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SCIENTIFIC COMMUNICATION IN THE WORLD OF DIGITAL TECHNOLOGIES: CONDITIONS AND PERSPECTIVES REGARDING THE DEVELOPMENT OF SCIENTIFIC JOURNALS

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Abstract

Purpose. The presentation of challenges with which scientific journals and – more broadly – scientific communication, will have to face in the substantive, technological and financial sphere in the conditions of constant evolution of the digital world, dynamic development of new information systems in science (e-library, library 2.0) and new phenomena conditioning the behaviour of Internet users.
Method. The views presented in the article are the result of a review of literature regarding scientific journals and empirical research, which was conducted from April to August 2018 among 132 authors representing the world of science and economic practices.
Findings. The open access (OA) movement has caused significant changes in the behaviour of people of science in publishing and depositing research results. The prospect of taking over all the functions of scientific journals by scientific repositories still seems to be distant due to the lack of alternative methods for assessing the quality of scientific publications. There are doubts about the division into scientific, institutional repositories and the repositories belonging to scientific journals, which results from unclear business models of individual solutions. The phenomenon of self-publishing is stimulated by the dynamic development of research carried out by business units, skilfully analysing the resources of large data sets and successfully popularising research results in social repositories. This is new quality in the area of information exchange, which requires rapid adaptation on scientific grounds. An insufficiently implemented postulate to popularise scientific knowledge and its transfer to business practice remains an equally important challenge.
Research and conclusions limitations. The results of the survey based on the respondents' subjective assessment should be treated with caution and do not allow to draw general conclusions. The research revealed significant discrepancies in respondents' opinions regarding the future of scientific journals and their prospects for functioning in new information systems. The highest doubts concern the quality assessment system of scientific publications and the business model of scientific repositories: the significant number of stakeholders of the scientific communication system, dispersed in various scientific, political and economic systems, further limits the possibility of formulating unambiguous decisions in this respect.
Originality. The presented article formulates challenges for scientific journals whose functions are being increasingly taken over by scientific and social repositories. In contrast to the previously published works, this suggests solutions in the field of artificial intelligence, which will enable complete change in the way of publishing and validation of knowledge as well as quality control of scientific research.
Type of work. Review article.
Keywords: archiving, electronic publications, archiving journals, electronic publishing, libraries, e-libraries, repositories, open access.

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Introduction

It is not easy to imagine a world of science without scientific journals, despite the fact that their history covers only about 350 years. Due to the spatial dispersion of research centres, journals became the basic tool for scientific communication, and at the same time, they served as centres of scientific thought and as a place for exchanging views. They also shaped the attitudes of generations of researchers in the form of specific rules of academic discussion, ethics and responsibility for the quality of research. The evolution of their role and significance has accelerated along with the rise of the Internet and the widespread implementation of the Web 2.0 philosophy (the disappearance of the division of users into senders and recipients of content). The pace of the increase in the resources of digital scientific documents has allowed for their more accurate identification and for a better system of making them available. The quality of many online publications is also a concern, which is hardly discernable for inexperienced users.

At the same time, the increasing criticism (in the methodological and economic area) of the existing system of publishing articles on the pages of scientific journals raises more and more fears regarding their future existence [Nowak 2009]. The limitations in access to scientific literature due to the continuous increase in prices and the licensing policy of publishers arouse objections from the world of science, which – especially in the younger generation – represent a completely new approach to the use of network resources, especially in the situation in which it remunerates the system with its scientific works. Meanwhile, the problem of free access to research results and even information about the fact that it is conducted, is not resolved. Even within individual scientific units, it is not always clear what individual researchers do. For the same university, there are often 2-3 applications within one competition for twin research areas. Scientific conferences and scientific journals are influenced by articles with a similar thematic scope, being the outcome of very similar research. The inability to effectively create research teams is, among others, the result of poorly organised circulation of information and access to knowledge as well as the processes of its creation. The scientific communication system based on scientific journals cannot cope with this challenge even during the period of intense digitisation. The expectations and protests of the scientific community (including the important voice of librarians) have been increasingly formulated and led to the creation of the Open Access movement and electronic scientific repositories[1] [Kamiski 2002; Kaser 2005].

[1] Also called e-archives. The term repository, however, better reflects the essence of the system, in which the author himself/herself, of his/her own will, deposits the results of his/her scientific research.

The increasing percentage of representatives of the digital natives generation[2]holding managerial posts at leading scientific institutions, will probably lead to the introduction of the academic world on digital level, in which the role of analogue information carriers will be limited. However, it is hard to recognise digitisation as the premise of "easier access". The overload of content (information overload), which cannot be acquired or reliably verified in scientific terms, becomes a growing barrier. The existence of an increasing number of repositories and database search systems has not yet resolved the problem of intellectual property rights. Doubts regarding the commercialisation and the right to obtain financial benefits from published research results are still unsettled.

Thus, to what extent does the process of verifying and sharing knowledge,as well as scientific communication require innovative solutions? The answer to this question necessitates analysis of the role of scientific journals and a review of the opinion of the world of science and economic practices regarding the existing and emerging model of creating and transferring information as well as knowledge.

Research aim and methods

The reason for undertaking this research is the conviction of the extraordinary importance concerning the issue of scientific communication, not only from the perspective of academic circles, but also the welfare of humanity in general. The purpose of the conducted research was:

- defining the historical role and importance of scientific journals for the development of scientific communication;
- indicating the causes of the crisis regarding scientific communication, identified with the crisis of scientific journals;
- determining the expectations of authors and recipients of scientific content in relation to scientific journals and the level of meeting these expectations through the existing system of scientific communication;
- indicating the potential place of scientific journals in the scientific communication system based on electronic repositories;
- formulating a business model proposal for a new scientific communication system.

The first two objectives were carried out on the basis of a literature review. In other areas, the research method was diagnostic survey, conducted in the form of interviews from April to August 2018,among 132 respond-

[2] The term digital native (digital native) refers to a person born in the times of universal access to the Internet, computers and other devices, treating these amenities as an obvious element of the surrounding world. Digital natives are opposed to digital immigrants [Prensky 2001].

ents. More than half of them (96 people) were authors regularly publishing in Polish and foreign scientific journals, including 68 active as reviewers and 12 who currently or in the past acted as scientific editors. This group also includes (28 people) young scientists (Ph.D. students). The remaining respondents (36 people) included representatives of companies dealing with acquiring knowledge from databases (data exploration, data mining). Some of them (21 people) commercialise the results of their own research, exploring data commissioned by business or research units, while all business-related researchers treat data mining as a business strategy planning tool. Part of the research results and reports, being their aftermath, are subject to publication on the Internet in the form of so-called gated content (a tool for acquiring new subscribers) or in the form of a portfolio informing about the company's competences in various areas of activity[3].

The selection of respondents representing such a scientific community as well as business representatives, significantly involved in the process of creating and distributing knowledge, was dictated by the assumption that a modern system of scientific communication should serve better, two-way transfer of knowledge between areas of science and practice. The development of e-commerce and the increase in the amount of data possessed by commercial units (financial system, insurance, transport, telecommunications, electronic reservations),as well as the emergence of modern data mining tools, have created a situation in which the current division into the world of science (understood as a provider of knowledge) and the business world (seen as its recipient), is no longer justified[4]. The scientific community loses great opportunities not being able to use the knowledge gathered by entrepreneurs or having no idea about its resources. The new system of scientific communication should also take this problem into account.

The study also considered the division of respondents into those who, at least from the beginning of higher education, had to deal with modern technologies and those who encountered them only in their professional work. This is not a strict division into digital immigrants and digital natives, which results from the fact that 28 respondents, despite their relatively advanced age, had to deal with modern data transfer technologies as early

[3] Examples of types of reports generated by the surveyed entities conprised: migration statistics (including tourist traffic), behaviour of buyers in the network, habits of mobile device users, the use of mobile applications, intensity of transportation use (including the volume of passenger railroad traffic), systematics of orders and logistics of enterprise supply, the efficiency of electronic booking systems for transport and accommodation, the intensity of acquaintance with exhibits of art galleries and museums equipped with beacons, the quality and quantity of tourist information sought on the web.

[4] The discussed dichotomy has led to a situation in which, up to now, the inefficient survey data remains the main source of data on tourism statistics in Poland. The opportunities offered in this area by data analysis of payment card systems, mobile telephone services and femtocells are ignored.

as in the 80s of the 20th century, and this fact clearly affected the their attitude towards introducing digital solutions in the world of science.

In turn, the presence of doctoral students in the surveyed group allowed to obtain opinions of the youngest representatives of the scientific community, especially those open to changes in the area of digital technologies, not yet connected with rituals, which affect the beliefs of the older generation regarding the form of scientific communication. The author's conviction about the necessity to take the views of this particular group of respondents into account arises from two premises: firstly, the emerging scientific communication system will create a working environment for young people and it is worth considering their expectations. Secondly, the fact that young people are not bound by the norms and habits that conditioned the scientific development of the older generation (let us assume: those born in the 1960s and 70s of the 20th century) creates real opportunities to go beyond the current scheme. One of the most important initiatives of the 20th century – the Public Knowledge Project (PKP) – was the work of a small group of students, and it turned out to be a breakthrough for the scientific publishing market.

The evolution of the role and importance of scientific journals and the crisis of scientific communication

A.J. Meadows [1998, p. 5] and C. Oppenheim [2000, p. 361] situate the beginnings of the system of scientific publications as early as in the 17th century in the form of correspondence between scholars concentrated in the so-called Boyle's colleges in England. At the initiative of the research group, under the auspices of the Royal Society, there were regular meetings devoted to the presentation of research results and the first versions of articles. The exchange of scientific ideas – due to the physical distance of many researchers – also took place via letters. The increase in the volume of correspondence resulted in attempts of its classification, which eventually resulted in the emergence of the first scientific journals (including the two oldest ones: "Journal des Sçavans" and "Philosophical Transactions of the Royal Society of London"), constituting a transparent and effective means of scientific information exchange [Schauder 1994; Meadows 1998, pp. 6-8].

The turn of the 18th and 19thcenturies brought forward the evolution of scientific journals associated with the boom of mathematical and natural sciences. The growing number of titles reflected the fragmentation of knowledge into more specialised fields [Day 1999]. A. Swan and S. Brown [2004, p. 4] note that since the creation of the first journals, the academic authors published the results of their research for two main reasons: the possibility of contributing to intellectual development in a specific field of

knowledge and establishing their rights to this part intellectual contribution. J. Guedon [2001] emphasises the important role of scientific journals in the area of determining the right of priority to a given discovery and systematising knowledge (assigning each publication information enabling its indexing). Scientific journals have influenced the shape of the metadata system[5], which is a prerequisite for creating public registries of scientific innovations.

The above-mentioned aspect caused a clear shift in the role of scientific journals from being a knowledge exchange platform towards being guards of intellectual property rights (the function of archivists of knowledge resources). It also resulted in the selection of another function, which is building the prestige of the world of science and the status of researchers and their parent units [Schauder 1994, p. 75]. It was not just about issuing a publication – but about a publication signed with a specific scientific journal, sought out by the academic world.

Ultimately, some of the leading system roles of scientific journals were created. According to P. Boyce [2000, p. 404], M. Day [1999] and F. Rowland [1997], they are:

- a system of measures to assess the competence and effectiveness of authors;
- a system to increase the visibility and build the prestige of authors (which results in increased possibilities for financing future research contracts, scientific promotion or even employment);
- a system of validation of knowledge and quality control (stage of reviewing works);
- a system of records of the progress of science over the years;
- knowledge distribution and archiving system.

The last two aspects gained special significance after World War II. The arms race, initiated during it and lasting for several dozen consecutive years, was possible due to the abrupt increase in the amount of scientific research funded by the Allies, as well as the acquisition of Axis documents just after the war. There was a need to develop new ways to organise, store and access this compilation of information. The foundations of the new system were created by V. Bush, former president of the Massachusetts Institute of Technology and director of the Department of Research and Development, formulating (but ultimately, never implemented) the offer of the MEMEX platform for storing information in the form of text, graphics and audio, enabling searching for information directly from the researcher's desktop using navigational links [Bush 1996/1945]. Although the system was based on microforms, it is considered a precursor of modern hypertext systems [Large et al. 1999, p. 43].

[5] Metadata is structured information used to describe information resources or information objects, providing detailed data on attributes of resources or information objects to facilitate their finding, identification and management of these resources [Chan, Hodges 2009].

The dynamics of economic development, the increase in economic competition and the growing demand for research, guaranteeing corporations the advantage of the so-called first movement, caused the industry to become an important client, in addition to the orders of the army and other forms of financing science from public funds. This fact has not only an administrative dimension – it has turned towards interdisciplinary research, somehow against the 300-year tradition of deepening the specialisation of scientific research. The emphasis on the diversification of methods for popularising the results of scientific research also increased [Tenopir, King 2000, pp. 18-21; Large et al. 1999, p. 43], as well as the involvement of governments (mainly the United States, Great Britain, thethen USSR and Japan) in supporting activities aimed at solving problems related to scientific communication. The biggest challenges include four issues: the explosion of information, an increase in publishing costs (and thus, prices)[6], delays in publishing and inefficient distribution channels - which in the literature was referred to as the "crisis of journals" [Tenopir, King 2000, pp. 21-22; 1999, pp. 43-44], and in the opinion of scientists, Cornell University was a manifestation of the "scientific communication crisis". Solutions are mainly sought in technological tools, such as electronic publication, digital information processing and digital storage of large data sets, electronic metadata retrieval and indexing services, and the creation of digital bibliographic information databases (including some of the oldest ones: Chemical Abstracts, Engineering Index and Index Medicus).

As early as in the 1980s, projects aimed at increasing the efficiency of scientific journals were financially supported by publishers, and in Great Britain, by the specially created British Library Research and Development Department (BLRDD). C. Tenopir and D.W. King [2000, p. 24] give examples of experimental works, such as ADONIS (a service for the delivery of scientific articles on CD-ROMs), large publisher projects (Elsevier, Springer and Blackwell Science) sponsored by the British Library and the European Commission as well as projects sponsored by commercial publishers (Red Sage, BLEND, ELVYN and TULIP). An additional motivation became problems with archiving the printed scientific achievements in the resources of national and university libraries [Tenopir et al. 2003]. At the same time, recipients of scientific texts, increasingly familiar with the consumption of digital content, see problems with storing printed scientific materials and tedious searches of private collections.

[6] The report by the Association of Research Libraries (ARL) states that the average price of a journal in the field of exact, medical and technical sciences (STM) increased by 227% between 1986 and 2002, and compact publishers by 75%, while prices of consumer goods increased only by 64%. In the same period, in the ARL library budgets, expenditures on the purchase of journals increased by 9%, while the amounts for the purchase of compact publishers decreased by 5% [Stępniak 2013].

Other challenges faced by the current system of scientific communication are rapid advances in most fields of science, and thus, a shorter time to implement the traditional publishing model [Sompel, Lagoze 2000; Tenopir, King 2000] and the problem of reaching a wide audience. The transfer of intellectual property rights from the author to the publisher works against the idea of promoting and widely disseminating research results and obtaining mutual recognition in the world of science and the economy [Bachrach et al. 1998]. S. Harnad [1998, 1999, 2000], further indicating that the existing peer review system raises doubts, which according to many authors, is too rigid and hinders the expression of new ideas and views by favouring the publication of authors from the most prestigious organisations.

The constant increase in journal subscriptions, which exceed the inflation rates and budgets of university libraries, is stigmatised, which jeopardises the economic efficiency of the scientific communication system [Bachrach et al. 1998; Harnad 1998; Tenopir, King 2000]. M. Bot and J. Burgemeester [1998] noted the increase in costs related to the rise in the volume of printed materials (more pages, more volumes annually), while the number of individual subscriptions, which began in the 1970s, decreased. Publishers respond to these phenomena by increasing the rates of institutional subscriptions, which leads to the creation of a vicious circle of rising costs and declining revenues as well as a progressive decline in the availability of certain titles, despite the original assumptions of the entire system. This encouraged the scientific community to seek out innovative publishing models that would serve formal and informal communication between scientists and go beyond the limitations of the printing world.

Another issue illustrating the phenomenon of scientific communication crisis is the problem raised by J. Sulston and J. Stiglitz (Nobel Prize winners) in "The Times": "Whose property is science?" [Sulston, Stiglitz 2008]. A system in which science is owned by publishers means the socialisation of research costs and the simultaneous privatisation of profits from the publication of research results. However, the question arises whether a similar procedure would not take place (on a much larger scale) in conditions of open access to knowledge? The institution of open access makes public resources a scientific resource (the use of goods by others cannot be legally prevented), which, of course, was the premise of the movement from the very beginning, but in practice, this means that commercial institutions will be able to limit research spending to use socially funded research results. Acting as a member of the SGH Library Council, the author was repeatedly asked to express her opinion in such cases. This approach also adopts concealed forms: universities paying for (often expensive) access to scientific databases record cases of students who are also employees of corporations who bring in orders from their own employers to perform research using university databases. This means new challenges in the area of access to scientific knowledge.

The "paper paradigm" [Morton 1997] carries numerous limitations incomprehensible to the recipients and creators of digital media, but the journals available in electronic version often simply constitute a copy of the paper edition. Such a solution (1:1 system) means that at its base, the functionality of scientific communication (even in the digital world) does not undergo rapid changes, even if the outreach of the publication is growing. The transfer of paper edition to the electronic circulation cannot only be a technical act (this one is relatively simple). It is impossible not to notice the anachronism, which is attachment to text form, at times when the most popular form of transmission is image and sound. In most sciences (mathematics, natural and social), the presentation of the research itself (scientific experiment, interview, registration of social behaviour, illustration of chemical processes) would be much more interesting and the recipient would be more trustful if a video or sound recording were made available, along with a description of the study results. More and more research and development units (a flagship example of NASA) keep this type of archives and even make them available in the form of multimedia files (biological sequences, time series, videos with the record of psychological experiments, etc.). Often, their goal is to popularise science (e.g. eksperymentychemiczne.pl resources). The advantage of the digital form is also (based on materials published on websites) the possibility of using links in the form of hyperlinks instead of the traditional form of annotations - which shortens the time of searching for source materials and facilitates access to broader knowledge resources.

Functions and functionalities of journals and scientific repositories – survey results

The predictions that printed journals will disappear within a few decades turned out to be exaggerated [Harnad 1990; Odlyzko 1995], but more and more publishers are launching Internet services that provide access to electronic versions of journals. Their maintenance in the circulation of scientific communication indicates that there has not yet been any entity that would fully take over the functions[7] of scientific periodicals. At the same time, the entrance of journals into the digital world indicates that there is a set of functionalities that they have not been able to implement so far, and they must be mastered quickly enough to meet the competition of scientific and social repositories. At the same time, the high costs of digitisation lead to

[7] In this case, the term "function" is used in a general sense as "a task that a person or thing fulfills or is supposed to fulfill" while "functionality" means a set of device, software or system's attributes determining the ability to satisfy designated and assumed needs, when used in certain conditions" *Słownik języka polskiego* [Polish Language Dictionary, PWN).

searching for models of independent publishing (self-publishing, self-archiving)[8] with the use of new technologies [Okerson 1992]. The premise is that researchers publishing in peer-reviewed journals do not do it for financial gain (royalties), but in order to create their own recognition and raise scientific status [Harnad, Hemus 1998], affecting future employment opportunities and salary levels [Cronin, Overfelt 1995; Walker 2002].

Originally, the term self-publishing defined the publication of works by professional publishing companies, with the proviso that this process is partially or fully financed by the authors. Less frequently, self-publishing meant the author's own editorial work and commissioning the publication of his/her own publication. The emergence of digital communication channels has added new significance to this phenomenon and has become one of the basic components of the development of digital information systems (library 2.0) and the development of "e-science". It is equally an issue in the field of technology as well as the social behaviour of information process entities [Nowak 2009]. University scientific repositories have become a motivating factor for researchers, which allow self-publishing even if the author does not have his/her own website.

Among the greatest benefits of publishing in electronic repositories is the limitation of barriers created by the conventional publication system [Pinfield 2004a, p. 4] and the wider availability of articles [Pinfield et al., 2002; Harnad, Brody 2004; Antelman 2004; Alejziak, Liszewski 2016], which translates into strengthening the brand of the researcher and the parent unit. S. Hitchcock [2005] showed that work that is freely available is more often cited. Rapid dissemination of information enables a more effective transfer of knowledge between the academic and business world [Warr 2001], and the possibility of using multimedia allows dynamic archiving of scientific data [Garner et al. 2001, p. 252]. Modern repositories offer the possibility of annotating, integrating and exporting data, publishing data in agreed formats and the ability to monitor interest in a given text using statistics. From an institutional point of view, it supports the quality of scientific communication, visibility of research results and building prestige, and as a result, it serves to attract high-level scientists and funds for research, the results of which are more widely disseminated and cited. Repositories also provide support for higher education institutions in the field of their research and teaching mission [Pinfield 2004b, p. 303]. An advantage for researchers from regions with lower economic and scientific development is access to knowledge resources gathered in any research unit of the world [Chan, Kirsop 2001].

[8] A general term used with regard to electronic publication of documents provided by the author on the Internet without the commercial mediation of the publisher.

Open access journals (OA) play the role of repositories (archiving own editions), and the articles published in them are present in repositories of scientific units. This means that the coexistence of several forms of depositing articles:

- electronic journals (e-journal) – an increasingly widespread form, meaning basically replacing a paper publication with a :1 digital format, in which the distribution may still be based on the terms of a paid subscription, but more often, it is the cost of a scientific unit. Apart from facilitating access, an electronic journal reduces the problem of archiving scientific materials in libraries [Kling, McKim 1999, p. 891]. In tourism sciences in Poland, the example of such a journal is "Turystyka Kulturowa" [Cultural Tourism] (functioning only in electronic form)
- electronic hybrid journals[9] (paper-electronic, p-e) – available via electronic channels, but retaining the distribution based on paper often as the original version [Kling, McKim 1999, p. 891]. In tourism sciences, among others, the examples of "Folia Turistica" (the paper version remains the original version) and "Turyzm" [Tourism] (from 2016, the priority based on the electronic version) can be given
- self-publishing (self-archiving) done by the author – usually based on the publication of an article on the author's website or a dedicated scientific unit repository [Okerson, O'Donnell 1995] or in a social repository (e.g. Gaudeamus, ResearchGate, Academia.edu)
- thematic repositories (separate for different scientific disciplines) – created by various organisations, including foundations or sponsors interested in the quickest possible access to research results [Ginsparg 1997; Holtkamp, Berg 2001; Brown 2001a, b].

While in the first two cases we are dealing with a scientific journal (having a scientific editor, editorial team, reviewers), maintaining a system of qualifications and reviewing sent scientific materials, in the case of self-archiving and social and thematic repositories, there is often a lack of a team supervising the thematic and qualitative selection texts. Such repositories are treated as a complementary form of distributing research results [Pinfield, James 2003]. The exception are repositories created by scientific units, which limit the possibility of depositing materials only regarding previously published articles (reviewed).

From the point of view of striving to ensure high availability, it does not matter if we are talking about online journals or other repositories[10]. How-

[9] In the field of mathematical and natural sciences, practically all scientific publications use a parallel paper and electronic form, assuming that the pace of circulation of scientific information and research results is crucial for further knowledge expansion in these disciplines [Kling et al. 2002, p. 2; Brown 2001a, p. 188]. This is extremely different in the case of humanistic fields [Brown 2001a, p. 188].

[10] For the sake of total clarity, it would be necessary to distinguish between online electronic repositories and those available only from the level of indicated computer units without

ever, from the perspective of the quality of scientific communication, this is a significant distinction. Since many repositories (in particular social media) do not verify the quality of publication, any user can include any article in them. The fact that, in many respects, the functions of digital scientific journals and repositories are doubled is also alarming. It is difficult to expect that the periodicals will expand their platforms to such sizes that they will serve to deposit materials from another source. Perhaps, therefore, it would be advisable to reverse the solution – that is, taking over the function of journals by repositories?

The respondents participating in the study were asked to indicate whether and to what extent they think the repositories will be able to independently handle the scientific communication system (taking over all known functions of scientific journals). It has been assumed that the inalienable functions of the scientific communication system (currently implemented mainly by journals) are:

- transfer of information on the widest possible scale,
- archiving,
- building the prestige of authors and scientific units,
- provoking scientific discussion and exchange of ideas,
- thematic and qualitative selection.

The order of the functions listed above was dictated by the probability of their implementation by digital systems (repositories).

92% of respondents felt that already today, repositories are used for archiving and transmitting information better than journals, reaching a range of dissemination unprecedented in the history of scientific journals. Thus, their influence on building the recognition of authors and citation rates is more and more strongly observed – 67% of respondents see a clear increase in bibliometric indicators (including the H index) since the introduction of their own publications to repositories.

Only 9% of respondents raised the issue of correlation between bibliometric indicators and the prestige of the author, journal or university. In their opinion, the search for materials from a given field begins with an overview of the resources of specific (recognised) periodicals. They appreciated the help offered in this regard by the digitisation of the contents of journals, but they stressed that they prefer to search these resources starting with the title of journals recognised in a given field. The remaining respondents (91%) – search through keywords that they think best match current scientific needs. The youngest respondents were even surprised by the suggestion that searching for materials could be started with the journal's title. The exception was, however,3 young employees of the Medical

online access (e.g. resources of government agencies). Because this second form does not make sense from the point of view of the assumed subject of this study (it is certainly about scientific communication and not about blocking it) – it was deliberately omitted.

University of Warsaw (all under the age of 35), for whom the title of the journal clearly guaranteed credibility and scientific reliability of an article. They emphasised the fact that the choice of literature for the dissertation is not accidental and the rank of a journal is one of the elements taken into account in reviewers' opinions. It seems that the degree to which young researchers adhere to scientific traditions depends on the relationship with supervisors (student-master relations). The weaker the relationship (and the patterns of scientific behaviour), the stronger the attachment to habits developed from childhood – and these assume that the first query (also within the scientific aspect) is directed towardsInternet search engines.

It is impossible not to mention that in recent years, the subject of acute criticism is the linking grant procedures with the parametric evaluation of a journal (impact factor and number of citations) and its prestige within a specific specialisation [Nowak 2000]. R. Prinke (2010) gives examples of research financing institutions – the National Science Foundation (USA), Research Assessment Exercise (Great Britain), Deutsche Forschungsgemeinschaft (Germany) – resigning from the inclusion of journal titles (impact factors) in which anapplicant for a grant published an article, move towards independent assessment of his/her actual achievements in the form of substantive content of articles or books.

Can detachment of the evaluation of a scientific publication from a specific journal, and thus, a journal's deprivation of this function be expected? 71% of respondents thought that if it seemed reasonable in a substantive sense, it would be difficult in a technical one (time costs). This group of respondents indicated that the use of impact factor is undoubtedly a huge and often unfair simplification, but it allows to reduce the costs of long-term qualification procedures. 24% of respondents, however, are supporters of a substantive assessment system based on automated evaluation of the achievements that could also be introduced in the peer review system. Proposals of this system are related to the issue of the thematic and qualitative assessment of scientific works.

Thematic selection of materials submitted for publication in journals is carried out in two manners: on the one hand – by a scientific editor associated with a clearly defined area of research and field of science, while on the other, based on the profile (subject) of the journal. They guarantee that the publications in the field of economics will not include works in the field of nuclear physics, but also block researchers ready to undertake interdisciplinary threads. 36% of respondents criticised this situation, paying attention to their own and heard cases of scientific "wandering" with research results that went beyond the profile of subsequent journals. One can of course doubt whether the respondents who made these reservations properly selected journals and accurately assessed the value of their own works, but it is worth considering the suggestions formulated in the interviews stating

that it is the broad repositories that should be not only a file archiving platform, but an institutional solution (modelled on the editorial-boards of journals), which would mediate between the author and reviewer, supporting the review process of the submitted article using appropriate algorithms.

The foundations of such a system already exist: journal editors based on the Open Journal System (OJS) report the need for a review regarding the pool of registered reviewers, and the person interested in the subject reports his/her candidacy. In some cases, it must justify this application, in others, it is enough to list his/her portfolio with the thematic range and keywords of the article and on this basis, the selection of the reviewer is approved. The respondents' proposal that the repositories should be entirely based on such a solution is interesting, mediating the search for reviewers, but this would have to fulfil several assumptions. First of all – full automation of the process, which would require user control of the repository (candidate for the reviewer) "upon entrance" (extensive portfolio, identification e.g. by ORCID, etc.). Only in this case would the robots (algorithms) be able to effectively and correctly perform the mediation tasks: they would define the pools of individuals best matching the thematic scope of the article and only would the possibility for review be enquired for this pool.

The proposal for such changes was met with the strong support of 53% of respondents and with reservations of the second part (almost 50/50 distribution). Proponents of the current system (47%) maintained that a small group of specialists in a given field, also known to the editor of a journal, who is also a respected figure in given circles, is the best guarantee of quality of scientific materials on the pages of periodicals. Proponents of change maintained that the current system prefers social ties, and the review of two, not always well-chosen reviewers, does not constitute any guarantee of quality. An additional argument for the automated selection system was, in their opinion, the possibility of increasing the number of required reviews to four and the obligation to publish the contents of the review. Interestingly, the proposal to disclose the contents of the review even convinced the supporters of maintaining the current system - they pointed out cases of submitting negative reviews, which obliged the author to improve the fragments of the text. After some time, it turned out that the text was slightly improved, and the editorial board allowed for its publication without hesitation. Respondents expressed their hope that the obligation to publish the text of the review would effectively stop publishers from applying such practices.

Respondents pointed out (91%) that an automated system of selection of reviewers would support the interdisciplinary nature of scientific research, because it would allow information about the article to reach a wider group of readers and reviewers than people permanently associated with a given journal (e.g. by searching other databases about reviewers). Representatives of the business world emphasised the general problem of searching for a special-

ist with "broad horizons" who, in co-operation with business practices, can effectively search for partners from side-fields, but important from the perspective of the project. Centuries of specialisation led to fragmentation, which is in clear contradiction with the needs of the modern world. In this sense, repositories centred in the OA movement allow a chance to return to the overall perception of knowledge while maintaining a specific structural discipline. What is more, within the framework of a single platform (assuming its specific functionality, of course), researchers could create sets of data and scientific materials consistent with the scope of their research interests, regardless of the systematics officially assumed. By their very nature, journals are not able to fulfil this function, even if they operate in digital form. Undoubted advantaged of repositories are also – based on e-commerce – systems for suggesting articles converging with user interests based on the analysis of data on previous searches. Such solutions are consistent with existing systems on the Internet based on the assumption that this information is looked for by the user, not a user of information. The risk associated with such an approach, however, means that a commercial system of promoting scientific content will greatly enter the world of scientific communication, which will deepen the disproportions between the most distinguished (and affluent) publishers and periodicals with limited SEO financing (search engine optimisation) and re-marketing activities. Many well-known publishers (e.g. Elsevier) and the largest repositories (e.g. ProQuest) already finance such solutions (with each search result in their databases, they present a list of titles converging with the essence of the user's query - obviously still limited to the content of their own databases).

The greatest discrepancy in respondents' opinions was observed in response to the question regarding the future of peer review systems. The most "radical" or "modern" group of respondents (36%) postulated to entrust the assessment of the quality of publications to artificial intelligence systems (artificial intelligence, AI), and thus, the complete exclusion of the "human" reviewer. The assumption of AI is to solve problems that are not effectively algorithmisable, which means that its element will include expert systems solving complex problems based on the analysis of knowledge bases, not the implementation of a simple algorithm, as is the case of traditional programmes [Jackson 1998, p. 2; Barrat 2013, p. 152]. With this assumption, the system of peer-reviewing scientific materials can achieve perfection much greater than ever possible for man, because the expert system will be able to supply complete knowledge available in open resources (which man will never achieve on the basis of his natural predispositions). This will ensure that every new scientific achievement will be verified within the context of all knowledge resources, not only those that are available to reviewers, additionally, in an incomparably shorter time, with the possibility of recognising innovative solutions. Research methods (their innovativeness, choice,

clarity, uniqueness, purposefulness, reliability, effectiveness) and correctness of inference will be analysed on the basis of algorithms that take the methodological achievements of the world of science into account. Not to mention such a trivial task (it undergoes simple algorithmisation and is currently used by numerous scientific journals), such as verification of a scientist's reliability (correctness of references, correspondence of quotations, date of publication and preservation of precedence, etc.). Just as today's promoters use anti-plagiarism systems to spot cases of unreliability of students and doctoral students, such an analogous system can be used independently or in the process of reviewing – e.g. to determine whether a given research area has not been explored previously using the same method. A surge in knowledge will undoubtedly require such solutions, and the question of time and financing of such solutions remains debatable. Evidence that such suggestions are not without scientific basis and cannot be treated as "science fiction" is visible in the project of the Faculty of Mathematics and Computer Science (Weizmann Institute of Science), whose use goes beyond reviews of scientific articles and can be used in any database powered by self-archiving (for more information see [Mizarro 2003]). Scientific journals are complex institutions, not just "administers of the publication process", but it is impossible to perceive them in terms of the only possible institution that protects the quality of research and scientific publications. Certainly, they are not threatened by simple data archiving platforms, which are currently scientific repositories – but the future of evaluation of research quality will be determined by solutions in the field of artificial intelligence.

However, a few respondents raised the problem of the difference between the notion of knowledge (which is subject to full codification) and wisdom (which means the resources of knowledge in relation to the system of professed values). At the outset, both man and the algorithm (programmed by man) have a certain system of values to which the scientific text under evaluation is related. However, while the reviewer in the course of the discussion and in the face of the author's arguments may assume a varying viewpoint, the robot (algorithm) operates within the limits set by the zero-one system. At the current stage of technological development, it is difficult to expect the ability to modify the value system of a machine's work - which is one of the foundations of scientific development.

An interesting argument for the search of a new model of scientific communication based on repositories are bibliometric indicators. 63% of respondents raised concerns regarding the legitimacy of applying commonly accepted measures of scientific activity, but could not propose alternative solutions. Only 2 respondents decided to present their own views on this issue, suggesting that the open access to knowledge system should become the basis for the readership of each article/author, on the model of solutions known to measure the popularity of entries on social networks. Of course,

this is not about trivial solutions: social networking sites value and evaluate (for commercial reasons) every act of consorting with published posts (keeping in sight for a prolonged period, "clicking", "liking", "sharing", etc.) regardless of the emotional involvement of the recipient (even if it gives the expression of disapproval, the algorithm takes the fact that someone has paid attention to the entry into account). At the same time, the social algorithms consider whether the media user only reads the entry, or also made it available to other users or has a comment.

New proposals for bibliometric evaluation should therefore aim at a model in which the analysis of the quality of reaction and intensity of interaction will be an important factor in the assessment. In the currently functioning system, only the fact of citing a given material/author is given, without being thoroughly analysed, whether the citation served polemical purposes, provided a comment strengthening the value, served the development of a given field of knowledge, was used interdisciplinarily, etc. Respondents (68%) suggested that open repositories should develop towards scientific discussion platforms rather than dead archives - bibliometrics would then to refer to a researcher's activity on the basis of scientific polemics and take the fact that some works may arouse more interest than others into account. The new model would also encourage researchers to become more involved in popularising their own work and science in general, both based on scientific social networks (e.g. Academia.edu) and portals closer to the business world (e.g. LinkedIn). 78% of respondents felt that journals were, in general, never a good place for lively scientific discussion - mainly due to physical limitations (time, scale and number of editions). At the same time, 82% felt that the current shape of scientific repositories did not meet the needs of a real exchange of scientific views. Social repositories (especially Gaudeamus and ResearchGate) were better rated, where 42% of respondents regularly search for scientific materials and contacts with representatives of other universities. Business representatives rated LinkedIn higher in this respect due to the much larger number of contacts, which translates into the speed of obtaining support in the event of a consultation request (88% of them regularly use this portal, e.g. looking for reports or information on analytical tools).

The above remarks indicate how far ahead the survey went into the future. However, there were also assessments (quite strict) on the existing state of university repositories. 82% of respondents indicated serious defects, including:

- depositing previously published scientific articles,
- duplicating such file formats acceptable in a given journal.

Authors (56%) expressed dissatisfaction with the fact that repositories do not allow the archiving of materials that did not fit in the article due to text volume limits, those that do not allow to deposit film or sound mate-

rials, even if such data were documented, for example, the course of an interview or experiment. In the survey conducted among young adepts of science, this fact was particularly stressed: all doctoral students emphasised that the electronic format of publications was intended to overcome physical limitations - including volume-related problems. Meanwhile, the need to deposit a faithful copy of the article, duplicates its limitations (the limit on the number of characters used)[11]. This means that a detailed description of the research method (e.g. the possibility to attach a questionnaire, a description of statistical tools or a programme created for the needs of digital analysis) must be omitted. This limits the field of scientific communication, in which discussion on the results of research as well as their course is equally important, and the review, which concerns not only the effects of research work, but also the tools used, is truly helpful. The solution given by 47% of respondents was the proposal to create two-way repositories in which a part devoted to the results of scientific research would limit the scope of materials to articles published and reviewed, and a less formal part would allow the opportunity to publish and discuss non-reviewed versions, methodological projects, research tools, etc.

According to 82% of respondents, one of the factors significantly hindering work on open repositories is the habit of publishing files in the so-called version of a portable document (Portable Document Format, PDF). Publishers and authors maintain that they protect themselves against unauthorised use of the file, which is a comic argument because the pdf file can be converted into any format. However, when a researcher wishes to compile statistical data from several files (which is the most authorised research method) - there is no way to do it from the repository base level. Business practitioners working in data mining system are developing their own tools to solve this problem, but researchers are left with tedious downloading of pdf files and converting them to their own drives. The false image of intellectual property protection means that science lags far behind commercial research.

79% of respondents drew attention to one more problem: many periodicals (even if they operate in the open access system) publish a specific issue of the journal as one file gathering all the articles of a specific issue. The database user is not able to group articles independently in accordance with the topic of research or projects being carried out – the only option is to download the complete notebook to their own device and possibly later prepare it for editing and own archiving. E. Rozkosz [2014] commented on this fact comparing the practice of issuing a digital version

[11] Interestingly, the use of such a publication system makes it impossible to achieve savings in the volume of published texts provided by digital publication, i.e. the use of so-called hyperlinks (digital links). In this article, the last 6 pages of the text version (Word) occupy a list of referenced literature items, which could be easily replaced by direct references to the Internet.

of the notebook in the form of a single file, with the trends in force in the first printed books (15th century). Alike incunabula, imitatinghand-written manuscripts, such a common form of digital edition resembles a paper copy of the issue of the journal.

The solution suggested by the respondents (used in some repositories and journals) is depositing individual articles on the repository's website, and as the platform's functionality develops - enabling users to create their own article lists and save independently defined files (such possibilities are provided by one of the older databases: ProQuest). This is a condition for the recognition of authors and it is an added value of the periodical, but requires the sharing of each article on a separate page along with metadata readable for indexing robots – i.e. web crawlers. This feature is available in all journals based on the Open System Journal (e.g. "Turystyka Kulturowa" [Cultural Tourism], "Turyzm" [Tourism], "Folia Turistica").

Proper indexing and meta-characteristics of the submitted articles are a prerequisite for repository success (ensuring wide access to recipients), because they allow to search publications from the level of scientific databases (such as Web of Science, Index Copernicus, SCOPUS, BazHum and those free of charge: Google Scholar, Scirus or getCITED) as well as ordinary internet search engines. Without this functionality, the repository does not differ significantly from a traditional library. The survey showed that only 30% of respondents are aware of the importance of providing each file deposited in the repository with an appropriate set of metadata (similar to the description of books in traditional libraries using a catalogue card).

How the authors dismissively refer to the need to assign metadata to files is demonstrated by a simple experiment: for the purposes of this article, 86 scientific articles in PDF formats deposited in the resources of 35 different e-journals were randomly downloaded and manually introduced into the BeCyPDFMetaEdit system[12]. In 58 of the analysed cases (taken from 24 different Polish scientific journals), the "digital catalogue card" was simply empty (see Fig. 1):

In 21 cases (coming from 8 journals), only the title of the journal appeared in all text fields (title, author, key words), instead of the metadata of a specific article and its author). In the repositories of 52 studied journals, whole issues are deposited in the form of a single PDF file (as discussed above). Because one PDF file can have only one "electronic catalogue card", this means that it is not possible to separately describe each article in the system. Increasing the visibility of the article or its author (indicated as one of the advantages of the electronic repository) turns out to be highly doubt-

[12] BeCyPDFMetaEdit is an application that can be used to edit various properties of PDF documents in the 1.6 version. This programme allows for modification of the subject, title or keywords.

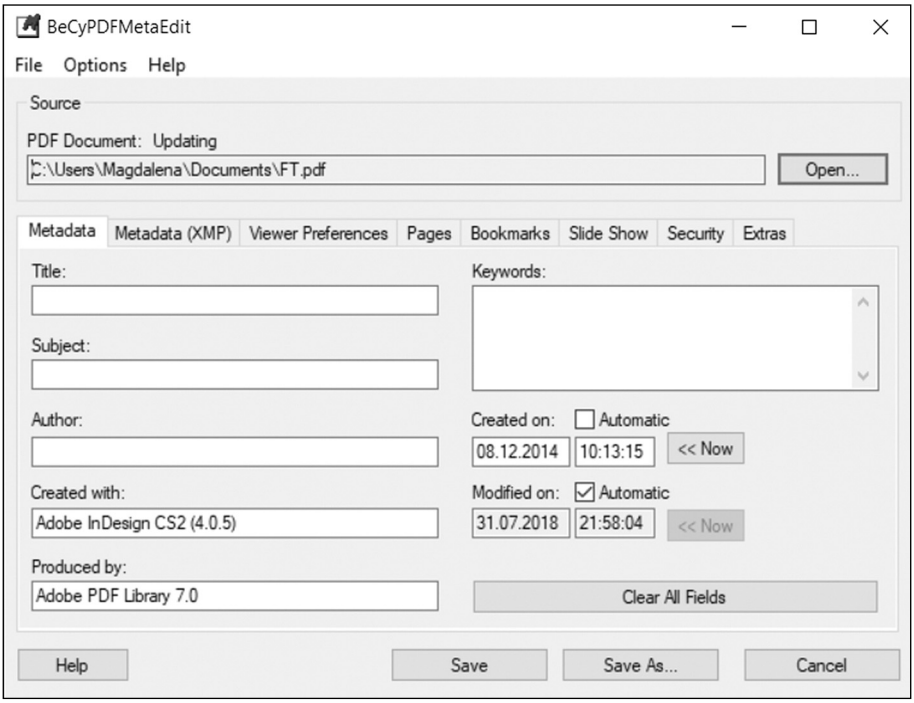

Fig. 1. Screenshot of the ”digital catalogue card” of a scientific article without metadata
Source: screenshot fromBeCyPDFMetaEditprogramme (own elaboration).

ful in this situation, all the more so because the indexing in the majority of the most important scientific databases (e.g. Web of Science or Scopus) is based on metadata files.

One of the added values of scientific journal repositories is the issue of software used to handle editorial work and the archive itself. Only 19% of respondents were aware that “what you cannot see”, i.e. the software, can be more important for the visibility of an article in online resources than the journal’s rank or scientific editors that lose their meaning in virtual space if they are illegible to algorithms. Only 2 journal editors, who were in the group of respondents, were aware that the right software – the so-called Content Management System (CMS) - is a significant added value to a periodical.

Concluding considerations on the subject of scientific repositories, it is worth adding that R. Kling et al. (2002) also proposed a model for publishing via guilds or confraternities as a less formal complement to the scientific communication system in which a group of scientists focused on one leading topic would share scientific materials, construct structured discussions, hold discussions on the first versions of unpublished materials (so-

called pre-releases) by expanding the group of people authorised to view the shared materials also by business representatives. On the basis of tourism sciences, such a solution was proposed by W. Rozwadowski creating a group called the "Tourism Confederation" on Facebook – quite quickly, it turned out that the group does not activate users beyond the usual "sharing" and "likes" used in social networks. Perhaps it is the nature of this medium (Facebook) that made it impossible to persuade scientists or practitioners to deepen discussions, share research results or planned research projects[13].

It seems that new electronic publishing models based on self-registration could revolutionise scientific communication, making it more efficient and effective [Crow 2002, p. 11; Pinfield 2003], however, assuming full transparency of the process, reciprocity of all parties and of course the lack of opportunistic attitudes, from which, unfortunately, there is no free academic environment (this view is shared by 86% of respondents). In the scientific world, where the costs (financial and temporal) of obtaining research material are very high, the fear of theft is enormous. This was the main reason for the failure of one of the largest publishers (Elsevier), who created 3 platforms dedicated to discussions on pre-print articles (chemistry, mathematics and IT). Despite a wide range of readers, the researchers were not willing to share materials not earlier published, and as a result (May 24, 2004), Elsevier finally closed all 3 platforms. The implementation process of new functionalities must take a certain level of researchers' readiness for change into account.

The Open Access (OA) movement and business and distribution models of the scientific communication system

Open Access Idea

The Berlin Declaration on Open Access of October 23, 2003, signed by 55 institutions around the world [www.zim.mpg.de/openaccess-berlin/berlindeclaration.html], defined open access as "immediate, permanent, free online access to the full text of all reviewed articles from scientific journals"[Harnad 2005]. The Declaration itself was the result of an actively developing movement gathering stakeholders of the scientific communication process under the name Open Archives Initiative (OAI). Its peak was

[13] The TRINET (Tourism Research Information Network) system created by the University of Hawaii (represented by Pauline J. Sheldon) and the University of Wisconsin-Stout (represented by J. Jafari) achieves slightly better results, but it is a fairly simple system of automated, multi-sided e-mail correspondence service, not a scientific repository [http://tim.hawaii.edu/about-values-vision-mission-accreditation/trinet/].

the Santa Fe Convention of 1999 [www.openarchives.org/], which set itself the goal of creating searchable databases of research materials and making them available on the Internet. The process centre is a protocol to collect OAI metadata [www.Openarchives.org/OAI/openarchivesprotocol.htm], which allows collection and accumulation of metadata from many archives.

The goal of the open access movement is to overcome the monopoly of large commercial publishers, as well as to provide scientific information to users while maintaining copyrights for its creators [ODLIS 2004-2007]. The open access movement is also a reaction to unfavourable phenomena in the very process of scientific publishing: long waiting-time for reviews, limits of texts accepted for publication and monopolistic practices of their publishers and distributors [Niedźwiedzka 2005].

Such international organisations as OCED and the UN have had certain impact on the development of the Open Access movement. This is evidenced, among others,by initiatives such as the OECD Declaration on Access to Research Data from Public Funds from January 30, 2004 [*Komunikat* … [Announcement ...] 2007], or the Declaration of principles and action plan for the Information Society (WSIS) from December 12, 2003 [*Światowy szczyt* … [World Summit ...] 2003]. There are also numerous international and national research projects devoted to potential difficulties in managing electronic archives (copyrights, reviewing and quality control procedures, archiving and availability of space on the servers of the institution, differences between subject domains, diversified nature of research institutions, and others). An example of such a project was FAIR (emphasising access to institutional resources), financed by the Information Systems Joint Committee (JISC) of the United Kingdom of Great Britain (2002-2005), under which projects related to repositories and intellectual property rights were financed [Bruce, Cordewener 2018].

In May 2018, the list of journals in the Directory of Open Access Journals (DOAJ) included 11,888 peer-reviewed open access journals (over 3 million articles), covering all disciplines: from agriculture to philosophy, including 535 Polish scientific journals[14]. Presence in the DOAJ database is prestigious and places the journal in global circulation, while the "Arianta – Scientific and professional Polish electronic journals" database created in 2005 [http://www.arianta.pl/] contains information on about over 2,300 Polish periodicals, which have their own websites and at least provide archives of contents on them [Drabek, Pulikowski 2005-2009]. The appropriate check boxes allow to narrow a search to periodicals with abstracts and/

[14] The database records only one Polish scientific journal in the field of tourism ("Turystyka Kulturowa" [Cultural Tourism]) and "Bulletin of Geography. Socio-economic Series"(which also includes articles about tourism). Unfortunately, there is a lack of Polish journalswith the longest tradition in the area of tourism sciences ("Turyzm" [Tourism] and "Folia Turistica"), despite the fact that they make articles available in the open formula.

or full texts (see Fig. 2). The database also allows the selection of journals scored by the Ministry of Science and Higher Education (MNiSZW), indexed in the Web of Science database (the so-called Master Journal List) or Index Copernicus. The information card of each journal contains information on

ARIANTA

NAUKOWE I BRANŻOWE POLSKIE CZASOPISMA ELEKTRONICZNE

Aneta Drabek i Arkadiusz Pulikowski

Folia Turistica	
Adres strony WWW:	http://www.folia-turistica.pl/
Drugi adres strony WWW:	http://wydawnictwa.awf.krakow.pl/index.php/czasopisma/folia-turistica/111-folia-turistica
ISSN:	[e]2353-5962 ; [p]0867-3888
Index Copernicus:	2008: 3,43 ; 2009: 3,58 ; 2010: 3,73 ; 2012: 3,79 ; 2013: 5,77 ; 2014: 69,11 ; 2015: 59,05
Punktacja MNiSZW:	2007: 4 ; 2009a: 6 ; 2010a: 9 ; 2012: 8 ; 2012a: 8 ; 2013: 7 ; 2014: 7 ; 2015: 11 ; 2016: 11 ; 2017s: 11
Data początkowa:	1990
Data online:	1990
Wydawca/Instytucja sprawcza:	Akademia Wychowania Fizycznego im. Bronisława Czecha (Kraków)
Symbol UKD:	379.85
Częstotliwość:	kwartalnik
Spisy treści:	1990/1-2017/4(44)
Abstrakty:	1990/1-2017/4(44)
Pełne teksty:	2009/20-2017/4(44)
Wskazówki dla autorów:	http://www.folia-turistica.pl/index.php/pl/dla-autorow
Branżowe:	NIE
Tylko online:	NIE
Wyszukiwarka:	NIE
Korzysta z Open Journal Systems:	NIE
Data aktualizacji:	2018-07-03
Dziedzina:	turystyka
Indeksowane w:	SPORT Bibliografia Geografii Polskiej IC Journals Master List BazEkon PBN - Polska Bibliografia Naukowa

« Powrót do wyszukiwania »

Fig. 2. Journal specification of ”Folia Turistica” in the Arianta system.

Source: www.arianta.pl

the website address, ISSN, Index Copernicus level and MNiSZW score, the date of the first issue (including the first on-line edition), publisher, UDC symbol, frequency, availability of content lists, abstracts and full texts, industry affiliation and scientific field, forms (on-line or also paper version) as well as a list of databases indexed by the journal. One of the most important information available from the Ariane level is an indication of whether the journal uses the Open Journal Systems (mentioned earlier).

When considering the resources of the Ariantadatabase (as at 27/07/2018), it can be established that among Polish publishers of OA journals, higher education institutions (402 titles) and scientific associations (175) are dominant. Later positions are occupied by private publishing houses (145), centres of the Polish Academy of Sciences (112), and research institutes (81). Fewer titles appear thanks to libraries, museums and archives (38), ministries and central offices (36), foundations (22). Nearly 24% are publishing houses that provide full resources, including journals, whose archives date back to the 1950s (e.g., "Zeszyty Naukowe Uniwersytetu Jagiellońskiego. Universitatis Iagellonicae Acta Mathematica" [Scientific Notebooks of the Jagiellonian University. Universitatis Iagellonicae Acta Mathematica] and "Acta Palaeontologica Polonica"). Most titles (132) regard journals in which, from the beginning of their existence, a printed and electronic format or only electronic version (on-line) has been adopted. According to A. Drabek [2009], when the Arianta base was being created, most Polish OA journals represented medicine and some disciplines in exact sciences. It was difficult to find any full texts concerning the humanities or social sciences. In the last two years, this situation has significantly changed, although the number of medical full-text journals continues to dominate (176 titles out of 961).

As pointed out by S. Pinfield et al. [2002], tools are widely available that ensure the compliance of metadata with OAI, which allows them to be indexed by search engine and scientific database robots. Repositories conforming to OAI standards, for example Citebase[http://citebase.eprints.org/cgi-bin/search], provide the ability to compile statistics and analyse article citations, creating a list of publications according to author or topic area and enabling sharing of improved links and analyses of an author's work [http://eprints.nottingham.ac.uk/informatio.html]. It is an invaluable tool enabling, for example, the identification of the least and the most exploited research areas and making decisions about directing funds for further research.

Journals and repositories in the world of Open Access: in the direction of a business model

Open Access distribution models comprise two basic forms: the "golden" and the "green" principle of open access. In the first case, scientific articles can be made available to readers by publishing in an open journal, and the

second form means depositing them in an electronic repository that can be searched from remote locations without access restrictions [Swan, Brown 2004, pp. 8-11; Maciejewska et al. 2007].

In a legal sense, the following can be distinguished:

- free OA, which grants the right to distribute a work or object of the related right in such a way that everyone can have access to them in the place and time chosen by them and the possibility of free and unlimited technical use of them in accordance with the relevant provisions of permitted use or other exceptions provided for by law,
- libre OA, which enables the dissemination of a work or object of the related right in such a way that everyone can have access to them in a chosen place and time, granting everyone a license for unlimited, free and non-exclusive use of them and from their possible elaborations; the license may contain provisions imposing the right to unlimited, unpaid and non-exclusive use, such as the obligation to provide the recipient with information about the creator, producer or publisher, the subject of the license and its provisions, or the obligation to provide the recipients.

The conducted survey showed that open access is identified by 89% of respondents with no fees, but in reality, this principle is not always implemented by the publishers in the most desirable way (full-text database available as soon as possible, for free and without any restrictions). Often, restrictions and conditions are established that secure the interests of publishers. Contrary to the assumptions of the Berlin Declaration, publishers defend their position while attempting to enter wide circulation, which is undoubtedly guaranteed by the open access movement.

The issue of financing scientific communication is becoming a challenge –whatever form it takes on eventually. For now, it seems that scientists and publishers are increasingly opposed towards each other, and the financial interest of publishers outweighs the need for scientific development. The problem is growing as more and more authors strive to publish articles in journals with the highest possible impact factor, if only because of the procedures for granting scientific grants. This is often associated with serious costs. The cost of accessing full-text databases is less noticeable, because it falls mainly on university libraries, but as they are forced to eliminate further titles - it begins to be painful for the readers themselves. Acertain practice of publishers is to create a package list of titles that a library must purchase, regardless of the actual interest of potential readers.

The effect of the intensifying discussion are very different solutions, some in the public sphere, others in the commercial one. B. Bednarek-Michalska [2013, p. 12] indicates that “on the one hand, we have serious government decisions in the US, Great Britain and the European Union regarding the introduction of open access models wherever public money is invested, and on the other, proposals from publishers who implement totally new open busi-

ness models". While it is obvious in the case of commercial journals that we are dealing with a company and a profit-oriented activity, the question arises whether the functioning of journals and scientific repositories financed from the budget should also be seen in the context of the business model.

According to definition, the business model is "the representation of how business creates and delivers value to clients and enterprises" [Johnson 2010, p. 22]. Expectations formulated for scientific journals – presented both in the overview and in the results of surveys – indicate that both authors and recipients of scientific knowledge treat scientific journals as suppliers of specific values (prestige, recognition, accessibility, branding, knowledge transfer, quality control, etc.). This is the minimum value that must be provided by scientific repositories. And creating value requires specific input. If the repositories were to take over the functions of scientific journals (assuming that many of them will require development work in the IT area), it would be naive and simplistic to assume that the model will finance itself only because the right to free access will be equivalent to consent for free sharing of research by authors. Other costs also remain (e.g. technology).

The frequency of such words as "free", "free-of-charge", etc. in publications regarding OA and respondents' statements may be optimistic, but no manager can be fooled by the illusion of 'free dinners'. Maintaining "free" repositories, in fact, absorbs enormous costs (machines, energy consumed by servers, technical service). In the American model, the publisher of a journal is usually an independent entrepreneur who autonomously takes care of the virtual space in which s/he will place a scientific repository. Thus, s/he must seek funding for such an investment. In the case of public entities, one can for a time reach for state subsidies or EU funds for the purchase of modern servers or software, but without a clearly defined business model, it may turn out that it is impossible to continue financing of the repository. What then does one do with a database of thousands of files and the trust of their depositors?

Currently, in the simplest operating model, open access repositories are created and maintained by a scientific unit (e.g. a university), which is obliged to provide adequate space on its own servers, ensuring repository administration and the quality of deposited scientific articles (review system). In many cases, universities find sponsors to cover the costs: an example of such a model was (suspended in 2017) D-Lib Magazine [www.dlib.org], financed by subsidies from the DARPA (Defense Advanced Research Project Agency) and NSF (National Science Foundation).

The second widespread open access model is publication on a commercial basis: the authors or their institutions pay for the publication of the article (including the review process), and then, the publisher provides the article free of charge, in electronic form. This model is used, for example, by BioMed Central (BMC) [www.biomedcentral.com], which launched an open

access service in 2000. Even if the system has not been officially adopted in Poland (although some journal use "the publishing pays" principle), it is in a veiled form in the case of publication of conference articles or of special issues. The absurdity of this solution is obvious when we take the fact that we are still talking about public funds from university subsidies into account. Similar business models are used by the largest publishers: Elsevier, Emerald, Ebsco, Wiley and Nature Publishing – not being able to directly obtain financial gain from sales for the production costs – use a system of fees from authors (Emerald charges them after accepting the text for publication – about $ 1,600 per article). Some university publishing houses also went in this direction: Oxford University Press [http://www.oxfordjournals.org/oxfordopen], the University of Tromsø Septentrio Academic Publishing [http://septentrio.uit.no], or Stanford University High Wire Press [http://highwire.stanford.edu].

It is hardly surprising considering that apart from the technical cost of maintaining open access databases, there remains the cost of verifying the quality of scientific materials (usually in the form of the cost of performing review, and in the future, probably the purchase of appropriate software). Here again, the innovativeness of Polish solutions consists in the ordering "free" reviews - in fact, carried out for the price of time of the scientists who, in return, benefit from the possibility of free (or relatively inexpensive) publication on the pages of a given journal. In commercial open-access models such as "the publishing pays", the publisher pays for a review procedure of submitted materials, but s/he charges fees for publishing in the journal. In "the buyer pays" model, the costs of the publisher's functioning are placed on the reader (in case of independent purchase of access to the repository's resources).

Such a diversified system is unclear and hinders the circulation of scientific information [Allen, Hartland 2018]. It also provoked the development of the pathological phenomenon of "predatory journals", which is often and extensively written on the blog by the researcher in the world of scientific publications – E. Kulczycki [2017]. One of the active organisations in the field of limiting similar abuses and efforts to develop a coherent transparent system of financing scientific communication (including appropriate business models, tools and standards supporting modern scientific communication) is the international organisation of open publishers of the Open Access Scholarly Publishers Association (OASPA), established in October 2008, which groups commercial and university publishers. Their list (Fig. 3) is highlighted on the Association's website [https://oaspa.org] and allows to review the policy of each publisher (including checking which business and legal models they prefer).

University (publicly funded) OA models require thinking about further development in terms of a very flexible business model due to the rapid pace of changes in the environment (including technological changes, the direc-

Title	Polish Botanical Society
Class	Professional Publisher (Small)
URL	https://pbsociety.org.pl/journals
Owner	Polish Botanical Society – nonprofit organization
Address	Al. Ujazdowskie 4, 00-478 Warsaw, Poland
Copyright link	*Acta Societatis Botanicorum Poloniae*: https://pbsociety.org.pl/journals/index.php/asbp/about/submissions#copyrightNotice *Acta Agrobotanica*: https://pbsociety.org.pl/journals/index.php/aa/about/submissions#copyrightNotice *Acta Mycologica*: https://pbsociety.org.pl/journals/index.php/am/about/submissions#copyrightNotice *Monographiae Botanicae*: https://pbsociety.org.pl/journals/index.php/mb/about/submissions#copyrightNotice
Copyright policy	The OA publications are distributed under the terms of the Creative Commons Attribution 4.0 License (https://creativecommons.org/licenses/by/4.0/), which permits redistribution, commercial and non-commercial, provided that the content is properly cited.
Complaint email	Each publication has general email address. *Acta Societatis Botanicorum Poloniae*: asbp@pbsociety.org.pl *Acta Agrobotanica*: aa@pbsociety.org.pl *Acta Mycologica*: am@pbsociety.org.pl *Monographiae Botanicae*: mb@pbsociety.org.pl
Complaint policy	No specific policy on complaints.
Publication charge link	*Acta Societatis Botanicorum Poloniae*: https://pbsociety.org.pl/journals/index.php/asbp/about/submissions#authorFees *Acta Agrobotanica*: https://pbsociety.org.pl/journals/index.php/aa/about/submissions#authorFees *Acta Mycologica*: https://pbsociety.org.pl/journals/index.php/am/about/submissions#authorFees *Monographiae Botanicae*: https://pbsociety.org.pl/journals/index.php/mb/about/submissions#authorFees
Publication charge policy	If a submission is accepted for publication, the author will be asked to pay the article publication fee to cover publication costs. The publication fee divers between journals. In case of the monographic series – *Monographiae Botanicae* – there is no publication fee.

Fig. 3. Polish Botanical Societyspecification in the OASPA database
Source: https://oaspa.org

tion of which cannot be predicted today). In this particular case, the business model cannot be solely based on financial profit – it must benefit from various sources to effectively build the image of aunit (university, journals), and indirectly – provide benefits to authors and the scientific communication system. In the case of OA models financed from public funds, it is not so much about generating profits, but rather about thoroughly thought-out and effective spending of public funds. The strategy of operation of such an entity (journal, repository) should predict benefit reporting that science and society (the taxpayer) achieve due to financing its activities. In OA models, one of the most important benefits is the fact that the undertaken "production" (scientific research, description of results, publication procedure) is available to everyone without legal, economic or technical constraints and can generate revenues resulting from the innovation of those who use free knowledge resources.

For now, the pace of technological development does not go hand in hand with the discussion on the assumptions of functioning and mutual relations of repositories, scientific journals and their funding systems, in which the stakeholders are the readers, librarians and advertisers or sponsors. Each of these groups represents different possibilities, abilities to pay title fees, communicate with the publisher and receive special marketing offers. B. Bednarek-Michalska [2013] identified several of the most popular business models of scientific journals based on:

- advertisement,
- crowdfunding,
- e-commerce,
- guaranteed fund,
- fund-raising,
- mixed model (hybrid),
- institutional support,
- membership fees,
- the "pay for second issue" principle,
- the "collecting fees for publishing the article" principle,
- submission fees.

All of them have already found their place on the publishing market. The simplest and the most tempting (charging for publishing or submission of an article), contrary to popular belief, are available only to 'big-league players', with a great reputation and high impact factor. In the case of little-known titles and insignificant repositories (created by secondary scientific units), determining the value provided to recipients should be particularly considered. The problem of the OA business model is all the more urgent because 'big leaguers' are already appearing on the market, exploiting the resources of open access knowledge on extremely commercial terms, thus, taking over the business model of the largest publishing houses, but on an incomparably larger scale. An example is the gigantic J-Gate open-access portal (over 50,000 in-

dexed journal titles publishing peer-reviewed texts and a powerful database of unrecorded materials) whose pricing policy (a model based on "the buyer pays" principle) is so opaque that obtaining information about the access price (for an individual or institution) requires separate e-mail correspondence. It is not difficult to guess that such practices will not only not solve the problem of scientific communication caused by the largest publishers of scientific journals, but will lead to the intensification of the oligopolisation of the scientific publication market (in terms of price and distribution) based on solutions well-known from the on-line booking market.

An argument for the well-thought-out design of the open access business model should also be the issue of knowledge transfer to the economy. Access to the results of research in the open access system is obtained by all entities – regardless of added value. Meanwhile, the business world manifests an unusually low inclination to share the results of its own research, often priceless from the point of view of science, while waiting for access to the latest results of socially funded research. In the conducted survey in the group of respondents representing business entities, only 6 people considered supplying the repositories with the results of their own research (e.g. in the field of data mining, measuring the effectiveness of distribution channels or logistic solutions), and none were willing to share the methodological description of the conducted research (rightly stating that it is the know-how of the enterprise and the basis ... of the business model). At the same time, respondents declared frequent (at least once a month) or very frequent (once a week) use of free knowledge base resources. The issue of public goods, which scientific repositories become, has already been raised earlier, but it is worth noting that in a situation of permanent underinvestment of the sphere of science and, at the same time, providing its products for commercial purposes, encourages the search for more "just" solutions. The business model guaranteeing access on the basis of a subscription for the world economy could then assume exemption from fees in the case of research co-operation, sponsorship of research or regularly supplying the repository with the results of research conducted by enterprises and corporations.

Organisational challenges

Editors, librarians or managers for scientific matters?

The final cost of depositing an article in a scientific repository is zero, so the investment, which is the creation of a repository, makes sense when it is filled as quickly as possible with a large number of deposited scientific articles. Unfortunately, young repositories encounter numerous obstacles in this area -starting with ignorance of the authors and misunderstanding of

the importance of the whole process, to legal issues (the need to clarify the right to submit of the article) ending with technical problems that effectively discourage them from doing so. M. Rychlik and E. Karwasińska [2008], examining the attitudes of employees of the Adam Mickiewicz University in Poznań towards the institutional repository of this university, observed that respondents who were above the age of 65 were marked by a negative attitude towards digitalisation. A survey on the attitudes of SGH academic staff conducted for the purposes of this article (repository put into implementation in May 2018) showed a slightly different relationship: people who had previously deposited their articles in any repository (54%), e.g. Academia.edu or Research Gate more willingly referred to the possibility of using another database, which is the SGH repository. The greatest resistance towards the procedure of depositing works aroused among those who undertook this task for the first time (12%). These individuals most often showed incomprehension of the purpose of this process.

Respondents least eagerly referring to the idea of self-archivisation in the scientific repository raised quite a surprising issue of exposure to the theft of the results of their own work despite the fact that they did not report similar concerns in relation to paper publications. This means that scientific repositories – in the opinion of at least part of the scientific community – are not yet perceived as a medium comparable to traditional publications, despite the fact that the time of depositing the material is dated, giving the time and place, and thus, allowing to prioritise the publication of scientific achievement.

Experiences of actions in the area of self-archivisationto date indicate that the whole scientific community is not ready for radical changes in the method of scientific communication and keeps up with technological requirements. To a large extent, the burden of educating this special environment fell on the editors of scientific journals who – themselves, being immigrants of the digital world – had to accept changes more quickly than their colleagues, facing challenges and learning about the opportunities offered by the digitalisation of science. Their efforts are not always crowned with success, because the dynamics of changes in the virtual world is incomparably greater than the possibilities of flexible adjustment of quite ossified structures of scientific institutions, within which these journals function. The problem is often the lack of proper IT support, or more precisely, the possibilities of communication between the world of science and programming: each action and expected result requires translation into the language algorithms that are readable for robots, which in fact, are all scientific databases.

The roles and tasks of editors of scientific journals more and more often go beyond the traditional functions of the scientific editor, who, in part, performed managerial functions (management of the editorial team and a team of reviewers), but primarily, with his/her achievements and recognition in

the scientific community, s/he was to build prestige and trust in the journal. Bringing its role to the education of scientific communities and striving for proper indexing in scientific databases seems to be a typically managerial task, which raises the question of a completely new function (profession?) in the structures of scientific information (see also [Correia, Teixeira 2005; *Who are…* 2018]), and perhaps even in the structures of specific scientific institutions, considering that scientific repositories in the future will be less and less connected with a single journal and more often with an institution (or collection of institutions) of scientific research. Let us tentatively call this person a scientific communication manager: in the J-Gate team, this function is referred to as the "information scientist" or "information manager" [*Who are* ... 2018].

The tasks of such a person include undertaking an initiative to create or develop open access repositories, which, in particular, requires communication of a new publishing culture (with different levels of advancement within different disciplines), development of management structures taking the technical capabilities of the unit and improvement or validation of materials provided by the authors in the area of their meta characteristics into account. The challenge is also to ensure the stability of archiving (the discipline of file depositing) and to promote discussions on the principles of open access among academic communities (including providing bibliometric data illustrating the benefits ofa wider exposure of publications).

The most difficult area regards tasks related to the elaboration of new rules for the evaluation of the quality of scientific articles and bibliometric indicators regarding system performance (including the number of downloads and citations at the level of a single article). This range of tasks falls within the scope of big data analysis and, as such, is a completely new area for the majority of journal editors. Here, the combination of in-depth knowledge of the principles of scientific environment and knowledge functioning in the field of digital analytics will be of key importance from the point of view of seeking new solutions: technologically advanced and, at the same time, guaranteeing respect for the rights and interests of authors. Thus, the tasks of the scientific communication manager must cover the co-ordination of various advisory programmes and support for researchers dealing with copyright issues and the development of principles for negotiating self-archiving rights.

Scientific repositories and the popularisation of research results

An interesting conclusion from the survey conducted for the purposes of this article turned out to be the opinion of respondents on the participation of the scientific community in popularising knowledge via the Internet. This scope of observation is somewhat beyond the subject-area of the arti-

cle, but at least one point is significantly related to the issue of open scientific repositories, especially non-referenced publications, which could add significant value to digital scientific journals (by limiting their resources for reviewed articles). Respondents pointed out that scientific publishing has always played a key role in disseminating science and research, influencing innovation in the world, but the development from recent years has caused changes dramatically eliminating traditional methods of distribution and popularisation of knowledge.

Many scientific publications are subject to rapid dissemination of channels other than those to date, often with the omission of commercial and university publishers. At the same time, breaking through the information buzz and in the era of an online flood of content, professional activities (an appropriate business model justifying high expenditures for creating and publishing content) or passion are required, of which the sacrifice is time. It is difficult to expect that scientists, whose task and duty is to multiply knowledge resources, take on the organisational, temporal and financial burden of such activities, because this would not be without effect on the quality of their scientific work. It is enough to recall the analogy of procedures for acquiring, managing and reckoning for scientific and research grants, in which support for parent units is purely symbolic, and researchers instead of concentrating on the merits, are forced to conduct extensive correspondence and administrative reports that in commercial institutions (e.g. the largest consulting companies) are conducted by assistants.

Contrary to the applied comparisons, access to knowledge and the avalanche increase in the amount of information are significantly different from the first information revolution caused by the invention of printing. At the end of the Middle Ages, increasing the availability of knowledge and information was an undoubted leap in civilisation, but the responsibility for creating knowledge, and even making it available (printing and distribution of content) remained a privilege of the few for many centuries. Meanwhile, the recent decades of continuous development of Internet technology are a revolution of a different kind: the freedom to access the Internet concerns not only its resources, but also technological possibilities, constantly modified by thousands of prosumers[15]. The development of free software and

[15] From the point of view of economic sciences, prosumption is the process of the consumer undertaking activities that create value, the result of which is a produced product that ultimately is consumed by him/her. The process of activity itself shapes the consumer's experience with the product [Szymusiak 2015]. In sociology, the term regards the phenomenon that causes the blurring of the market division into the sphere of production and consumption. It is a process involving the participation of individuals or their organised groups in the production of a product intended for own use [Toffler 1980]. An example of prosumer activities in the field of Internet technology development is the Mozilla project, referring to the postulates of the so-called open source movement. It includes hundreds of programmers (including amateurs) in the process of creating solutions and applications that are an alternative to the offers of the largest manufactu-

the simultaneous race of commercial internet applications (including blogging tools, social networking sites), as well as the widespread availability of electronic devices, have given freedom to create and publish content by all users: regardless of the level of knowledge, sense of responsibility and language skills. This caused an avalanche of subsequent changes in the virtual environment. Social media function entirely on the basis of the Web 2.0 philosophy, which means, among others, the disappearance of users' division into senders and recipients of content, but also lack of systematic verification of the quality of materials published on the Internet.

Scientific circles reacted to these phenomena late – when it became obvious that the widespread availability of information does not go hand in hand with universal access to knowledge, which is a prerequisite for skilful information filtering and the selection of valuable content. Elite environments of educated individuals, responsible and in charge of the quality of their own publications, turned out to be relatively passive when it comes to conscious actions to ensure universal access to scientific knowledge resources. "Universal availability" should be understood here as an appropriate manner of presenting research results, the language of expression used and an attractive form of publication, corresponding to the needs and capabilities of a mass audience.

This phenomenon is neither new nor related solely to the creation of the Internet: articles and scientific monographs have remained intellectually unavailable to the average recipient for centuries. The new media only highlighted the gap between the world of scientific publications and the mainstream information flow: often falsified, biased, unverified, unstructured logically, devoid of scientific foundations, but attractively provided and easily acquired. In the awareness of many representatives of scientific circles, there is also an image of social media (and, more broadly, the Internet) as a place of trivial entertainment and shallow messages, in which – without compromising rank and seriousness – "true science" does not exist and should not take place. Commercial research institutions have much less resistance in this respect, as shown by the excellent publications on LinkedIn (e.g. a film channel run by WSPS, Harvard or LSE) and (still not quite numerous) professionally developed Wikipedia entries (preserving all the features of scientific publication). In both cases, popularising publications created by the world of science in new media support the process of strengthening the brand (universities, research teams) and creating the so-called "ranges"[16], which quickly bring a quick response to announcements

rers of operating systems and Internet tools. The result of their collective effort is, among others, creation of the largest non-commercial Internet browser – Firefox, and a number of other tools available to people who do not even have a basic knowledge of programming.

[16] In the new media, the term "range" refers to the number of unique users for whom the given information was actually displayed.

about scientific conferences or recruitment for higher education (here is an example of the University of Warmia and Mazury in Olsztyn in the area of recruitment in the field "Analysis and trend creation" conducted on the Instagram website).

The revolution in the world of scientific information continues, and tracking its course is necessary in order to quickly respond to subsequent changes for the benefit of the scientific unit, the authors themselves and, above all, the world's knowledge resources and the development of science. This means additional responsibilities for active participation in organisations and on forums dealing with open access to learning. It also brings forward new challenges in the field of designing the functionalities of scientific repositories: 67% of respondents recognised that repositories offering simple tools for sharing knowledge and scientific achievements in a less formal form than scientific articles would be a desirable tool for popularising knowledge. Social repositories (Acedemia.edu, ResearchGate, J-Gate) moved in this direction, enabling simple ways of communicating short messages in the form of a stream of messages (similar to solutions known from microblogs). By means of hyperlinks leading to additional materials (also full texts of scientific articles), readers can be directed to resources of scientific knowledge, but the very introduction of a strictly popularising nature gives the chance to acquire recipients from outside the scientific group. A similar assumption was adopted by the LinkedIn portal, which introduced the option of an internal blog: here the effectiveness of popularising knowledge and its transfer to practice is all the greater because the portal reaches the business audience. Unfortunately, in the surveyed group, only 8% of the scientific representatives use LinkedIn for purposes other than posting their own business card, while all the surveyed business representatives systematically publish research results and reports, thus creating their own portfolio or of the represented company, acquiring new business contacts and partners for future research.

Summary

A review of the subject-related literature and a survey among a group of authors systematically publishing the results of scientific research have identified the various functions of scientific journals, which seem to be a prerequisite for the correct circulation of scientific information. Many of them have already taken over online knowledge distribution channels, including open access scientific repositories. There are still few, but inalienable functions, which in the current state of technological development, repositories are not able to handle: in particular, one of the foundations of the development of scientific communication, i.e. qualitative verification of the

knowledge being made available. The barrier to the development of appropriate digital system functionality is not only the insufficiently advanced level of artificial intelligence development, but also legal uncertainties and the opaque financing structure of scientific communication, which have been associated with the development of open access services from the very beginning. Increasing the pace of work on new solutions requires a team of specialists aware of the importance of science and the specificity of the scientific community, as well as technological issues affecting the efficiency of the target forms of scientific communication. Managers of scientific communication development should consist of a group representing the interest of science creators and society burdened with its development costs - unfortunately, nowadays the awareness of the need to educate specialists in the new profession has mainly been noticed by commercial repositories, which threatens maintaining or even increasing the crisis of scientific communication.

According to the respondents, repositories can and even should offer functionalities lacking in the environment of paper circulation of scientific information: we are talking about a fast rate of knowledge distribution, faster knowledge transfer between the world of science and economics, and effective and attractive ways to popularise scientific achievements (using a variety of recording forms – text, sound and graphic). Currently, there is no indication that repositories created on the basis of this initiative of scientific institutions should fully respond to this postulate, although examples of good practices can be found (including unsurpassed NASA, but also the Polish portal experimentychemiczne.pl). To a much greater extent, the dissemination of knowledge remains a domain of business representatives, who see in it new opportunities to popularise their own brand. This leads to the conclusion that the value offered to all parties (stakeholders) of the scientific communication system absolutely requires working out appropriate business models that will allow for the professionalisation of such activities.

The burden of tradition remains a barrier. The existing communication systems in science have been dominated by scientific journals whose origins date back to the 17th century. Repositories (often made available in the form of OA or in another free form for users) can definitely change this situation. Undoubtedly, the change of century-old habits will require time, but the dynamics regarding the expectations of young adepts of science and their freedom of movement in the world of new technologies are already clearly conducive to the dissemination of new forms of knowledge sharing.

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