals (e.g., Rinia *et al.* 2001; Levitt and Thelwall 2008).
- 5.3 While it is expected that, for instance, a *JASSS* article which investigates a cognitive science-related topic by adopting a social simulation approach will be cited more widely by an artificial intelligence- than a psychology-focused journal, the relative weakness of the multi-disciplinary links of *JASSS* in their reverberations within the domain of the social sciences is a problem which still must be seriously addressed by future research. A stronger capacity to provide feedback on social sciences is in fact a strategic concern for social simulation, given its stated mission of influencing the manner in which social science investigations are typically conducted.
- 5.4 In this respect, it is worth considering one severe limitation of our bibliometric analysis, which is that our databases did not in fact address the impact of *JASSS*-published articles on monographs and edited books. Such publications remain one of the most common forms of communication within the social sciences. As has been suggested by the *JASSS*-related findings of Meyer, Lorscheid and Troitzsch (2009) as well as those pertaining to *CMOT* by Meyer, Zaggi and Carley (2011), it would be reasonable to expect that the importance of citations in scholarly journals will continue to grow at the cost of citations of books and book chapters. This is a sign of the times. Monographs and book chapters, however, are still a suitable communication tool for social simulation. Excluding this scholarly publishing environment from an impact analysis therefore could have led us to have underestimated the impact of *JASSS* on the social sciences. This limitation could in turn be resolved, at least in part, by extending our analysis to include Google Scholar; this database covers a broad set of knowledge output sources, however, the screening of which would require a considerable effort for any more in-depth analysis.
- 5.5 Despite the required caveats typical of any impact analysis performed on only a single journal (e.g., Leydesdorff 2008), our results have allowed us

also to highlight certain policy implications. First, our results testify to the problem of concentrating on individual impact measures. If we look at aggregate indicators, such as the impact of *JASSS* in various fields, data from a single source can be sufficient. On the other hand, it is difficult to use data from a single source to evaluate specific aspects in greater detail, such as the impact of individual articles or topics. To sum up, working with multiple sources remains necessary if we are to provide a comprehensive picture of a journal, field or research area.

- 5.6 Second, there is an important message in these findings for cross-disciplinary journals such as *JASSS*, which represent an innovative field whose disciplinary/thematic connections are in a state of flux and are thus difficult to map. Our work indicates the importance of monitoring the impact and citation structure and dynamics of such journals, as doing so can provide information on the nature of innovation, reveal the penetration of certain topics of study into various areas and testify to typical academic 'political' problems of this type of research within institutionalised disciplines. In the case of *JASSS* in particular, our results could motivate targeted actions, such as the organisation of special issues and initiatives in an effort to consolidate existing links with already strongly connected areas and strengthen those areas with weaker ties.

Appendix

Table A.1: List of ISI-indexed journals which cited *JASSS* articles, ordered by the number of citations (2002-2010). Note that *JASSS* was not covered by ISI in 2007 for technical reasons.

List of citing <i>JASSS</i> ISI indexed journals	2002	2003	2004	2005	2006	2008	2009	2010	Total	%
Lecture Notes in Artificial Intelligence		1		4	10	20	44	17	96	9.8
International Journal of Modern Physics C				27	9	9	15	5	65	6.6
Physica A: Statistical Mechanics and its Applications				11	7	15	12	13	58	5.9
Lecture Notes in Computer Science				6	4	12	4	20	46	4.7
Advances in Complex Systems						13		24	37	3.8
Physical Review E - Statistical, Nonlinear, and Soft Matter Physics				5	4	7	8	5	29	3.0
Computational and Mathematical Organization Theory						5	5	16	26	2.6
Environmental Modelling and Software					3	2	2	18	25	2.5
Computers, Environment and Urban Systems						6		12	18	1.8
Ecology and Society				1	10			5	16	1.6
European Physical Journal B					5		4	6	15	1.5
Complexity				4	3			8	15	1.5
Geoforum						14			14	1.4
Ecological Modelling					3	3		7	13	1.3
Technovation							13		13	1.3
Proceedings - Winter Simulation Conference								13	13	1.3
History of economic ideas								12	12	1.2
Annals of the New York Academy of Sciences								11	11	1.1
Simulation-Transactions of the Society for Modeling and Simulation International				2			2	5	9	0.9
Simulation Modelling Practice and Theory						6		2	8	0.8
Lecture Notes in Economics and Mathematical Systems						2	6		8	0.8
Connection Science						5		3	8	0.8
AIP Conference Proceedings				4				4	8	0.8
Understanding Complex Systems							7		7	0.7
Cybernetics and Systems				2			5		7	0.7
Studies in Computational Intelligence							7		7	0.7
Land Use Policy						5	2		7	0.7
Landscape Ecology							5	2	7	0.7
Journal of Statistical Mechanics: Theory and Experiment						2	5		7	0.7
International Journal of Geographical Information Science				1	4			1	6	0.6
International Journal of Sustainable Development and World Ecology							1	5	6	0.6
Journal of Environmental Management			1				5		6	0.6
Agricultural Systems				1				5	6	0.6
Ecological Economics						4	2		6	0.6
Earth Surface Processes and Landforms								6	6	0.6
Journal of Economic Behavior and Organization						2		4	6	0.6
PICMET: Portland International Center for Management of Engineering and Technology								6	6	0.6
Adaptive Behavior					1	3	2		6	0.6
Reviews of Modern Physics							6		6	0.6
Environment and Planning B: Planning and Design				1		4			5	0.5

Autonomous Agents and Multi-Agent Systems			1	2	2	5	0.5
Social Science Computer Review	1	4				5	0.5
Cahiers Agricultures			2		3	5	0.5
Sotsiologicheskie Issledovaniya	3		2			5	0.5
ACM Transactions on Modeling and Computer Simulation		1			4	5	0.5
Information Sciences				2	3	5	0.5
P 2010 Crossstr C					5	5	0.5
Systems Research and Behavioral Science		2		2		4	0.4
Computers and Electronics in Agriculture			3		1	4	0.4
Journal of Mathematical Sociology	4					4	0.4
Cognitive Systems Research				1	3	4	0.4
IEEE Transactions on Systems, Man, and Cybernetics Part A:Systems and Humans			2		2	4	0.4
Semiotica				4		4	0.4
International Studies Review					4	4	0.4
IEEE International Conference on Fuzzy Systems					4	4	0.4
Contributions to Economics				4		4	0.4
2009 Int C Computer Engineering				4		4	0.4
Jahrbucher fur Nationalokonomie und Statistik			4			4	0.4
Physica D: Nonlinear Phenomena			2		2	4	0.4
Euro Physics Letter	1	3				4	0.4
PLoS ONE					3	3	0.3
Frontiers in Artificial Intelligence and Applications				3		3	0.3
International Journal of Transport Economics		3				3	0.3
Technological Forecasting and Social Change				3		3	0.3
IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics	2		1			3	0.3
Systemic Practice and Action Research			3			3	0.3
IEEE Congress on Evolutionary Computation				1	2	3	0.3
Sustainability Science				3		3	0.3
Contr Manage Science				3		3	0.3
Synthese				1	2	3	0.3
Sociological Research Online					3	3	0.3
Applied Artificial Intelligence					3	3	0.3
Computers and Mathematics with Applications				3		3	0.3
Ecological Complexity				3		3	0.3
Canadian Journal of Agricultural Economics				3		3	0.3
Journal of Economic Interaction and Coordination					3	3	0.3
IEEE International Joint Conference on Neural Networks					3	3	0.3
IEEE Transactions on Automatic Control				3		3	0.3
Journal of Internet Technology					3	3	0.3
Logic Journal of the IGPL					3	3	0.3
Population and Environment					3	3	0.3
International Journal of Drug Policy				3		3	0.3
International Journal of Health Geographics				3		3	0.3
Euro Physics Letter					3	3	0.3
Journal of Theoretical Biology					3	3	0.3
New Journal of Physics					3	3	0.3
P. of the Royal Society A: Mathematical, Physical and Engineering Sciences				3		3	0.3
Comparative Politics				3		3	0.3
Archives Europeennes de Sociologie					3	3	0.3
Water Resources Research				2		2	0.2
Mathematical and Computer Modelling		2				2	0.2
P 2010 as youth c					2	2	0.2
Rationality and Society			2			2	0.2
PLoS Computational Biology					2	2	0.2
Advances in Intelligent and Soft Computing					2	2	0.2
Artificial Life					2	2	0.2
Communications in Computer and Information Science					2	2	0.2
WS So Agent Technologies				2		2	0.2

ICEIS 2008		2		2	0.2
AD Int Water Management Cop		2		2	0.2
Physics and Chemistry of the Earth		2		2	0.2
Political Research Quarterly			2	2	0.2
American Journal of Community Psychology			2	2	0.2
Tidsskrift for Samfunnsforskning			2	2	0.2
Journal of Anthropological Archaeology		2		2	0.2
BMC Systems Biology			2	2	0.2
20 International Conference Euro Min C		2		2	0.2
2009 IEEE S Comp			2	2	0.2
22 European Conference Mod Sim Proceedings		2		2	0.2
Journal of Computer Assisted Learning			2	2	0.2
Journal of Computer Science and Technology			2	2	0.2
UK's 2009 11 International Conference			2	2	0.2
Journal of Industrial Ecology			2	2	0.2
Computational Economics			2	2	0.2
Energy Policy			2	2	0.2
Geneva Papers on Risk and Insurance: Issues and Practice			2	2	0.2
4 International Conference Aut Sol		2		2	0.2
Dyna Colombia			2	2	0.2
International Workshop on Advance Issue of E-Commerce			2	2	0.2
International Federation for Information Processing		2		2	0.2
Lecture Notes in Control and Information Sciences	2			2	0.2
P5 IEEE International Workshop		2		2	0.2
Environmental Management			2	2	0.2
Environment and Urbanization			2	2	0.2
Geojournal Library			2	2	0.2
Service Industries Journal			2	2	0.2
Addiction			2	2	0.2
RAIRO - Operations Research			2	2	0.2
Studies in History and Philosophy of Science			2	2	0.2
Chinese Physics Letters		2		2	0.2
Computer Physics Communications			2	2	0.2
Science Culture Series Physics	2			2	0.2
Dyna Bilbao			2	2	0.2
Mathematical social sciences			2	2	0.2
Proceedings 1 Int Worksh Ed			2	2	0.2
Societes		2		2	0.2
Sociological Theory and Methods			2	2	0.2
British Journal of Criminology	2			2	0.2
Proceedings 26 Ann s comp			2	2	0.2
Water Resources Management			1	1	0.1
Journal of Economic Issues	1			1	0.1
European Journal of Operational Research			1	1	0.1
Sociological Methods and Research			1	1	0.1
American Journal of Sociology	1			1	0.1
IEEE Congress on Evolutionary Computation		1		1	0.1
International Journal of Production Economics	1			1	0.1
I C Wirel Comm Netw			1	1	0.1
Water Science and Technology			1	1	0.1
Interciencia			1	1	0.1
Szociologiai Szemle		1		1	0.1
2008 Portland International Conference		1		1	0.1
AI Communications			1	1	0.1
Computers in Industry			1	1	0.1
IEEE Transactions on Evolutionary Computation			1	1	0.1
Journal of Universal Computer Science			1	1	0.1
Kybernetes	1			1	0.1
WEBIST 2009 - Proceedings of the 5th International Conference on Web Information Systems and			1	1	0.1

Technologies											
Forest Policy and Economics				1					1	0.1	
ACM Transactions on Autonomous and Adaptive Systems							1		1	0.1	
Computer Systems Science and Engineering				1					1	0.1	
Detc 2008 p asme							1		1	0.1	
Ele com eng						1			1	0.1	
Global Networks				1					1	0.1	
ICAART 2009 International Conference on Agents and Artificial Intelligence							1		1	0.1	
Journal of Information Technology				1					1	0.1	
P ann hicss								1	1	0.1	
Environment and Planning A				1					1	0.1	
Journal of Regional Science								1	1	0.1	
Progress in Human Geography						1			1	0.1	
Baltic Journal of Management							1		1	0.1	
IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics						1			1	0.1	
Sciences in China Series B							1		1	0.1	
Journal of Hydrology								1	1	0.1	
Fundamenta Informaticae							1		1	0.1	
American Political Science Review				1					1	0.1	
Computers in Human Behavior				1					1	0.1	
Revue Francaise de Sociologie				1					1	0.1	
Acta Physica Polonica B					1				1	0.1	
Total	0	2	1	92	84	189	264	351	983	100	

Table A.2: List of Scopus-indexed journals which cited *JASSS* articles, ordered by number of citations (2002-2010). Conference proceedings and book series publications are in italics.

List of citing <i>JASSS</i> Scopus indexed sources	2002	2003	2004	2005	2006	2007	2008	2009	2010	Tot	%
Lecture Notes in Computer Science		1	4	9	21	12	13	47	18	125	9.7
Advances in Complex Systems				1		5	7		14	27	2.1
Environmental Modelling and Software		2	1	1	3	5	1	2	11	26	2.0
Physica A: Statistical Mechanics and its Applications		2	1	3	2	4	4	4	4	24	1.9
Computational and Mathematical Organization Theory						2	5	3	8	18	1.4
Ecological Modelling		3	3		3		3		6	18	1.4
Simulation			1	8	4		1		3	17	1.3
Computers, Environment and Urban Systems			1	1			4	1	8	15	1.2
Ecology and Society				3	7	1		1	3	15	1.2
Lecture Notes in Economics and Mathematical Systems					2		5	5	2	14	1.1
Simulation and Gaming		1				9	1	2	1	14	1.1
Computational Economics			1	2		7	1	1	1	13	1.0
Proceedings - Winter Simulation Conference				1	1	3	1	1	6	13	1.0
Proceedings of the International Conference on Autonomous Agents	3	1		5	4					13	1.0
Environment and Planning B: Planning and Design				3		2	5	1	1	12	0.9
Filozofia						11	1			12	0.9
Geoforum							11			11	0.9
International Journal of Modern Physics C	1	1	1	1	1	1	1	3		10	0.8
Landscape Ecology						4		4	2	10	0.8
Complexity			2		3				4	9	0.7
Journal of Environmental Management			1					6	2	9	0.7
Sotsiologicheskie Issledovaniya				7			1		1	9	0.7
Understanding Complex Systems							1	7	1	9	0.7
Agricultural Systems			1	1		2			4	8	0.6
Handbook of Computational Economics					8					8	0.6
Journal of Mathematical Sociology		1	4	2	1					8	0.6
Technovation								8		8	0.6
Journal fur Betriebswirtschaft									7	7	0.5
Studies in Computational Intelligence						2		5		7	0.5

Cybernetics and Systems			3	1	1	2		6	0.5	
Ecological Economics	1			1	2	1	1	6	0.5	
International Journal of Geographical Information Science			1	3			2	6	0.5	
Journal of Memetics	1	1	1	3				6	0.5	
Mind and Society					1	5		6	0.5	
Nonlinear Dynamics, Psychology, and Life Sciences	1		1	4				6	0.5	
Revue Francaise de Sociologie			3		3			6	0.5	
3rd Biennial Meeting,"Summit on Environmental Modelling and Software"				2			3	5	0.4	
AAAI Fall Symposium - Technical Report				4		1		5	0.4	
ACM International Conference Proceeding Series				1		3	1	5	0.4	
Adaptive Behavior				1	1	2	1	5	0.4	
Annals of the New York Academy of Sciences							5	5	0.4	
Cahiers Agricultures					2		3	5	0.4	
Computing in Science and Engineering	3		1		1			5	0.4	
Earth Surface Processes and Landforms						1	4	5	0.4	
Information Sciences				1		2	2	5	0.4	
International Journal of Simulation and Process Modelling						3	2	5	0.4	
Journal of Community and Applied Social Psychology		1					4	5	0.4	
Journal of Economic Behavior and Organization			1		2		2	5	0.4	
Land Use Policy					1	3	1	5	0.4	
Lecture Notes in Artificial Intelligence		5						5	0.4	
Proceedings of the 5th Biennial Conference of the International Environmental Modelling and Software Society						4	1	5	0.4	
Social Science Computer Review			1	3		1		5	0.4	
Systems Research and Behavioral Science	1			4				5	0.4	
Technological Forecasting and Social Change					1		4	5	0.4	
2008 IEEE International Conference on System of Systems Engineering						4		4	0.3	
2009 International Conference on Intelligent Agent and Multi-Agent Systems							4	4	0.3	
AISB'05 Convention: Proceedings of the Socially Inspired Computing Joint Symposium			4					4	0.3	
American Journal of Sociology			4					4	0.3	
Annee Sociologique					4			4	0.3	
Artificial Intelligence Review	3	1						4	0.3	
Computers and Electronics in Agriculture						4		4	0.3	
Connection Science	1		1				2	4	0.3	
Contributions to Economics	1			3				4	0.3	
E:CO Emergence: Complexity and Organization				1		1	2	4	0.3	
European Journal of Operational Research			1		2	1		4	0.3	
Frontiers in Artificial Intelligence and Applications						2	2	4	0.3	
International Journal of Sustainable Development and World Ecology							4	4	0.3	
International Journal of Transport Economics				4				4	0.3	
Jahrbucher fur Nationalokonomie und Statistik						4		4	0.3	
Journal of Economic Interaction and Coordination						1	2	1	4	0.3
Journal of Experimental Criminology						4		4	0.3	
Journal of Futures Studies					4			4	0.3	
Journal of Management and Governance				4				4	0.3	
MODSIM07 - Land, Water and Environmental Management: Integrated Systems for Sustainability					4			4	0.3	
PLoS Computational Biology							2	2	4	0.3
PLoS ONE						1		3	4	0.3
Proceedings - IEEE/WIC/ACM International Conference on Intelligent Agent Technology			1		3			4	0.3	
Proceedings - 12th IEEE International Conference on Computational Science and Engineering							4	4	0.3	
Proceedings of the ACM Symposium on Applied Computing	1				1	2		4	0.3	
Proceedings of the IASTED International Conference on						2	1	1	4	0.3

Modelling and Simulation									
Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems	4							4	0.3
Semiotica							4	4	0.3
Spring Simulation Multiconference							4	4	0.3
Sustainability Science						3	1	4	0.3
Water Resources Research						3	1	4	0.3
Xitong Fangzhen Xuebao / Journal of System Simulation						4		4	0.3
18th World IMACS Congress and MODSIM09 International Congress on Modelling and Simulation						3		3	0.2
Acta Geographica Sinica			1	1				1	3
Agricultural Water Management								1	3
Agriculture, Ecosystems and Environment	2		1						3
AIP Conference Proceedings								3	3
American Political Science Review	1	2							3
Artificial Intelligence	1	1						1	3
Autonomous Agents and Multi-Agent Systems				1	1		1	1	3
Canadian Journal of Agricultural Economics								3	3
Cognitive Systems Research				1			1	1	3
Conference Proceedings - IEEE International Conference on Systems, Man and Cybernetics	1		1					1	3
Ecological Complexity								3	3
IASTED International Conference on Modelling, Simulation, and Optimization	2							1	3
Int. Congress on Environmental Modelling and Software					2			1	3
Interfacing Modelling and Simulation with Mathematical and Computational Sciences								3	3
International Conference on Management Science and Engineering						1	1	1	3
International Journal of Bifurcation and Chaos					2			1	3
International Studies Review								3	3
Journal of Economic Issues	1	2							3
Journal of Environmental Planning and Management							1	2	3
Journal of Simulation								3	3
Journal of Statistical Mechanics: Theory and Experiment					2		1		3
Personality and Social Psychology Review								3	3
Physical Review E - Statistical, Nonlinear, and Soft Matter Physics	1						1	1	3
PICMET: Portland International Center for Management of Engineering and Technology							2	1	3
Proceedings - DIS 2006: IEEE Workshop on Distributed Intelligent Systems - Collective Intelligence and Its Applications									3
Simulation Modelling Practice and Theory							1	2	3
Structural Change and Economic Dynamics								3	3
Theory and Decision	3								3
Tidsskrift for Samfunnsforskning								3	3
Transactions in GIS						2	1		3
Water Resources Management							2	1	3
Winter Simulation Conference							1	2	3
WSEAS Transactions on Information Science and Applications						2	1		3
11th International Conference on Computer Modelling and Simulation								2	2
2006 1st International Symposium on Environment Identities and Mediterranean Area									2
2006 IEEE Congress on Evolutionary Computation									2
2008 IEEE Congress on Evolutionary Computation							2		2
2010 2nd International Conference on Computational Intelligence and Natural Computing								2	2
ACM Transactions on Modeling and Computer Simulation								1	2
Addiction								2	2
AI Communications								2	2

AISB 2008 Convention: Communication, Interaction and Social Intelligence			2		2	0.2
Annual Genetic and Evolutionary Computation Conference					2	0.2
Applied Artificial Intelligence	1				1	0.2
Cambridge Journal of Economics		1	1		2	0.2
Complexity International			2		2	0.2
Computers and Mathematics with Applications				2	2	0.2
CyberGeo	1		1		2	0.2
Cyberpsychology and Behavior	2				2	0.2
DISP			2		2	0.2
Ecological Informatics			1		1	0.2
Electronic Notes in Theoretical Computer Science				2	2	0.2
Energy Economics			2		2	0.2
Energy Policy				1	1	0.2
European Physical Journal B	1		1		2	0.2
Futures		1			1	0.2
GECCO 2005 - Genetic and Evolutionary Computation Conference		2			2	0.2
Group Decision and Negotiation	1				1	0.2
ICE-B 2009 - International Conference on e-Business				2	2	0.2
ICETE 2009 - International Joint Conference on e-Business and Telecommunications				2	2	0.2
IEEE International Conference on Computer Systems and Applications			2		2	0.2
IEEE Transactions on Automatic Control				2	2	0.2
IFIP International Federation for Information Processing			2		2	0.2
Inteligencia Artificial				2	2	0.2
Interactive Learning Environments			1	1	2	0.2
International Conference on the Applications of Digital Information and Web Tech				1	1	0.2
International Journal of Cooperative Information Systems			2		2	0.2
International Journal of Drug Policy				2	2	0.2
International Journal of Health Geographics				2	2	0.2
International Journal of Production Economics			2		2	0.2
Journal of Agricultural Education and Extension					2	0.2
Journal of Business Research			2		2	0.2
Journal of Computer Assisted Learning			1		1	0.2
Journal of Conflict Resolution			1	1	2	0.2
Journal of Economic Methodology			1	1	2	0.2
Journal of Enterprise Information Management				1	1	0.2
Journal of Industrial Ecology				2	2	0.2
Journal of Information Technology		2			2	0.2
Journal of Internet Technology			2		2	0.2
Journal of Mediterranean Archaeology		2			2	0.2
Journal of Risk Research				2	2	0.2
Journal of Socio-Economics			2		2	0.2
Journal of Theoretical Biology	1				1	0.2
Kybernetes		2			2	0.2
Lecture Notes in Control and Information Sciences		2			2	0.2
Management Science			1		1	0.2
Mathematical and Computer Modelling		2			2	0.2
Mathematical social sciences				2	2	0.2
Modelling for Environment's Sake: Proceedings of the 5th Biennial Conference					2	0.2
Natures Sciences Societies		2			2	0.2
New Journal of Physics				1	1	0.2
Physica D: Nonlinear Phenomena			2		2	0.2
Political Research Quarterly					2	0.2
Population and Environment					2	0.2
Proceedings - 2009 International Conference on Computer Engineering and Technology				2	2	0.2

Proceedings - 2010 6th IEEE International Conference on e-Science,				2	2	0.2
Proceedings - 2010 International Symposium on Intelligence Information Processing and Trusted Computing				2	2	0.2
Proceedings - Frontiers in Education Conference		1	1		2	0.2
Proceedings of the 2008 Spring Simulation Multiconference		2			2	0.2
Proceedings of the ACM International Multimedia Conference and Exhibition		2			2	0.2
Proceedings of the IEEE International Conference on Control Applications			2		2	0.2
Proceedings of the International Conference on Management of Emergent Digital EcoSystems				2	2	0.2
Rationality and Society	1		1		2	0.2
SAR and QSAR in Environmental Research				2	2	0.2
SECRYPT 2009 - International Conference on Security and Cryptography				2	2	0.2
SIGMAP 2009 - International Conference on Signal Processing and Multimedia Applications				2	2	0.2
Societes		2			2	0.2
Sociological Research Online			2		2	0.2
Sociological Theory and Methods			1	1	2	0.2
Synthese				2	2	0.2
Systemic Practice and Action Research			2		2	0.2
Transportation Research Part C: Emerging Technologies	1		1		2	0.2
Twenty-First Century Society				1	1	2
Water Science and Technology				2	2	0.2
Web Intelligence and Agent Systems	1			1	2	0.2
WINSYS 2009 - International Conference on Wireless Information Networks and Systems				2	2	0.2
2005 IEEE/WIC/ACM International Conference on Intelligent Agent Technology	1				1	0.1
2006 IEEE International Conference on Computational Cybernetics, ICCB	1				1	0.1
2006 IEEE International Conference on Granular Computing	1				1	0.1
2006 SICE-ICASE International Joint Conference	1				1	0.1
2008 1st International Conference on Infrastructure Systems and Services			1		1	0.1
2008 3rd Workshop on Workflows in Support of Large-Scale Science				1	1	0.1
2008 Conference on Human System Interaction, HSI 2008			1		1	0.1
2008 IEEE International Systems Conference Proceedings			1		1	0.1
2008 IEEE Swarm Intelligence Symposium,			1		1	0.1
2008 International Conference on Wireless Communications, Networking and Mobile Computing			1		1	0.1
2008 Proceedings of the ASME International Design Engineering Technical Conferences and Computers				1	1	0.1
2009 2nd International Conference on Infrastructure Systems and Services				1	1	0.1
2009 Chinese Control and Decision Conference				1	1	0.1
2009 IEEE Conference on Commerce and Enterprise Computing				1	1	0.1
2009 IEEE Congress on Evolutionary Computation				1	1	0.1
2010 2nd International Symposium on Aware Computing, ISAC 2010 - Symposium Guide					1	1
2010 IEEE 9th International Conference on Development and Learning, ICDL-2010 - Conference Program ,					1	1
2010 IEEE World Congress on Computational Intelligence					1	1
23rd Convention of the Society for the Study of Artificial Intelligence and Simulation of Behaviour				1	1	0.1
2nd International Conference on Software Engineering					1	1

and Data Mining					
3rd International Conference on Genetic and Evolutionary Computing,				1	1 0.1
3rd International Joint Conference on Computational Sciences and Optimization,				1	1 0.1
48th Annual Meeting of the Association for Computational Linguistics				1	1 0.1
5th Biennial Conference of the International Environmental Modelling and Software Society				1	1 0.1
ACM Symposium on Applied Computing			1		1 0.1
Acta Biotheoretica	1				1 0.1
Ad Hoc Networks		1			1 0.1
Advances in Virus Research			1		1 0.1
African Journal of AIDS Research		1			1 0.1
African Studies Quarterly				1	1 0.1
Agricultural Economics				1	1 0.1
AHS-AISH Publication		1			1 0.1
AI and Society				1	1 0.1
AISB 2008 Symposium on Agent Cognitive Ability and Orders of Emergence				1	1 0.1
Ambiente e Sociedade				1	1 0.1
American Ethnologist			1		1 0.1
Animal Behaviour				1	1 0.1
Animal Research		1			1 0.1
Annals of Operations Research				1	1 0.1
Annals of Regional Science		1			1 0.1
Annals of the Association of American Geographers 93	1				1 0.1
Annual Conference of the North American Fuzzy Information Processing Society		1			1 0.1
Annual Review of Sociology	1				1 0.1
Aquatic Sciences	1				1 0.1
Archives Europeennes de Sociologie				1	1 0.1
ASEE Annual Conference and Exposition, Conference Proceedings			1		1 0.1
Australian Economic Review		1			1 0.1
Baltic Journal of Management				1	1 0.1
Behavioral and Brain Sciences		1			1 0.1
Behavioural Processes		1			1 0.1
Beijing Jiaotong Daxue Xuebao/Journal of Beijing Jiaotong University				1	1 0.1
Biennial Conference of the International Environmental Modelling and Software Society				1	1 0.1
Bioinformatics				1	1 0.1
Biological Invasions				1	1 0.1
BioSystems		1			1 0.1
BMC Biology				1	1 0.1
British Journal of Criminology		1			1 0.1
Bulletin of Mathematical Biology			1		1 0.1
Campus-Wide Information Systems				1	1 0.1
Canadian Journal of Forest Research				1	1 0.1
Chaos				1	1 0.1
Cognitive Computation				1	1 0.1
Cognitive Science			1		1 0.1
Collection of Technical Papers - AIAA Space 2005 Conference and Exposition		1			1 0.1
Communications in Computer and Information Science				1	1 0.1
Comparative Politics				1	1 0.1
Complexus			1		1 0.1
Computer Physics Communications				1	1 0.1
Computer Systems Science and Engineering			1		1 0.1
Computers in Human Behavior		1			1 0.1
Computers in Industry				1	1 0.1

Concurrency Computation Practice and Experience	1	1	1	0.1
Conflict Management and Peace Science			1	0.1
Convention of the Society for the Study of AI and Simulation of Behaviour			1	0.1
Cortex	1		1	0.1
Criminal Law and Philosophy		1	1	0.1
Culture, Health and Sexuality			1	0.1
Decision and Simulation in Engineering and Management Science - International Conference	1		1	0.1
Design Studies		1	1	0.1
Development		1	1	0.1
Drug and Alcohol Review		1	1	0.1
Duke Law Journal	1		1	0.1
DYNA			1	0.1
Dyna			1	0.1
Emergence: Complexity and Organization			1	0.1
Environment and Planning A	1		1	0.1
Environment and Urbanization			1	0.1
Environmental Management			1	0.1
Epidemics		1	1	0.1
Euro Physics Letter		1	1	0.1
Espace Geographique			1	0.1
Espace-Populations-Societes	1		1	0.1
European Economic Review			1	0.1
European Journal of International Relations	1		1	0.1
European Journal of Political Economy		1	1	0.1
European Journal of Social Sciences			1	0.1
European Review of History			1	0.1
Evolution and Human Behavior			1	0.1
Evolutionary Computation		1	1	0.1
Forest Policy and Economics	1		1	0.1
Fundamenta Informaticae		1	1	0.1
Future Generation Computer Systems		1	1	0.1
GECCO'08: Proceedings of the 10th Annual Conference on Genetic and Evolutionary Computation		1	1	0.1
Geneva Papers on Risk and Insurance: Issues and Practice			1	0.1
Geoinformatica	1		1	0.1
Global Design to Gain a Competitive Edge: An Holistic and Collaborative Design Approach Based on Computational Tools		1	1	0.1
Global Networks	1		1	0.1
Health Policy			1	0.1
Human Biology		1	1	0.1
Human Organization	1		1	0.1
Human Relations	1		1	0.1
Human Systems Management			1	0.1
IAHS-AISH Publication	1		1	0.1
ICEIS 2006 - 8th International Conference on Enterprise Information Systems	1		1	0.1
ICML 2010 - Proceedings, 27th International Conference on Machine Learning			1	0.1
ICSOFT 2010 - Proceedings of the 5th International Conference on Software and Data Technologies			1	0.1
IEEE Computational Intelligence Magazine		1	1	0.1
IEEE Congress on Evolutionary Computation	1		1	0.1
IEEE Intelligent Systems		1	1	0.1
IEEE International Conference on e-Business Engineering			1	0.1
IEEE International Conference on Industrial Informatics		1	1	0.1
IEEE International Conference on Systems, Man and Cybernetics	1		1	0.1
IEEE International Engineering Management Conference	1		1	0.1
IEEE Transactions on Evolutionary Computation		1	1	0.1

IEEE Transactions on Systems, Man, and Cybernetics Part A:Systems and Humans	1			1	0.1	
IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics			1	1	0.1	
IEEE Workshop on Distributed Intelligent Systems		1		1	0.1	
IEEE/WIC/ACM International Conference on Intelligent Agent Technology			1	1	0.1	
IFAC Proceedings Volumes (IFAC-PapersOnline)			1	1	0.1	
Improving Water Quality and Environment 2008			1	1	0.1	
Industrial and Corporate Change	1			1	0.1	
Industrial Marketing Management			1	1	0.1	
Informatics in Education		1		1	0.1	
Innovations in Education and Teaching International			1	1	0.1	
Integrating Sciences and Information Technology for Environmental Assessment and Decision Making			1	1	0.1	
Interaction Studies		1		1	0.1	
Interciencia				1	1	0.1
International Conference on Advanced Computer Theory and Engineering				1	1	0.1
International Conference on Intelligent Agent Technology			1	1	0.1	
International conference on System Science and Simulation in Engineering				1	1	0.1
International Journal of Agricultural Resources, Governance and Ecology	1			1	0.1	
International Journal of Epidemiology				1	1	0.1
International Journal of Human Computer Studies			1	1	0.1	
International Journal of Intelligent Information and Database Systems				1	1	0.1
International Journal of Interdisciplinary Social Sciences				1	1	0.1
International Journal of Networking and Virtual Organisations			1	1	0.1	
International Journal of Services and Operations Management		1		1	0.1	
International Journal of Sustainable Development and Planning			1	1	0.1	
International Journal of Technology Intelligence and Planning				1	1	0.1
International Regional Science Review	1			1	0.1	
International Social Science Journal		1		1	0.1	
International Symposium on Computer, Communication, Control and Automation				1	1	0.1
International Workshop on Education Technology and Computer Science			1	1	0.1	
Journal for General Philosophy of Science		1		1	0.1	
Journal for the Scientific Study of Religion		1		1	0.1	
Journal for the Theory of Social Behaviour			1	1	0.1	
Journal of Advanced Computational Intelligence and Intelligent Informatics				1	1	0.1
Journal of Agricultural Economics		1		1	0.1	
Journal of Applied Logic	1			1	0.1	
Journal of Business Ethics	1			1	0.1	
Journal of Differential Equations				1	1	0.1
Journal of Electrical Engineering		1		1	0.1	
Journal of Experimental Psychology: General			1	1	0.1	
Journal of Grid Computing			1	1	0.1	
Journal of Information and Computational Science		1		1	0.1	
Journal of Information and Organizational Sciences			1	1	0.1	
Journal of Information Ethics			1	1	0.1	
Journal of Intelligent Manufacturing			1	1	0.1	
Journal of Intelligent Transportation Systems: Technology, Planning, and Operations	1			1	0.1	
Journal of Land Use Science			1	1	0.1	
Journal of Mathematical Biology			1	1	0.1	
Journal of Neurolinguistics	1			1	0.1	

Journal of Probability and Statistics			1	1	0.1
Journal of Product Innovation Management	1			1	0.1
Journal of Regional Science			1	1	0.1
Journal of Rehabilitation	1			1	0.1
Journal of Security Education	1			1	0.1
Journal of the American Society of Nephrology			1	1	0.1
Journal of the Operational Research Society			1	1	0.1
Journal of Universal Computer Science			1	1	0.1
Journal on Chain and Network Science		1		1	0.1
Judgment and Decision Making			1	1	0.1
KpbiMuKo 2010 CriMiCo - 2010 20th International Crimean Conference Microwave and Telecommunication			1	1	0.1
Land Economics		1		1	0.1
Language and Communication		1		1	0.1
Livestock Production Science	1			1	0.1
Local Environment	1			1	0.1
Mathematical Biosciences		1		1	0.1
Mathematical Methods of Operations Research			1	1	0.1
Mathematical Modelling and Numerical Analysis			1	1	0.1
Mathematics and Computers in Simulation	1			1	0.1
Microprocessors and Microsystems			1	1	0.1
Minds and Machines			1	1	0.1
Modelling and Simulation in Materials Science and Engineering	1			1	0.1
National Academy of Sciences of the United States of America			1	1	0.1
Natural Hazards and Earth System Science 9			1	1	0.1
New Media and Society		1		1	0.1
P. of the Royal Society A: Mathematical, Physical and Engineering Sciences			1	1	0.1
Perspectives on Politics		1		1	0.1
Philosophical Psychology	1			1	0.1
Photogrammetric Engineering and Remote Sensing			1	1	0.1
Presence: Teleoperators and Virtual Environments		1		1	0.1
Proc. - 6th Intl. Conference on Advanced Information Management and Service, IMS2010, with			1	1	0.1
Procedia - Social and Behavioral Sciences			1	1	0.1
Proceedings - 10th IEEE Joint Conference on E-Commerce Technology and the 5th Enterprise Computing			1	1	0.1
Proceedings - 2007 International Conference on Cyberworlds,		1		1	0.1
Proceedings - 2008 IEEE/WIC/ACM International Conference on Intelligent Agent Technology			1	1	0.1
Proceedings - 2008 IEEE/WIC/ACM International Conference on Web Intelligence			1	1	0.1
Proceedings - 23rd European Conference on Modelling and Simulation			1	1	0.1
Proceedings - 4th International Conference on Automated Solutions for Cross Media Content and Multi-Channel Distribution			1	1	0.1
Proceedings - 5th International Conference on Intelligent Systems Design and Applications 2005	1			1	0.1
Proceedings - BIBE 2005: 5th IEEE Symposium on Bioinformatics and Bioengineering 2005	1			1	0.1
Proceedings - IEEE International Conference on Mobile Data		1		1	0.1
Proceedings - International Computer Software and Applications Conference			1	1	0.1
Proceedings - International Conference on Advanced Information Networking and Applications,			1	1	0.1
Proceedings - SocialCom 2010: 2nd IEEE International Conference on Social Computing,			1	1	0.1
Proceedings of 2010 IEEE International Conference on			1	1	0.1

Intelligent Systems and Knowledge Proceedings of SPIE - The International Society for Optical Engineering	1			1	0.1
Proceedings of the 12th Annual Genetic and Evolutionary Computation Conference				1	0.1
Proceedings of the 2004 Congress on Evolutionary Computation		1		1	0.1
Proceedings of the 2007 IEEE Symposium on Artificial Life			1	1	0.1
Proceedings of the 2008 IEEE Systems and Information Engineering Design Symposium			1	1	0.1
Proceedings of the 2010 IEEE International Symposium on Parallel and Distributed Processing				1	0.1
Proceedings of the 42nd Annual Hawaii International Conference on System Sciences				1	0.1
Proceedings of the 9th Joint Conference on Information Sciences		1		1	0.1
Proceedings of the ASME International Design Engineering Technical Conferences				1	0.1
Proceedings of the British Academy				1	0.1
Proceedings of the European and Mediterranean Conference on Information Systems				1	0.1
Proceedings of the IASTED International Conference on Modelling, Simulation, and Optimization		1		1	0.1
Proceedings of the IEEE International Conference on Automation and Logistics			1	1	0.1
Proceedings of the IEEE/WIC/ACM International Conference on Web Intelligence			1	1	0.1
Proceedings of the International Conference on Information Management				1	0.1
Proceedings of the International Conference				1	0.1
Proceedings of the International Joint Conference on Neural Networks				1	0.1
Proceedings of the World Congress on Intelligent Control and Automation (WCICA)			1	1	0.1
Public Administration Review				1	0.1
Quantitative Finance				1	0.1
RAIRO - Operations Research				1	0.1
Revista de Economia Institucional				1	0.1
Revue d'Intelligence Artificielle				1	0.1
Robotics and Autonomous Systems	1			1	0.1
Sao Paulo em Perspectiva		1		1	0.1
SBGAMES2009 - 8th Brazilian Symposium on Games and Digital Entertainment				1	0.1
SEFM 2009 - 7th IEEE International Conference on Software Engineering and Formal Methods				1	0.1
Service Industries Journal				1	0.1
Service Oriented Computing and Applications				1	0.1
SIAM Journal on Control and Optimization				1	0.1
SIAM Review		1		1	0.1
Sixth IEEE International Symposium on Cluster Computing and the Grid Workshops			1	1	0.1
Social Science Information				1	0.1
Society and Natural Resources				1	0.1
Sociological Methods and Research				1	0.1
Soft Computing				1	0.1
Stochastic Environmental Research and Risk Assessment			1	1	0.1
Studies in Conflict and Terrorism			1	1	0.1
Systems Analysis Modelling Simulation		1		1	0.1
Systems Science			1	1	0.1
Theoretical Biology and Medical Modelling			1	1	0.1
Theory in Biosciences				1	0.1
Theory, Culture and Society		1		1	0.1
Transactions of the Japanese Society for Artificial Intelligence		1		1	0.1

Trends in Cognitive Sciences										1	0.1
Urban Studies									1	1	0.1
Water Science and Technology: Water Supply										1	0.1
WEBIST 2009 - Proceedings of the 5th International Conference on Web Information Systems and Technologies									1	1	0.1
World Academy of Science, Engineering and Technology 67										1	0.1
Zeitschrift für Planung und Unternehmenssteuerung										1	0.1
Tot citations	13	35	58	115	151	154	175	281	301	1283	100

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References

- DEFFUANT, G., Amblard, F., Weisbuch, G., Faure, T. (2002). How can extremism prevail? A study based on the relative agreement interaction model. *Journal of Artificial Societies and Social Simulation*, 5(4), <http://jasss.soc.surrey.ac.uk/5/4/1.html>.
- EPESTEIN, J. M. (2008). Why Model? *Journal of Artificial Societies and Social Simulation*, 11(4)12, <http://jasss.soc.surrey.ac.uk/11/4/12.html>.
- HEGSELMANN, R. and Krause, U. (2002). Opinion dynamics and bounded confidence: Models, analysis and simulation. *Journal of Artificial Societies and Social Simulation*, 5(3), <http://jasss.soc.surrey.ac.uk/5/3/2.html>.
- HUUTONIEMI, K., Klein, J. T., Bruun, H., and Hukkinen, J. (2010). Analyzing interdisciplinarity: Typology and indicators. *Research Policy*, 39(1), 79-88. [doi:10.1016/j.respol.2009.09.011]
- LEVITT, J. M., and Thelwall, M. (2008). Is multidisciplinary research more highly cited? A macrolevel study. *Journal of the American Society for Information Science and Technology*, 59(12), 1973-1984. [doi:10.1002/asi.20914]
- LEYDESDORFF, L. (2007). *Environment and Planning B: Planning and Design* as a journal: The interdisciplinarity of its environment and the citation impact. *Environment and Planning B*, 34(5), 826-838. [doi:10.1068/b3307t]
- LEYDESDORFF, L. (2008). Caveats for the use of citation indicators in research and journal evaluations. *Journal of the American Society for Information Science and Technology*, 59(2), 278-287. [doi:10.1002/asi.20743]
- MEYER, M., Lorscheid, I., and Troitzsch, K. G. (2009). The development of social simulation as reflected in the first ten years of JASSS: A citation and co-citation analysis. *Journal of Artificial Societies and Social Simulation*, 12(4) 12, <http://jasss.soc.surrey.ac.uk/12/4/12.html>.
- MEYER, M., Zaggl, M. A., and Carley, K. M. (2011). Measuring CMOT's intellectual structure and its development. *Computational and Mathematical Organization Theory*, 17(1), 1-34. [doi:10.1007/s10588-010-9076-0]
- RICHIARDI, M., Leombruni, R., Saam, N., Sonnessa, M. (2006). A common protocol for agent-based social simulation. *Journal of Artificial Societies and Social Simulation*, 9(1) 15, <http://jasss.soc.surrey.ac.uk/9/1/15.html>.
- RINIA, E. J., Van Leeuwen, T. N., Bruins, E. E. W., Van Vuren, H. G., and Van Raan, A. F. J. (2001). Citation delay in interdisciplinary knowledge exchange. *Scientometrics*, 51(1), 293-309. [doi:10.1023/A:1010589300829]
- SQUAZZONI, F. (2010). The impact of agent-based models in the social sciences after 15 years of incursions. *History of Economic Ideas*, 18(2), 197-233.