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Selection of Periodicals to Support Nanotechnology Research

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Abstract—A comprehensive method for the selection of international scientific periodicals necessary for high-quality research in specific life sciences and technology problems is presented. This method is based on the analysis of citations considering both the citedeness of selected editions in specialized journals and their citing to specialized journals. A list of international journals and other periodicals that are vital for high-quality nanotechnology research was obtained. Based on this list, the development of a documentary constituent of the scientific information environment using a research library to support nanotechnology research is expected. A final list consisting of 572 items was compiled based on the application of "threshold" values and the aggregation and exclusion of data.

Keywords: scientific journals, scientific periodicals, citation analysis, citatedness, citation, value, "influence factor of discipline," bibliometrics, selection, evaluation, technology

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INTRODUCTION

In a similar manner to our previous studies [1, 2], this paper is part of the ongoing research aimed at creating an appropriate pillar of the scientific information environment (hereinafter, "environment") to provide access to publications issued in global scientific journals as well as in other periodicals and continuing editions, which are vital for high-quality research in priority scientific and technological areas of the Republic of Belarus in the period between 2016 and 2020[1]. The typological orientation of the documentary constituent of the environment created based on periodicals was substantiated in [2, p. 29].

Such an environment must be both quite compact and sufficiently complete. Typically, when it is necessary to reach a balance of completeness and compactness, one refers to the need to select serial editions from the first two "zones of scattering" according to Bradford. However, the "Bradford law" involves the evaluation of publications in terms of their productivity [3][2], whereas we consider it appropriate to evaluate publications in view of their *value* [2, p. 29], where the latter is treated as an information property defined by the practical use of information in various areas of human activities aimed at achieving a specific goal[3]. Until recently, the idea that citation is a reliable indicator for the use of scientific documents and their collections, particularly periodicals [6, p. 342; 7, p. 133; 8, p. 2] has rarely been questioned[4]. Therefore, we used the citation index method for the selection and

[1] On priority scientific and technological areas in the Republic of Belarus for the period 2016–2020. Presidential Decree no. 166, Belarus, 22 April 2015.—URL: http://www.scienceportal.org.by/upload/2015/April/SandT.pdf. (access: October 10, 2017).

[2] Note that the productivity assessment of periodicals has been implemented in recent years in view of their coverage by various databases. To achieve our final goal, it is necessary to select databases with the best coverage of the relevant periodicals that satisfy the requirements of both "more serial editions" and "affordability." Such a problem statement makes it pointless to assess the productivity of periodicals.

[3] The definition is based on a dictionary interpretation [4, p. 464], where the concept of usability is replaced by the concept of *direct* use. This replacement is due to the fact that, as noted in [5, p. 167], any a priori judgment on the value of given information is doubtful even if the most renowned scientists are engaged as experts.

[4] The alternative opinions on the assessed use were critically reviewed in [2, pp. 29–30]. Several authors believe that citatedness reflects the quality of cited material rather than its value, or they do not distinguish between quality and value (e.g., [8, pp. 2–3; 9, pp. 109–110]). This viewpoint was critically reviewed by one of the coauthors in [10, pp. 3–6].

evaluation of periodicals to support nanotechnology research.

THE RESEARCH CONTEXT: A BRIEF OVERVIEW OF BIBLOMETRIC STUDIES ON NANOTECHNOLOGY

The growing interest in nanotechnology as a scientific discipline among experts in bibliometrics and scientific data is driven by the current trend of miniaturization, possible applications of nanomaterials and nanotechnology interdisciplinarity. R.A. Andrievskii provides another reason: "The problems of nanotechnology revealed multiple gaps in both fundamental and technological knowledge, which [...] helped focus the attention [...] on solving the arising problems" [11, p. 6].

T. Braun et al. examined the growth of journal publications containing the "nano" prefix in their titles [12], which was the first bibliometric publication focusing on nanotechnology papers. Later, M. Meyer and O. Persson [13] explored the disciplinary, geographic, institutional and coauthorship structure of such works and tried to compare the related patterns in publication and patenting.

The above-mentioned study of R.A. Andrievskii provided data from various foreign studies on the exponential growth of journal publications on nanotechnology [11, p. 6], the growing number of specialized journals issued worldwide and their "impact factor" [ibid, p. 7], as well as the expanding number of monographs, collections, and patents issued [ibid, pp. 7–9]. A. Yu. Kuznetsova and I.K. Razumova identified 3016 journals worldwide that published papers on the topic of "nanosystems and materials industry" and analyzed the distribution of these journals by publishers [14, p. 25], as well as their accessibility to Russian scientists [14, p. 26]. The authors also analyzed the structure of Russian and foreign publications on the related topic [15, p. 31–36] and determined a strong correlation "between the reading of scientific literature and the publication of scientific works" [ibid, p. 34]. A.I. Terekhov explored the "comparative dynamic grant support for research in the field of nanomaterials, particularly the key "building blocks "of nanotechnology such as nanoparticles, fullerenes, nanotubes, quantum dots, and dendrimers" [16].

In his work published in 2004 [17], J. Schummer provided data on the growing number of publications in the 1995–2003 period that contained the "nano" prefix in their titles, which was collected from 11 bibliographic databases [17, pp. 428–429]. This study also included data illustrating the distribution of publications containing the "nano" prefix in their titles across eight journals with the "nano" prefix in their titles (based on data from the Science Citation Index of 2002) [17, pp. 432–434]. Furthermore, J. Schummer evaluated the degree of interdisciplinarity in "nanoscience and nanotechnology" by analyzing coauthorship patterns and also by assessing interregional and interinstitutional cooperation based on the analysis of the coauthorship of publications in the related journals.

The distribution of publications on fullerenes across 587 periodicals, reflected in six foreign polytematic databases was analyzed in [18]. This study listed the 28 most productive journals; in total, 316 periodicals were recommended; however, their full list was not presented.

The thematic structure of publications in the pilot issue of the information compendium "Industry of Nanosystems and Materials" published by VINITI RAS was analyzed in [19].

Another study [20] provided the list of the 20 most-productive bionanotechnology journals compiled from the Science Citation Index database by using the keywords NANO and BIO. It also referred to changes in the list and analyzed the distribution of publications by various subject categories. Finally, this study explored the geographical structure of research studies and the language structure of publications. In [21], the studied field of knowledge was nanobiotechnology. It explored the productivity of various journals, countries, and institutions in the identified field and presented a mapping for citations of nanotechnologies studies, which singled out nanobiotechnology studies.

The journals in the field of "nanostructure and nanotechnology" were studied in terms of both their productivity evaluated with the use of bibliographic sources and their citedness in the source journal *Nano- and Microsystem Technology* [22, pp. 21–22]. This study provided the list of the 43 most-productive Russian periodicals, including non-core publications and polythematic journals (e.g. *The Herald of the Russian Academy of Sciences*).

D. Lucio-Arias and L. Leydesdorff [23] investigated the documents whose titles referred to "fullerenes" and "nanotubes," reflected in the Science Citation Index database and the database of the US Patent and Trademark Office in the period from 1987 to 2005. The authors showed, among other issues, the growing number of documents that contained such words in their titles and provided data on the distribution of publications by journals, on journals that cite and are cited by specialized journals [ibid, pp. 611–614]; and on the dynamic number of patent applications filed with the US Patent and Trademark Office [ibid, pp. 621–625].

Nine of the most productive journals in terms of publishing nanostructures, nanomaterials, and nanotechnology studies authored by researchers from the Siberian Branch of the Russian Academy of Sciences were identified in [24]. The latter study also provided data on the most-productive authors and institutions, as well as the structure of cooperation and the specific structure of documents created by this cohort of authors, etc.

A.I. Terekhov [25] presented an extensive bibliometric data on the development of nanotechnology in Russia, including the age distribution of participants in "nanoprojects" by year. Unfortunately, this study did not provide any data on scientific journals.

The contributions of India and China to the development of nanotechnologies were studied in [26] by assessing the publication activities of these countries, various citation indexes of relevant publications, the representation of Chinese and Indian studies in top specialized journals, the thematic structure of publications, the publication activities of scientific institutions and the structure of their collaborations, and data on the patenting and creation of commercial products based on nanotechnology.

The structure of the papers presented at a nanotechnologies forum and the institutional affiliation of speakers were studied in [27]. The thematic distribution of studies in the field of graphene physics, including the share and specific foci of the related Russian-language studies, were analyzed in [28]. Another paper published by the same authors [29] explored the geographic structure of publications on nanoenergetics (in accordance with their coverage in *Physics of Nano-objects and Nanotechnology* published by VINITI) and the contribution of Russian science to the related flow of publications was assessed. L. Leydesdorff [30] used a new bibliometric citation indicator (*Integrated Impact Indicator* or I3) for 20 specialized "nano-sciences and nanotechnologies" journals in his methodological (rather than applied, as in other cases) paper. He subsequently evaluated the productivity and citatedness of these journals and further explored the distribution of data on publications in these journals and their citations by country and institution.

Although the study of E.A. Ovchenkova ("Nanotechnology Journals in the System of Russian Periodicals") had a promising title [31], it was primarily focused on the basic external characteristics of 27 Russian journals published in 1982–2011, rather than on their bibliometric parameters. The studied characteristics, including the first publication year of a periodical, the editing organization, the subject matter, and the periodicity, were identified based on the analysis of the websites operated by the largest Russian libraries and the Russian Federal Agency for Press and Mass Communications.

Another study compared Australian publications on nanotechnology with publications from the "rest of the world" in the period between 1988 and 2012 [32]. In this context, the comparison of such publications by their thematic structure (i.e., by the subject categories of the Web of Science), as well as the selection of the top Australian institutions, is of the greatest interest.

As in [24], in [33] the results of the bibliometric study on "nano-sciences" and nanotechnology works published by researchers from the Siberian Branch of the Russian Academy of Sciences in the period between 2007 and 2012 were presented. The authors explored the dynamics of publication activity and the productivity of institutions, identified the 12 most productive journals, revealed the thematic structure of publications using various classification schemes, and listed the most-cited papers. This work was based on four international databases and one national one (RINC).

Another work of N.M. Builova et al. [34] presented the specific and geographical structure of documents describing "primarily, nanostructured or nano-sized" solar cells [34, p. 33]. It also included the analysis of the distribution of data by thematic attribute.

One example of an in-depth study is the work of Yu.V. Mohnacheva et al. [35]. Based on the Web of Science database, the authors analyzed the share of publications by researchers from the Moscow region in the total array of Russian nanotechnology publications. The authors also reviewed the share and growing number of joint publications coauthored with scientists "from 59 countries, revealing the closest collaboration patterns with scientists from Germany (25% of the total number of publications coauthored with scientists from foreign institutions), the United States (23%), France (15%), the United Kingdom (11%) and Japan (9%)" [ibid, p. 58]. This study also explored the citation of nanotechnology publications by the Moscow-region scientists compared to the citation of Russian publications in this field [ibid, pp. 58–60]. The specific structure of publications was also studied [ibid, p. 60], including "the major funds that support scientific research in the field of nanotechnology pursued by scientists from the Moscow region in the period between 2005 and 2014" [ibid, p. 61]. Finally, the thematic structure of patents obtained by the scientists of the Moscow region in the period from 2004 to 2013 (397 patents in total) was analyzed [ibid, pp. 62–67].

In [36], it was argued, based on a comparative analysis of the growing number of related publications in different countries, that nanotechnology is one of the fastest growing research areas in the world. The place of Russia in the global documentary flow on nanotechnology was shown and the data on international collaborations pursued by Russian scientists was provided.

Finally, the authors of [37] argued that "nanoinformatics" exists as an independent discipline that "integrates methods and tools for the distribution of data on nanomaterials, as well as instruments and technologies enabled by them" [ibid, p. 1]. This point of view is not new, as this study basically summarized the trends that could be observed since 2010.

As follows from the above, there are various bibliometric (scientometric) and scientific information approaches to the study of nanotechnology that attempt to formalize the assessment of this phenomenon and its components "from the outside." At the same time, considerable attention is paid to the evaluation of scientific periodicals and serial editions [11, 14, 17, 18, 20, 22–24, 26, 30, 31, 33]; however, global periodicals were substantially covered only in [14] and to some extent in [18]. Serial editions were explored in [14] from the perspective of their productivity. However, the evaluation of global serial editions by their citedness in the related field of science was beyond the scope of this particular work as well as of other studies.

MATERIALS AND METHODOLOGY

The selection of periodicals for the support of nanotechnology research as a sub-area of the priority scientific and technological area "Bio- and nanoindustry"[5] in the Republic of Belarus was based on the "citation-analysis" method, which included the method of G. Hirst as one of the most important components [38]). This method was described in detail in [2]. Due to the publication of more recent data in Journal Citation Reports ® (JCR) (compared to those used in [2]), the "citation window" equal to 1 year refers to 2016, whereas the "publication window" equal to "5 + 1" years refers to 2011–2015, as well as to 2016, the year during which the citations were analyzed. (It is necessary to recall that the cumulative number of citations to all citable items of a periodical in question within the "publication window" reflects the value of the cited publication for the theme presented by citing journals *in general*, and the value of the "discipline impact factor" calculated according to G. Hirst [38] [6] reflects the value of an *average article* from the periodical for the topic represented by citing journals).

The following ***specialized journals*** were selected as the ***sources of bibliographic citations***: *Nature Nanotechnology* (ISSN: 1748-3387; Nature Publishing Group; England; impact factor of 38.986), *Nano Letters* (Issn: 1530-6984; Amer Chemical Soc; United States; impact factor of 12.712), *Nano Today* (Issn: 1748-0132; Elsevier Sci Ltd; England; impact factor of 17.476) and *Nano Research* (ISSN: 1998-0124; Tsinghua Univ Press; Peoples Republic of China; impact factor of 7.354)[7]. The selection accounted for the description of the journal topics first in the Ulrichsweb™ database and then on the journal websites or webpages; the actual content of the latest available issues was checked.

The ***thresholds*** for the inclusion of cited information sources in the list of selected sources were established as follows: first, the titles of journals and other information sources included in the Citing Journal Data list were subject to selection, which were cited in each of the four mentioned source journals at least eight times considering the citations obtained during the entire period of publication (pre-selection). Thus, 80.80, 94.45, 85.72, and 90.98% of references accounted for *Nature Nanotechnology, Nano Letters, Nano Today,* and *Nano Research,* respectively. For these pre-selected titles, the references in four source journals were summarized for publications of the **"publication window" period**, and the titles of the cited periodicals, whose 2011–2016 publications were cited eight or more times in total in four journals were added to the final list. Thus, 41 130 references to 2011–2016 publications of the total of 45 491 references (90.22%) to the publications of this window were under consideration.

The values of the "discipline impact factor" were calculated for all pre-selected journals (at least eight references in any source journal, considering the references obtained for the entire period of publication). As in [1, 2], the threshold value of the "discipline impact factor" was established after the lists of periodicals had been obtained based on the results of cumulative citation, which was performed to ensure maximum convergence in the volume of lists obtained using different approaches.

The cited periodicals were ranked both by the total number of citations and by the quotient for the number of references divided by the number of works (articles and reviews) published in the cited edition.

Several quoted sources included in JCR's Citing Journal Data were not included in the Journal Citation Reports "master list" and in some cases referred to non-continuing books and other non-serial sources. We encountered such sources in our previous studies [1, 2]. As previously [39, pp. 140–143], not only did we eliminate the quoted sources of information that could not be identified, but, also, those that were not serials or were not considered useful for creating the planned environment, but we also combined data on the same sources cited under various titles. We also tried to analyze the problems that arose in the process of identification[8]. Sometimes, unexpected questions arose with regard to the interpretation of the obtained data. Next, we analyze several examples of excluded and pooled sources.

[5] See foot note 1.

[6] Not to be confused with the "impact factor" or "journal impact factor".

[7] Hereinafter, the spelling of the titles of journals, publishers, and countries corresponds to that adopted by JCR.

[8] In the publications dedicated to the identification errors of the Web of Science, van Raan [40, pp. 136–138] considered the latter at the level of individual publications, rather than at the level of periodic or continuing editions. In the analysis of various errors that lead to the limited use of the Web of Science and Scopus data on the related references performed by F. Franceschini et al. [41], the errors in the source title were only briefly mentioned as one of possible errors and no separate examples were given to analyze such errors. Finally, D.V. Sokolov [42, p. 135] stated that "technical errors associated with the difference in the title of journals, organizations or publishers and their English-language transcriptions are quite frequent, which may lead to the distortion of the final statistics," however, without any examples.

Below are several examples of **sources excluded** from consideration.

1. *Scientific journal* J Mater Chem (*Journal of Materials Chemistry*, ISSN: 0959-9428, Royal Soc. Chemistry, England, 40 references in specialized citing journals) was published until 2012, when it was replaced by three journals (*Journal of Materials Chemistry*, A, B and C series). At first glance, it may seem that these references to the source journal should be attributed to its successors. However, the "transfer" of the references received by a non-existent journal to the "account" of the *three* successor journals no longer seems to be the correct solution (in what proportion should these references be divided? Is it appropriate to "mechanically" assign one-third of references to each journal?); thus, the *Journal of Materials Chemistry* was simply excluded from consideration and its successors were regarded as independent periodicals.

2. *Unidentified scientific journal* J Phys Rev Lett (eight references). This appears to be an error; it was meant to refer to *Physical Reviews Letters*[9], as the search for the cited abbreviation and its possible transcripts by JCR, in the Ulrichsweb™ database and via Google was not successful. Although there are no other possible explanations, there is no guarantee that our idea is correct. The journal was quoted under this name only in *Nano Letters*. If our guess is correct, the loss of these eight references is minor given that Physical Reviews Letters was quoted 1062 times.

3. *A priori unnecessary and unidentifiable non-serial sources.* Such a formulation is not a paradox or a mistake: this block includes the citation objects such as PREPRINT (23 references) and THESIS (11 references), that is, separate preprints and dissertations, which however cannot be identified based on these records[10]. On the one hand, they cannot be identified, and on the other, they are not needed for the planned information environment since they do not represent an enlargeable coherent set of data.

The *Nature Nanotechnology* journal, which is our top source with the highest impact factor, is given as an example of **combined data** on the same information sources, whose abbreviated titles were presented differently in the JCR citation data. Despite its status, this journal was reflected both in its JCR abbreviation Nat Nanotechnol (1758 references to such an abbreviation within the publication window) and as Nat Nano (6 more references)!

Below is an example of a time-consuming abbreviation expansion.

The abbreviated source P Soc Photo-Opt Inst obtained 25 references in four journal sources. This abbreviation belongs to a periodical recorded in JCR under the title of *Proceedings of the Society of Photo-Optical Instrumentation Engineers* (ISSN: 0361-0748; Soc Photo-Optical Instrumentation Engineers; United States), and once in 1997 indexed in it. We entered ISSN in the JCR in the Ulrichsweb™ database and retrieved the edition called SPIE – International Society for Optical Engineering. Proceedings, which ISSN looks differently: 0277-786X. "Proceedings of SPIE, Society of Photo-Optical Instrumentation Engineers." We checked the publisher's website listed in the Ulrichsweb™ database (http://spie.org/publications/conference-proceedings) and found the titles *Proceedings of SPIE* and, after a more in-depth look at the website, *Proceedings of SPIE, Society of Photo - Optical Instrumentation Engineers*. All these abbreviations are variations of the same title. We entered it in the Ulrichsweb™ database and again obtained the title of SPIE: the International Society for Optical Engineering. Proceedings. We decided to use the title of the periodical adopted on the publisher's website (its cover with this name is listed on the website) as well as the ISSN listed in the Ulrichsweb ™ database (the ISSN was not found on the publisher's website).

As in [1, 2], in addition to the selection of sources based on the analysis of their citations in specialized journals, we made an additional selection of sources based on the data on the ***sources' citing to specialized journals,*** having chosen ***citing*** periodicals, an approach that was tested and described by one of the coauthors as early as in [43, p. 32]. Naturally, the cause–effect relationships between citing and cited items are different: the *citing* sources, which were selected in this case, *were* neither the most valuable nor the most used sources. However, data on periodicals using specialized sources within a specific field, pointed to some extent, to possible external "intellectual outlets" for the scientific results obtained within the related specialization [1, 2]; therefore, the researchers' awareness of such sources could facilitate their search for possible applications of their results in "external" disciplines. (In this case, the property of value refers to the specialized cited journals, rather than to the citing periodicals.)

Thus, using the Cited Journal Data JCR section we selected serial editions with higher total with higher rates of total referencing to selected specialized journals in the related field in 2016 (a 1-year "citation window"), or rather, of their publications in the period between 2011 and 2016 (5 + 1 year "publication window"). The threshold value was chosen in view of the

[9] Physical Reviews Letters – URL: https://journals.aps.org/prl/highlights (access December 20, 2017).

[10] It is tempting to expand PREPRINT as a reference to the Web-platform "preprints" (URL: https://www.preprints.org/; access December 20, 2017). The same applies to THESIS: *editions* entitled as THESIS are published in Russia and in Greece (the data of the Ulrichsweb™ database). However, this information has no impact on our interpretation: the "preprints" platform was launched in 2016, whereas the references to PREPRINT were made already in 2013; the Russian edition of THESIS is specialized in social sciences and the eponymous Greek journal is specialized in European politics, hence, a thematic discrepancy with nanotechnology is clear. This means that the first straightforward interpretation is correct.

observed citation-behavior patterns in relation to the "nanotechnology" field. Given the special status of this area of modern science, nanotechnology journals receive *many times more references* than are made *in* them. Thus, four selected journals cited 373 sources in 2016, whereas more than 1000 sources referred to these four journals in the same year. Furthermore, if, for example, 436 references refer to a value with a rank of 26 in terms of citations received, the citing rank is 44. Therefore, on the one hand, to avoid an excessively long final recommendation list, we must apply larger thresholds to the list of citing sources of information to keep it within certain limits. (Particularly, given the fact that the list of cited periodicals is more important.) On the other hand, however, the obtained list should at least partially reflect the revealed trend of a significantly higher level of citations to nanotechnological publications than the number of citations contained in them. In view of these considerations, after a series of trial attempts, the threshold values were established for the citing sources of information. The citation ***threshold*** was chosen equal to 15 for the value of total citations received by specialized journals from the citing sources of information.

An indicator similar to the "discipline impact factor," which we called "***the discipline susceptibility factor***" in [1, p. 493], was defined somewhat differently. Since the number of articles published in 2011–2016 in the cited specialized journals, i.e. *Nature Nanotechnology*, *Nano Letters*, *Nano Today,* and *Nano Research*, to which the citing sources of information can refer, is a constant value, the introduction of an amendment to this quantity will not change the value of the share indicator of its citing in other journals. The use of such an adjustment is generally meaningless, as the citing, rather than the cited, periodicals are subject to evaluation.

Therefore, all references to the above-mentioned journals made in 2016 within the "publication window," which are now objects, rather than sources of citations, were adjusted to the number of articles and reviews contained in the *citing* edition. In this case, we took their number related to the year 2016 only into account: thus, the citing journals were evaluated with an adjustment to their productivity in the year of citation. If such an adjustment was introduced, it was not the activity of the cumulative citedness of the 2011–2016 journals–objects that represent the "nanotechnology" field that was subject to evaluation, but the citing activity of the middle article of the citing (evaluated) journal in 2016.

The ***threshold*** was established for the "discipline susceptibility factor" based on the analysis, taking the multiple excess of the citedness index of specialized journals compared to citations they contain into account, to avoid obtaining an excessively long final recommendation list and to partly reflect in it the revealed tendency of a significantly higher citedness level of nanotechnological publications, rather than citations they contain; it was selected in such a way as to make it possible to bring together, in terms of volume, the obtained list and the list of sources selected based on the total index of citations received by specialized journals from the other sources.

Several (in this case, dozens) of citing sources included in the Cited Journal Data JCR are absent from the "Journal Citation Reports" master list and refer to non-continuing books and other non-serial sources. Following an attempt to verify their names, unidentifiable citing sources of information were excluded. We also combined data on the same citing sources recorded in the Cited Journal Data JCR under different names.

Below are several examples of **sources** that had to be **excluded** from consideration.

The source, denoted in JCR by the "2016 IEEE 16 INT C" abbreviation, was cited 125 times (!) in specialized nanotechnology journals. However, in our online search (access date: December 21, 2017), we identified the proceedings of three conferences in 2016 issued by the IEEE, whose names could also "fit" these abbreviations: the 2016 International Conference on Computing Technologies and Intelligent Data Engineering (ICCTIDE '16), Jan. 7–9, 2016 (URL: https://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=7589933; access date: 21.12.2017); the International Conference on Pattern Recognition Systems (ICPRS-16), April 20–22, 2016 (URL: https://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=7480233; access date: 21.12.2017) and SC'16: Proceedings of the International Conference for High Performance Computing, Networking, Storage, and Analysis, Nov. 3–18, 2016 (URL: https://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber= 7875333; access date: 21.12.2017). One can doubt the extent to which these names match the citing abbreviation; however, there is no closer matching and if these options are dropped the abbreviation has to be considered as not decodable. Which of the three conferences is referred to? Not only we were not able to guess this, further information about other conferences (but not about their publications, unlike to the three conferences mentioned above) could be found online with equally "semi-suitable" titles. In any case, the proceedings of a one-time conference had to be removed from the list (as opposed to the serial edition of works); however, such a high level of quotation was certainly intriguing and prompted us to attempt its identification.

Further (quite selective!) examples of sources excluded from the list, whose titles could not be decoded, are as follows: 2016 74 Ann Dev Res (35 references to specialized journals), Int C Trans Opt Netw (27 references) and 2016 17 Int C Elect (16 references). The opposite example of the excluded source: the abbreviation of Iran Conf Electr Eng (13 references) was easily decoded as the "Iranian Conference on

Electrical Engineering"; however, no materials in any unified information set were detected. Each year of the conference had its own *separate* website; however, it did not contain any publications or references to them (e.g., URL: http://icee2017.kntu.ac.ir/en/; access date: December 21, 2017). The absence of a visible information source corresponding to the decoded name prevented us from including the decoding data in the final table.

The implementation of a series of methodologically similar types of work using the material on different subject matters allowed interesting comparisons: thus, we provided a broad list of *three varieties* of cited sources that were excluded from consideration for nanotechnologies (a field that extensively "gives away" references), whereas only *one* unidentified citing source was excluded for more "traditional" topics, such as "energy security and energy conservation, energy-efficient technologies and engineering"[11].

Examples of the need to **combine data** on the same information sources, whose abbreviated names would be presented differently in JCR's Cited Journal Data, are absent in this case.

Below is an example of time-consuming decoding of a title**.**

The IEEE Nanotechnology Materials and Devices Conference (the title was retrieved from the IEEE Xplore Digital Library website (http://eeeex-plore.ieee.org/search/searchresult.jsp?searchWithin=%22Publication%20Title%22, access date: December 21, 2017) is a source that made 25 references to specialized journals. The analysis of the content of this source provided on the website of the IEEE Xplore Digital Library by year showed that the proceedings of this conference had been published over recent years as separate collections with the year of the conference indicated in their title, while, for example, in 2006 the materials of this conferences were published in the *IEEE Transactions on Nanotechnology* journal. The non-periodic character of these collections indicates the lack of the related information in the Ulrichsweb™ database. Moreover, the information provided in the JCR did not help us to understand clearly whether the reference was made to the collection for different years, or to special issues of the *IEEE Transactions on Nanotechnology* journal. Nevertheless, we found the home page of this conference (URL: http://ieeex-plore.ieee.org/xpl/conhome.jsp?punumber=1001739, access: December 21, 2017), which showed that uniformly named collections of works exist for several years under a unified name, that is, there is an ongoing collection of scientific papers associated with this conference.

A similar example is the IEEE Int Symp Circ S source (24 references to specialized nanotechnology journals), which also has a home page on the IEEE Xplore Digital Library website (URL: http://ieeex-plore.ieee.org/xpl/conhome.jsp?punumber=1000089, access: December 21, 2017), where it is called *Circuits and Systems (ISCAS), IEEE International Symposium*. The difference for this example is that the publication of the conference proceedings was recorded in the Ulrichsweb ™ database as an annual hard-copy publication, a fact that made the decoding of the abbreviation quicker and easier.

A particularly interesting example of combining information is the citation data on the *Nature Reviews Materials* journal (ISSN: 2058-8437, Nature Publishing Group, United Kingdom), whose citatedness in specialized nanotechnology journals was recorded in JCR using the abbreviated title of the journal Nat Rev Mat (9 references); however, the citing to specialized journals by the latter was recorded under the Nat Rev Mater abbreviation (312 citations).

RESULTS AND DISCUSSION

Based on the determined threshold of eight references to the aggregate number of publication citations in 2011–2016, we selected 237 titles of 373 cited sources; we were guided by this value in the choice of the threshold value of the "discipline impact factor." Using a threshold equal to 0.0035 (which provides the maximum convergence in the volume of lists obtained using different approaches) we selected 236 out of 360 cited sources, for which the "discipline impact factor" was defined. A total of 273 source names were selected using two indicators and given thresholds (taking integral and exceptional microflows into account). This number refers to the information sources left on the list followed by the combination of titles, duplication of the same periodicals cited by specialized journals under different abbreviations, and the elimination of cited information sources that were either unnecessary or unidentifiable.

As indicated above, the citation threshold for the general citation of specialized journals by citing information sources (which is significantly higher than the index of information sources quoted in these journals and exceeds 1000) is 15; its application results in 464 titles of citing sources.

In order to bring together the obtained list with the previously obtained list of 464 titles, the threshold for the "susceptibility factor of the discipline" was set at 0.03; it was established only for sources that cited specialized journals at least ten times. Despite this increased threshold, the final list reached 463 items.

In total, 572 information sources titles were selected based on these thresholds (taking integral and

[11]Preliminary results of this research were presented in Yurik I., Lazarev V. Selection of serial publications to support research on energy security and energy conservation, energy-efficient technologies and equipment [: Table]. Version 2. URL: https://figshare.com/articles/energy_sec_xlsx/5606053/2. (access: December 21, 2016).

Table 1. Key journals and periodicals to support nanotechnology research (fragment).

	Impact Factor	Title of a periodical in Journal Citation Reports	CΣ	CΣ rank	P(2016–2011)	CΣ/P	CΣ/P rank	RΣ	RΣ rank	P(2015)	RΣ/P	RΣ/P rank	ISSN	Publisher	Country	Full title of the periodical
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	12.712	NANO LETT	4481	1	6562	0.6829	4	4864	1	1170	4.1573	5	1530-6984	AMER CHEMICAL SOC	UNITED STATES	NANO LETTERS
2	13.942	ACS NANO	2712	2	7356	0.3687	8	3932	6	1250	3.1456	11	1936-0851	AMER CHEMICAL SOC	UNITED STATES	ACS Nano
3	12.124	NAT COMMUN	1920	3	12168	0.1578	27	1696	14	3534	0.4799	121	2041-1723	NATURE PUBLISHING GROUP	ENGLAND	Nature Communications
4	38.986	NAT NANOTECHNOL (merged)	1764	4	808	2.1832	1	587	40	148	3.9662	6	1748-3387	NATURE PUBLISHING GROUP	ENGLAND	Nature Nanotechnology
5	13.858	J AM CHEM SOC	1737	5	16536	0.1050	37	1030	28	2391	0.4308	132	0002-7863	AMER CHEMICAL SOC	UNITED STATES	JOURNAL OF THE AMERICAN CHEMICAL SOCIETY
6	19.791	ADV MATER	1572	6	5636	0.2789	12	2963	8	1152	2.5720	19	0935-9648	WILEY	Germany	ADVANCED MATERIALS
7	3.836	PHYS REV B	1476	7	31533	0.0468	64	3430	7	5329	0.6436	91	2469-9950	AMER PHYSICAL SOC	UNITED STATES	PHYSICAL REVIEW B
8	37.205	SCIENCE	1379	8	5006	0.2755	15	252	73	806	0.3126	172	0036-8075	AMER ASSOC ADVANCEMENT SCIENCE	UNITED STATES	SCIENCE
9	3.411	APPL PHYS LETT	1091	9	26283	0.0415	67	2764	9	3046	0.9074	64	0003-6951	AMER INST PHYSICS	UNITED STATES	APPLIED PHYSICS LETTERS
10	39.737	NAT MATER	1085	10	921	1.1781	2	226	83	172	1.3140	50	1476-1122	NATURE PUBLISHING GROUP	ENGLAND	NATURE MATERIALS
11	11.994	ANGEW CHEM INT EDIT	1068	11	14275	0.0748	51	857	31	2675	0.3204	167	1433-7851	WILEY	Germany	ANGEWANDTE CHEMIE-INTERNATIONAL EDITION
12	8.462	PHYS REV LETT	1062	12	18113	0.0586	60	694	36	2333	0.2975	179	0031-9007	AMER PHYSICAL SOC	UNITED STATES	PHYSICAL REVIEW LETTERS
13	7.367	NANOSCALE	912	13	9488	0.0961	39	4472	3	2174	2.0570	33	2040-3364	ROYAL SOC CHEMISTRY	ENGLAND	Nanoscale

Table 1. (Contd.)

	Impact Factor	Title of a periodical in Journal Citation Reports	CΣ	CΣ rank	P(2016–2011)	CΣ/P	CΣ/P rank	RΣ	RΣ rank	P(2015)	RΣ/P	RΣ/P rank	ISSN	Publisher	Country	Full title of the periodical
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
14	40.137	NATURE	764	14	5205	0.1468	28						2045-2322	NATURE PUBLISHING GROUP	ENGLAND	NATURE
15	4.259	SCI REP-UK	720	15	38366	0.0188	105	4711	2	20517	0.2296	216	2045-2322	NATURE PUBLISHING GROUP	ENGLAND	Scientific Reports
16	4.536	J PHYS CHEM C	699	16	19474	0.0359	72	2515	10	3241	0.7760	73	1932-7447	AMER CHEMICAL SOC	UNITED STATES	Journal of Physical Chemistry C
17	29.518	ENERG ENVIRON SCI	667	17	2398	0.2781	13	531	42	325	1.6338	39	1754-5692	ROYAL SOC CHEMISTRY	ENGLAND	Energy & Environmental Science
18	7.354	NANO RES	575	18	1196	0.4808	5	1121	25	351	3.1937	9	1998-0124	TSINGHUA UNIV PRESS	PEOPLES R CHINA	Nano Research
19	12.124	ADV FUNCT MATER	565	19	3920	0.1441	30	1794	13	872	2.0573	32	1616-301X	WILEY	Germany	ADVANCED FUNCTIONAL MATERIALS
20	38.618	CHEM SOC REV	564	20	2149	0.2624	16	746	35	273	2.7326	18	0306-0012	ROYAL SOC CHEMISTRY	ENGLAND	CHEMICAL SOCIETY REVIEWS
21	7.504	ACS APPL &MATER INTER	529	21	13569	0.0390	69	3996	5	4057	0.9850	62	1944-8244	AMER CHEMICAL SOC	UNITED STATES	ACS Applied Materials & Interfaces
22	8.867	J MATER CHEM A	528	22	9310	0.0567	61	2510	11	2086	1.2033	52	2050-7488	ROYAL SOC CHEMISTRY	ENGLAND	Journal of Materials Chemistry A
23	37.852	NAT PHOTONICS	494	23	719	0.6871	3	280	62	121	2.3140	26	1749-4885	NATURE PUBLISHING GROUP	ENGLAND	Nature Photonics
24	6.319	CHEM COMMUN	490	24	20223	0.0242	89	813	33	2967	0.2740	191	1359-7345	ROYAL SOC CHEMISTRY	ENGLAND	CHEMICAL COMMUNICATIONS
25	8.643	SMALL	445	25	3285	0.1355	32	1372	17	649	2.1140	29	1613-6810	WILEY	Germany	Small
26	9.353	J PHYS CHEM LETT	436	26	4116	0.1059	36	896	29	818	1.0954	58	1948-7185	AMER CHEMICAL SOC	UNITED STATES	Journal of Physical Chemistry Letters

Table 1. (Contd.)

	Impact Factor	Title of a periodical in Journal Citation Reports	CΣ	CΣ rank	P(2016–2011)	CΣ/P	CΣ/P rank	RΣ	RΣ rank	P(2015)	RΣ/P	RΣ/P rank	ISSN	Publisher	Country	Full title of the periodical
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
27	9.466	CHEM MATER	405	27	4709	0.0860	44	1128	23	1028	1.0973	57	0897-4756	AMER CHEMICAL SOC	UNITED STATES	CHEMISTRY OF MATERIALS
28	3.440	NANO-TECHNOLOGY	382	28	5868	0.0651	58	1979	12	1146	1.7269	36	0957-4484	IOP PUBLISHING LTD	ENGLAND	NANOTECHNOLOGY
29	9.661	P NATL ACAD SCI United States	375	29	21363	0.0176	111	12		3187	0.0038		0027-8424	NATL ACAD SCIENCES	UNITED STATES	PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA
30	47.928	CHEM REV	343	30	1398	0.2454	17	820	32	277	2.9603	13	0009-2665	AMER CHEMICAL SOC	UNITED STATES	CHEMICAL REVIEWS
31	22.806	NAT PHYS	335	31	883	0.3794	7	107	161	177	0.6045	92	1745-2473	NATURE PUBLISHING GROUP	ENGLAND	Nature Physics
32	16.721	ADV ENERGY MATER	308	32	1623	0.1898	23	1084	26	388	2.7938	16	1614-6832	WILEY	Germany	Advanced Energy Materials
33	4.123	PHYS CHEM CHEM PHYS	305	33	16191	0.0188	105	1622	15	3503	0.4630	128	1463-9076	ROYAL SOC CHEMISTRY	ENGLAND	PHYSICAL CHEMISTRY CHEMICAL PHYSICS
34	20.268	ACCOUNTS CHEM RES	295	34	1561	0.1890	24	198	95	286	0.6923	83	0001-4842	AMER CHEMICAL SOC	UNITED STATES	ACCOUNTS OF CHEMICAL RESEARCH
35	2.068	J APPL PHYS	277	35	22928	0.0121	140	1187	21	2312	0.5134	110	0021-8979	AMER INST PHYSICS	UNITED STATES	JOURNAL OF APPLIED PHYSICS

exclusive microflows into account). This number refers to the information sources retained in the list after combinations and exclusions.

The obtained complete list of sources was uploaded in the figshare repository in the form of a table [44]. The periodicals were sorted in the descending order of the cumulative value of citedness in specialized journals. In the absence of such a value or when it was below the threshold, the periodicals were sorted in the descending order of the "discipline impact factor." In the absence of the latter or if its value was below the threshold, the periodicals were sorted in the descending order of the cumulative value of citing to specialized journals in nanotechnology. In the absence of the latter or if its value was below the threshold, the periodicals were sorted in the descending order of the "discipline susceptibility factor." Table 1 contains a fragment of complete data on 35 periodicals, including data on their ciredness in specialized source journals (cumulative citedness and the value of the "discipline impact factor") and their citing to the same specialized object journals (cumulative citing and the value of "the discipline susceptibility factor"), as well as reference data on ISSN, the country of publication, the publisher, and the impact factor, based on "Journal Citation Reports" or an online search.

If the information environment being created enables the use of all the selected sources, we will certainly strive to do so. Otherwise, it should be borne in mind that if the value of the cumulative number of references to the cited journal within the "publication window" reflects the overall value of the cited publication and the value of the "discipline impact factor" corresponds to the value of an average paper, practically this means that the first indicator will refer to publications that supposedly contain a larger number of valuable articles; hence, the first approach has some advantage. A similar approach should be pursued with regard to periodicals that are selected and evaluated based on their citations of specialized sources. However, since the latter are no longer associated with the magnitude of citing to value, they should be implemented in the second round, and in the case of scarce financial or organizational resources, they should not be involved. In other words, the presentation order of the methodology fully reflects the relative priority of the application of its components.

Note that the use of a single indicator of the aggregate number of references within the "publication window" allowed us to identify 237 periodicals with a citation level of eight and higher, and the application of the "discipline impact factor" allowed us to add 36 additional journals to this list whose "discipline impact factor" was equal to or exceeded the threshold, but which were not included in the list in view of the cumulative citation index value[12]. Thus, the "top priority" list included 237 titles. For a less rigid approach involving additional organizational or financial resources, it included 273 items.

CONCLUSIONS

To select global periodicals to support high-quality nanotechnology research, we used a comprehensive methodology based on the use of citation-analysis at the level of periodicals within a "citation window" equal to 1 year, considering the cumulative *citations* to periodicals in *selected specialized journals-sources* and the calculation of the "*discipline impact factor*," that is, an indicator similar to the "impact factor" (the ratio of the number of references to the number of publications), whose numerator, however, contains the value of citation of the selected periodicals, not in all journals indexed by JCR, but only in **selected specialized journals** [38], ***characterized by the fact*** that the "publication window" is set equal to "5 + 1" year, that is, 5 preceding years and the year during which the references were taken into account. Furthermore, the additional steps of the methodology involved the selection based on data on *citation* of *specialized journals* by the rest of the periodicals within a "citation window" equal to 1 year and a publication window equal to "5 + 1" years. This involved the selection of citing periodicals and the calculation of the "discipline susceptibility factor," that is, the ratio of the number of references made during the year by the periodicals being selected to the publications in highly specialized journals to the number of publications in *citing* periodicals for 1 year. Using the threshold values, a total list of 572 journals and other periodicals was obtained, of which 273 editions (47.73%) were subject to priority selection for the inclusion in the upcoming scientific and information environment, since they were listed either in terms of total citedness within the "publication window," or in terms of the "discipline impact factor," or both. No similar study has been so far performed for nanotechnology, despite the great interest of bibliometric experts in this field of modern science (see the "A brief review of bibliometric studies on nanotechnologies" section above).

[12] An illustrative example is the *Journal of Photochemistry and Photobiology C – Photochemistry Reviews*, included in table uploaded in the repository figshare [44]. The cumulative citation index of this journal in specialized source journals only includes four references (which is below the threshold; the rank of the indicator is not established); however, the "discipline impact factor" (0.0367) corresponds to the rank of 71, which is more than sufficient to pass the threshold. The high "discipline impact factor" is due to the low productivity of the journal (which is a "thin journal"). Another even more striking example is the *Solid State Physics* journal, which was included in the final list with only two references in specialized journals, but which had even a lower productivity of 25 papers, corresponding to the rank 49 by the "discipline impact factor."

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