

# Rapid Changes of Serbian Scientific Journals: Their Quality, Visibility and Role in Science Locally and Globally

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**Abstract:** *More than 400 scientific journals are published in Serbia, and 357 are referred to in the Serbian Citation Index - national citation index. The visibility of Serbian scientific journals in the citation database Web of Science has risen significantly in the last decade. Results of this analysis show the presence of Serbian journals in Web of Science, JCR, Scopus and Serbian Citation Index (SCIndeks) during four years (2007 to 2010). The paper discusses different bibliometric parameters in Web of Science, JCR and the Scopus portal SCImago (citations, average citations/year, impact factor, Hirsch index) for Serbian journals. Bibliometric indicators that appear in the National Citation Index are also analyzed. The number of Serbian journals with impact factor has increased during the observed period. The impact of Serbian publishers rose remarkably in 2010, and Serbia has two highly ranked journals.*

**Keywords:** *Scientific journals, citation analysis, Web of Science, Scopus, national citation index, Serbia*

## Introduction

Journals are the main medium in scientific communication. Parameters that characterize those journals can be used for analyzing the scientific disciplines, both in separate regions and globally. It is also possible to follow the development of the scientific community itself, since the appearance of journals show that the scientific community in a particular country has reached the level at which communication through journals is needed. Journals serve as a medium for dissemination of information and as a social institution showing the scientific contribution of particular institutions and authors. The number of journals is constantly rising, but it is known that for each discipline a small number of journals publish the most relevant results with high impact on its development. Bibliometric indicators are widely used for evaluation of journals and their impact on a local and global scale. In this paper, the most influential Serbian journals, according to citations to papers they have published, are analyzed.

## Literature Review

The state of science for a particular country can be evaluated through the presence of national journals in various citation index databases. The highly ranked and very precise citation index database Web of Science produced by Thomson Reuters is recognized worldwide. The majority of the bibliometric parameters in Web of Science are very indicative and well defined. Web of Science consists of the following cited reference indexes: Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), Conference Proceedings Citation Index- Science (CPCI-S) and Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH) (Web of Science, 2012). There are many different citation indexes, international and national. Still, it is not usual that a developing country, such as Serbia, has its own national citation index, but thanks to the efforts of the Centre for Evaluation in Education and Science (CEON/CEES), the Serbian Citation Index has existed in this form for more than six years (Kosanović & Šipka, 1996; Šipka, 2001; Šipka, 2006; Šipka & Kosanović, 2008). The Centre for Evaluation in Education and Science (CEON/CEES) is an independent, non-governmental organization which collaborates with many researchers and academic staff in Serbia and abroad. The

Centre has many activities and goals but the most important one is precise analysis of facts concerning science and higher education in Serbia (CEON/CEES, 2012). One of its products, the Serbian national citation index (SCIndeks), covers scientific journals from Serbia which are continuously monitored and bibliometrically evaluated by the Centre (SCIndeks, 2012).

Numerous international and Serbian papers describe scientific tendencies in Serbia during the recent decades, mostly concerning the problems of scientific journal publishing, their visibility in the scholarly community, and ranking according to strictly defined rules and parameters. Many authors from Serbia have analyzed results of citations in national and international journals. In addition, authors from the Department for Scientific Information of the University Library in Belgrade have also explored, using different methods, citations and bibliometric indicators, and the presence of Serbian journals in WoS and SCIndeks (Filipi-Matutinovic & Kosanovic, 2007; Filipi-Matutinovic et al., 2009; Popović & Antonić, 2011).

Many scientists from Serbia and abroad have researched the status of science in Serbia during different periods (mostly the last decade or two) (Igić, 2002; Lewison & Igić, 1999). Particularly interesting are data which describe historical aspects of science development in Serbia from the 1980s until the beginning of the 21st century, and the position of Serbian science and other countries in the region (Sambunjak et al., 2008). Those data clearly reflect the turbulent historical conditions in Serbia – economic and social crisis, UN sanctions, civil war in Yugoslavia, and the highest hyperinflation in world history.

Bibliometric practice includes analysis of periodical production on the national level based on different aspects and methods (Maričić, Sorokin, & Papeš, 2000; Andreis & Jokić, 2008; Moed et al., 2011; Mishra, Panda, & Goswami, 2010). Results and conclusions are very heterogeneous being based on varying parameters and periods of time.

It is common practice to compare citation analysis of leading national journals in different international and national bibliographic data sources (Thomson Reuters, Scopus and National Citation Index, etc.) or for specific scientific disciplines (Zibareva & Soloshenko, 2011; Markusova, 2008; Hennemann, Wang, & Liefner, 2011; Sember, Utrobčić, & Petrak, 2010). Those results might be very valuable for promoting procedures of modern evaluation methods in science, further advancement of academic publishing, planning and future goals.

## Methodology

The paper presents the results from the Web of Science, Scopus and the Serbian Citation Index during the period 2007- 2010. We have analyzed 18 journals referred to in WoS with and without impact factor and we have compared them with the same corpus of journals in SCIndeks. The only exception is *International Journal of Electrochemical Science*: being an international journal, it is not referred to in SCIndeks. In WoS we used the following search criteria: publication name, publication years and the option “create citation report”. Results for Scopus are from its portal SCImago, covering 39 journals from Serbia. On the portal SCImago Journal & Country Rank for bibliometric analysis, we specified the indicator “country search”, choosing “Serbia”. Finally, in SCIndeks we searched citation results from the Journal Bibliometric Report.

For the period 2007-2010 we have examined the ten most cited papers in WoS (author’s country affiliation – Serbia) and h-index for each journal.

The repository doiSerbia (2011) was used for general information about the journals.

## Results and Discussion

The impact of Serbian journals on a local and global scale can be estimated from the results obtained from all available citation databases: Web of Science, Scopus and Serbian Citation Index. Since the bibliometric report for Serbian journals in the Serbian Citation Index is available until 2010, and since the number of journals from Serbia included in WoS and Scopus rose significantly in 2007, we compared the number of articles and citations in those databases from 2007 to 2010. Articles included in Scopus and Web of Science can be considered more visible on a global scale. The number of citations that they receive from other articles included in those databases shows is the visibility of Serbian scientific output. It is important to mention that Scopus has much broader coverage of regionally important journals than does Web of Science, since Web of Science is much more selective.

### *Journals in JCR*

In Journal Citation Reports there are data about 18 Serbian journals with calculated Impact Factor (IF). Those journals are analyzed in more detail, since they represent the main visible results communicating Serbian science to

the world. One of those journals is the oldest medical journal from Serbia, published continuously since 1872. The distribution of the starting years and their inclusion in JCR is shown in Table 1.

Table 1. Journals: Date first published and inclusion in JCR

Journals	Year	in JCR
Acta Veterinaria – Beograd	1951	1978
MATCH Communications in Mathematical and in Computer Chemistry	1975	1998
Journal of the Serbian Chemical Society	1946	2000
Science of Sintering	1974	2005
Archives of Biological Sciences	1993	2009
Hemijska industrija	1947	2009
International Journal of Electrochemical Science	2006	2009
Journal of Mining and Metallurgy, Section B: Metallurgy	1997	2009
Psihologija	1968	2009
Thermal Science	1997	2009
Applicable Analysis and Discrete Mathematics	1956	2010
Chemical Industry and Chemical Engineering Quarterly	2005	2010
Computer Science and Information Systems	2004	2010
Filomat	1994	2010
Nuclear Technology Radiation Protection	2002	2010
Panoeconomicus	2006	2010
Srpski arhiv za celokupno lekarstvo	1872	2010
Vojnosanitetski pregled	1930	2010

Fourteen journals were included in Web of Science in 2007 and 2008, and got their IF in 2009 and 2010. Six journals are published by faculties, 3 by scientific institutes, 8 by professional associations and one by a commercial publisher. Seventeen journals are open access. Five journals appeared in the last decade, with the intention of being included in the Web of Science. All five are published in English as the most widely used language of scientific communication. The journal *Applicable Analysis and Discrete Mathematics* has changed its title (the former title was *Publications of the Electrical Engineering, Series Mathematics*) and set higher standards for accepting articles. *Srpski arhiv za celokupno lekarstvo* is still published in Serbian but has extended abstracts in English, and explanations of tables and figures are bilingual (Serbian and English).

### Journals by Subject

The journals under investigation are classified in five different disciplines. The majority are listed as Technology, Metallurgy and Chemical Engineering (8); four are Life Sciences and Medicine, three are Mathematics, two are Social Sciences and one deals with Computer Science.

Table 2. Journals by subject and by authors' country addresses  
(Ten most cited papers in each journal)

Subject	No	A (%)	B (%)	C (%)
Life Sciences and Medicine	4	15	8	77
Mathematics	3	73	10	17
Computer Science	1	36	10	55
Technology, Metallurgy and Chemical Engineering	8	49	4	47
Social Sciences	2	45	5	50
Total	18	44	7	49

A= Foreign authors

B= Foreign + Serbian authors

C= Serbian authors

The ten papers most cited in WoS (from 2007 to 2010) for each journal in a particular area were identified. The percentage columns show the participation of papers by foreign authors, papers with foreign and Serbian co-authors and papers by Serbian authors. The largest per cent of foreign authors can be noted in the field of mathematics. The largest per cent of Serbian authors publish in the area of Life Sciences and Medicine. The total per cent of foreign and Serbian authors in those journals shows almost equal distribution of highly cited items between them.

### Journal Citations

The results for citations distribution in WoS, SCIndeks and Scopus are given in Table 3.

Table 3. Citation distribution of Serbian journals listed in WoS, SCIndeks and Scopus

Year	Articles in WoS			Articles in SCIndeks			Articles in Scopus		
	Articles in journals	Citations WoS	Average cit/article	Articles in journals	Citations SCIndeks	Average cit/item	Articles in journals	Citations Scopus	Average cit/article
2007	728	92	<b>0.126</b>	1010	1013	<b>1.003</b>	1594	4744	<b>2.976</b>
2008	1169	609	<b>0.521</b>	986	1231	<b>1.248</b>	3479	11320	<b>3.254</b>
2009	1334	1731	<b>1.298</b>	1090	1094	<b>1.004</b>	4236	8655	<b>2.043</b>
2010	1463	3090	<b>2.112</b>	1238	1381	<b>1.115</b>	4843	3582	<b>0.740</b>
Total	4694	5522	<b>1.176</b>	4324	4719	<b>1.091</b>	14152	28301	<b>2</b>

It can be seen from Table 3 that the number of citations for the journals chosen by Thomson Reuters to be included in Web of Science database is growing fast. The situation with the same corpus of journals in the national citation index is different – the number of citations does not change much during the four years (no data for *International Journal of Electrochemical Society*). The Scopus database with the whole sample of 39 journals from Serbia gives very inconsistent results (it appears that the results for 2010 are not yet fully available).

Table 4. Journals by subject and their citation count in WoS and SCIndeks 2007-2010

Subject	Journal	Citations WoS	Average cit/year	Citations SCIndeks	Average cit/year
Life Sciences and Biomedicine	Acta Veterinaria	59	<b>14.75</b>	246	<b>61.5</b>
	Archives of Biological Sciences	168	<b>42</b>	373	<b>93.25</b>
	Srpski arhiv za celokupno lekarstvo	70	<b>17.5</b>	464	<b>116</b>
	Vojnosanitetski pregled	94	<b>23.5</b>	324	<b>81</b>
Mathematics	MATCH Communications in Mathematical and in Computer Chemistry	2161	<b>540.25</b>	1548	<b>387</b>
	Filomat	14	<b>3.5</b>	52	<b>13</b>
	Applicable Analysis and Discrete Mathematics	116	<b>29</b>	85	<b>21.25</b>
Computer Science	Computer Science and Information Systems	13	<b>3.25</b>	27	<b>6.75</b>
	Journal of the Serbian Chemical Society	672	<b>168</b>	719	<b>179.75</b>
Technology, Metallurgy and Chemical Engineering	Thermal Science	189	<b>47.25</b>	130	<b>32.5</b>
	Chemical Industry and Chemical Engineering Quarterly	70	<b>17.5</b>	39	<b>9.75</b>
	Science of Sintering	84	<b>21</b>	109	<b>27.25</b>
	Hemijska industrija	44	<b>11</b>	135	<b>33.75</b>
	Journal of Mining and Metallurgy Section B Metallurgy	76	<b>19</b>	82	<b>20.5</b>
	Nuclear Technology Radiation Protection	42	<b>10.5</b>	83	<b>20.75</b>
	International Journal of Electrochemical Science	1624	<b>406</b>	/	/
	Social Sciences	Psihologija	17	<b>4.25</b>	257
	Panoeconomicus	9	<b>2.25</b>	46	<b>11.5</b>

In Life Sciences and Biomedicine the average number of citations received per article in the national citation index is much greater than in Web of Science. In Mathematics the situation is completely opposite, showing that the results published in those journals are used more abroad than in Serbia. In the subject field Technology, Metallurgy and Chemical Engineering the average number of citations received in the local citation database and in Web of Science are nearly equal. In Social Sciences many more citations are received in the national citation index than in WoS.

### Hirsch Index and Journal Ranking in JCR

Table 5 shows the Hirsch index for all 18 journals with impact factor from 2007 to 2010. The lowest h-index value is 3, and the highest h-index value is 25. The journal with the highest h-index, *MATCH Communications in Mathematical and in Computer Chemistry*, is first in the JCR category of Mathematics, Interdisciplinary

Applications. The journal with h-index value 22 (*International Journal of Electrochemical Science*) is ranked in the 2<sup>nd</sup> quarter in the category of Electrochemistry, after only two years in JCR. The largest number of journals (9) belong to the 4<sup>th</sup> quarter (Figure 1).

Table 5. Hirsch index 2007 - 2010

Journal	h-index
MATCH Communications in Mathematical and in Computer Chemistry	25
International Journal of Electrochemical Science	22
Journal of the Serbian Chemical Society	11
Thermal Science	8
Applicable Analysis and Discrete Mathematics	7
Journal of Mining and Metallurgy, Section B: Metallurgy	6
Chemical Industry and Chemical Engineering Quarterly	6
Nuclear Technology Radiation Protection	6
Acta Veterinaria – Beograd	5
Archives of Biological Sciences	5
Science of Sintering	4
Computer Science and Information Systems	4
Srpski arhiv za celokupno lekarstvo	4
Vojnosanitetski preglad	4
Hemijska industrija	3
Filomat	3
Psihologija	3
Panoeconomicus	3

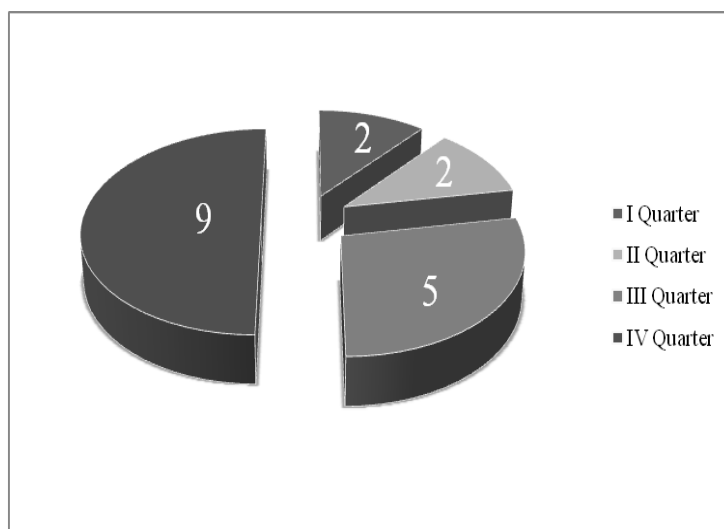


Figure 1. Journals by JCR subject ranking

Since Serbian journals have had IF for a relatively short time, a rise of h-index and rank in the JCR categories can be expected in the years to come.

### *Journals by Regional Countries*

Table 6 shows the number of journals in JCR for the period 2007-2010 for the countries in the region that are geographically and demographically similar to Serbia. Serbia has more journals than Bulgaria and Greece, but considerably fewer than Croatia and Hungary. All five countries had significant growth in the number of journals included in 2009 and 2010. The number of regional journals in the JCR in 2010, compared to 2007, rose by approximately 70% (Bulgaria 70%, Greece 75%, Serbia 78%, and Croatia 73%). The number of Hungarian journals increased slightly less, 57%. The fact is that the editors of Web of Science decided to increase the number of journals

in the database from those in the region fulfilling WoS criteria (accuracy of publication, original articles, age of cited references, citations, etc.).

Table 6. Journal numbers in JCR

Country	2007	2008	2009	2010
Bulgaria	3	3	8	10
Greece	4	7	10	16
Serbia	4	4	10	18
Hungary	16	15	24	37
Croatia	13	14	36	48

## Conclusion

During the last decade Serbian scientific journals have shown continuous improvement according to bibliometric indicators. First, the total number of journals with Impact Factor jumped from four in 2007 to 10 in 2009 and 18 in 2010. Presently, four of them are ranked very high (two in the 1<sup>st</sup> quarter of the JCR category ranking, two in the 2<sup>nd</sup> quarter, and five in the 3<sup>rd</sup> quarter), and we expect that this ranking will soon be even higher. At the same time, the number of citations also shows an increase, but the difference between various subject disciplines is noticeable: in the subject of Mathematics the number of citations is greater on the international level than on the national. The possible conclusion can be that the thisgroup of journals in the area of Mathematics is more globally oriented and interconnected with the world scientific community. The opposite result is visible in the subject of Life Sciences and Biomedicine: higher numbers of citations in national journals. One of the main reasons is the journal language (*Srpski arhiv za celokupno lekarstvo* and *Vojnosanitetski pregled* are published in Serbian). Generally, journals in the native language are more noticeable in the national citation index SCIndeks (e.g. *Hemijska industrija* and *Psihologija*).

Some of these journals have a long tradition of publishing, but there are also several new journals. All of them have had to adjust to international criteria. At the same time, the new policy of Web of Science is to include important regional journals (published in English or some native language). Finally, these results are consequences of the stricter legislation in the process of evaluation of national scientific output by the Ministry of Education and Science of the Republic of Serbia in the new millennium and the use of bibliometric criteria in evaluation. Even though bibliometric criteria are not ideal for evaluation of individual scientists (Van Raan, 2005), this pressure on scientists contributes to the visibility and impact of Serbian journals and Serbian science in general.

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