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An Exploratory Study into Professional Scholarly Journals Publishing Software Adoption in Lithuania

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Abstract. *Introduction.* This study investigates the adoption of professional scholarly journal publishing software in Lithuania, with a focus on the trends and patterns of its use in 2020. It underscores the limited research on proprietary software and the absence of comprehensive country-specific case studies. *Method.* We compiled a list of sources by manually reviewing all journal websites and independently verified the collected data against other databases. Additionally, we contacted publishers individually via email to clarify the data. *Analysis.* Data were analysed using descriptive analysis with the help of SPSS statistical package. *Results.* The analysis reveals that the second- or third-generation Open Journal Systems (OJS) software is the most popular open-source publishing solution, utilized by nearly half of the Lithuanian journals. The Social sciences and Technology sciences are the most frequent users of OJS, both in Lithuania and abroad. The use of OJS in Lithuania gradually decreases to 24% as one moves from publication towards production management, with a significant reduction in the use of OJS for manuscript delivery. The increased use of proprietary software for manuscripts may be related to pricing and the composition of the journal's authors. *Conclusions.* The ecosystem of scholarly journals in Lithuania has not yet reached the minimum level of technological advancement where all journals use professional software for publishing.

Keywords: open-source; proprietary; Open Journal Systems; scholarly publishing; Lithuania

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Profesionalios mokslinių žurnalų leidybos programinės įrangos naudojimo Lietuvoje žvalgomasis tyrimas

Santrauka. *Įvadas.* Šiame tekste aptariama profesionalios mokslinių žurnalų leidybos programinės įrangos naudojimo tendencijos ir dėsningumai 2020 m. Uždarojo kodo programinės įrangos leidyboje tyrimai yra riboti, o tyrimų, kuriuose būtų išsamiai analizuojamas konkrečios šalies atvejis, trūksta. *Metodas.* Sudarėme žurnalų sąrašą rankiniu būdu patikrinę visų žurnalų interneto svetaines, o surinktus duomenis papildomai patikrinome kitose duomenų bazėse. Be to, elektroniniu paštu individualiai susisiekėme su leidėjais, kad patikslintume duomenis. *Analizė.* Duomenys buvo analizuojami taikant aprašomąją analizę, naudotas SPSS statistikos paketas. *Rezultatai.* Atlikus analizę nustatyta, kad populiariausias atvirojo kodo sprendimas leidybai yra antrosios arba trečiosios kartos OJS programinė įranga, kurią naudoja beveik pusė žurnalų Lietuvoje. Dažniausiai tiek Lietuvoje, tiek užsienyje OJS naudojasi socialinių ir technologijos mokslų atstovai. Pereinant nuo leidybos prie gamybos valdymo, OJS naudojimas Lietuvoje palaipsniui mažėja iki 24 proc. Dažnesnis nuosavybinės programinės įrangos naudojimas rankraščiams gauti gali būti susijęs su programinės įrangos kainodara ir žurnalo autorių sudėtimi. *Išvados.* Išsamesnė analizė galėtų padėti papildyti išvadas apie veiksnius, lemiančius profesionalios leidybos programinės įrangos naudojimo situaciją Lietuvoje.

Pagrindiniai žodžiai: atvirasis kodas; uždarasis kodas; Open Journal Systems; mokslo periodikos leidyba; Lietuva

It's not who I am underneath, but what I do
that defines me. – Batman in *Batman Begins* (2005).

Introduction

One of the critical criteria establishing high professional standards of scholarly journals publishing practice is the software used by journal managers to support their activity (Ndungu, 2021).

This raises the question of whether deploying a professional journal management system necessarily equates to the quality of a journal. Several factors demonstrate the existence of this correlation. For instance, journals that have not adopted a professional journal management system may be mistaken for predatory journals due to poorly maintained websites or appearances uncharacteristic of well-established journal websites (Beall, 2015; Teixeira da Silva et al., 2023). There is a wide range of characteristics expected from a scholarly journal website, which cannot be easily implemented using general website management software such as WordPress or similar platforms. Only professional and dedicated software designed for scholarly journals can offer the comprehensive range of features expected in a scholarly journal website (Moradzadeh et al., 2023).

The benefits of using professional publishing software, as opposed to simpler 'paper and pencil' methods, are numerous, including efficient workflow management, quality control and consistency, enhanced peer review process, and improved accessibility and visibility. Other advantages encompass integrated data management and analytics, compliance with standards, integration with databases and indexing services, customization and scalability, cost-effectiveness, community and support, and the facilitation of experimental and innovative approaches (Baker, 2020; Edgar & Willinsky, 2009; Farmanbar & Kolstrup, 2020; Homenda & Pekala, 2016; Murray et al., 2008).

The operational aspects of journal management, in addition to the content published, are emphasized in the criteria for open access scholarly journals. This is evident in resources like *Open Access Journals Toolkit* by The Open Access Scholarly Publishing Association (OASPA) and the Directory of Open Access Journals (DOAJ) (*New Open Access Toolkit to Empower Scholarly Publishers and Researchers*, 2023) which assert the importance of considering software, hosting, and integration needs for successful online journal operation. Furthermore, several studies discuss the benefits of employing professional publishing software in the context of scholarly journals (Abdu, 2023; Baker, 2020; Luparenko, 2020; Mwantimwa & Wema, 2022; Zakaria, 2009).

At the backdrop of exiting recommendations, there appears to be a lack of available data on whether or not, or to what extent scholarly journals follow those recommendations – i.e. how scholarly journals address software, hosting, and integration needs within their operational frameworks. To fill this void, this research adopts what Goudarzi & Dunks (2023) referred to as "disciplinary approach" to investigate the state of affairs in scholarly journals publishing within the broader concept of scholarly infrastructure. Specifically, we follow Goudarzi & Dunks (2023) in their call to study scholarly infrastructure through its capability to support productive functions of its users, and – at the same time – to foster "positive and desirable social practices and values" (p. 16). By examining the adoption of professional publishing software among Lithuanian scholarly journal publishers, we seek to shed light on the extent to which these publishers possess the essential tools and resources to uphold high standards in scholarly publishing. This includes, employment of submission delivery, peer review management, production management and publishing subsystems. In this context, Lithuanian scholarly publishing presents an excellent case for the study, as there is a great variability in terms of the use of professional software: as of 2020, half of the publishers have adopted open-source publishing software, while a quarter do not employ professional software at all.

We posit that this research can: a) identify the status quo in the adherence to high standards of scholarly publishing, particularly in terms of the technical infrastructure employed; b) potentially reveal the extent of publishers' openness to technological innovation; c) elucidate how the selected software equips publishers for future challenges and scalability, particularly amidst rapidly evolving digital technologies and the increasing volume of scholarly output, and, finally, d) provide insights into broader digital transformation trends in the country's scholarly publishing sector, such as identifying the pace at which Lithuanian publishers are adapting to digital changes in comparison to global trends.

The use of specific types of professional publishing software may indicate publishers' priorities and highlight differences across scientific disciplines. This is because professional software for journal publishing typically refers to dedicated systems designed to meet the standard requirements of scholarly journal publishing. The structure of the paper encompasses sections on literature review, methods, and results. The results section is subdivided into four parts, each examining the use of specific technologies in Lithuania for scholarly journal publishing. Concluding the paper, there are discussion and conclusions sections, followed by recommendations and an outline of the study's limitations.

Literature Review

The significance of technology in the landscape of contemporary scholarly journals, both now and over the past decade, is evident (Ndungu, 2021). This is well presented in a scoping review on journal quality criteria (Moradzadeh et al., 2023), where the authors listed long list of aspects that should be considered when evaluating journal quality by its technical base.

However, there is a lack of studies discussing the use of professional scholarly journals publishing software. We can provide a few rare examples of such analyses. For instance, Abdu (2023) and Ndungu (2021) discuss that the use of online publishing platforms helps for global visibility and accessibility, better management and distribution of scholarly content, improved dissemination and impact of research, and integration of research into global scholarly communication, benefiting from the sustainability and efficiency offered by professional platforms. Similarly, Jacksi (2015) adds that adherence to international benchmarks is critical for maintaining the quality and credibility of academic publications, crucial for academic institutions aiming to increase their international presence, enhancing the utility and user experience. Luparenko (2020) notes that professional software supports various aspects of publishing, from manuscript submission to long-term storage and access control, and it meets the needs of individual researchers, scientific institutions, and journal editors, emphasizing the need for customizable and versatile platforms. Additionally, Mwantimwa & Wema (2022) and Zakaria (2009) point out that the use of professional software can significantly boost academic productivity, help reduce journal management costs, minimize clerical activities, enhance access to publications and communication, and facilitate linkages with other systems such as ORCID. Daraghmi et al. (2021) provide insights into novel technologies in scholarly journals publishing, discussing the use of a blockchain-based platform and pointing out that this novel technology can be useful in handling the increasing volume of scholarly submissions and records, allow efficient management of various operational aspects of journal publishing, help maintain deadlines and schedules in the publishing process, and employ authentication and encryption techniques for access control and security, which are vital for protecting sensitive academic information, and facilitate transparency and ease of access to scholarly content.

The analysis of the adoption of professional scholarly journal publishing software on a country level is significantly limited, as the best-known studies on this topic concentrate on an international context (Edgar & Willinsky, 2009, 2010; Farmanbar & Kolstrup, 2020; Homenda & Pekala, 2016; Khanna, Raoni, et al., 2022). These studies focus on the evaluation of open-source software, specifically OJS, for scholarly journal publishing, analysing case studies of journals in the country or selecting individual universities.

There are several other papers discussing the employment of OJS, written by its developers (Edgar & Willinsky, 2009, 2010) and adopters (Farmanbar & Kolstrup, 2020; Homenda & Pekala, 2016; Owen & Stranack, 2012). Here we can see a trend towards open-access publishing in scholarly journals and the potential benefits of shared software and reader-centric licences that could accelerate electronic publishing (Gudaityte et al.,

2011). Also, while platforms like OJS are widely used, they present technical challenges and, although OJS is open-source and free, the associated costs with time, technical skills, and programming abilities are recognized. Despite these issues, the use of open-source in publishing is fostering new opportunities for scholars, researchers, societies, small publishers, and librarians to exert greater control over the publishing process, and libraries are emerging as publishers and showing interest in using open-source software in publishing. However, there is a very limited selection of papers discussing other open-source software development or adoption when, according to one study (Maxwell et al., 2019) there are 52 open-source platforms for scholarly publishing. A notable exception of this kind is the study by S. Baker (Baker, 2020), who discussed OJS together with three other known open-source software for publishing – *Ambra*, *Janeway*, and *Lodel*. OJS has been identified as the best software for journal publishing, which is why none of the other options can currently boast a user community as wide as OJS (*Number of Journals Using Open Journal Systems*, 2019). This is so not without reason. In his study, Stewart Baker (2020) utilized QualiPSo's Open Maturity Model to examine the maturity of the open-source publishing software. The study demonstrated that OJS exhibited a high level of maturity when compared to other open-source journal publishing software.

Another notable study is the comparative analysis of manuscript management systems for scholarly publishing, covering both open-source and proprietary publishing software, conducted by Soon Kim et al. (Kim et al., 2018). However, it does not provide information on the frequency of use of these systems, as the study is focused on their capabilities.

The significance of technology in contemporary scholarly journals is evident, yet there is a lack of studies investigating the frequency and type of professional journal publishing software used, as well as which brand is most dominant in certain scholarly journal publishing ecosystems.

Open-source publishing software like OJS, which has been proven to be mature and widely adopted, is creating new opportunities for greater control in the publishing process and increasing interest among publishers. Interestingly, there is a lack of studies critically discussing the rationale for using proprietary software in scholarly publishing. There exists a gap in existing research concerning why proprietary or open-source software is chosen. Our study plays a role in enhancing the understanding of the evolution of journal publishing in Lithuania. It delves into the adoption of professional publishing software by Lithuanian scholarly journals, aiming to illuminate the degree to which Lithuanian publishers are equipped with the necessary tools and resources to adhere to standards in contemporary scholarly publishing.

Method

Our study investigates the adoption of journal publishing software on both open-source and proprietary platforms. Selecting a journal publishing platform is a multifaceted task that involves aspects such as journal publication, submissions acceptance, peer-review, and production management. This research helps to fill the research gap by examining

the adoption of professional publishing software among Lithuanian scholarly journals, shedding light on the extent to which publishers in Lithuania are equipped with the necessary tools and resources to meet high standards in scholarly publishing.

Determining the precise number of active scholarly journals in Lithuania presents a challenging task, as there is no recognized register encompassing all potential scholarly journals. The ISSN agency does not differentiate between scholarly journals and other periodicals, nor does it annually verify the activity status of journals listed in the ISSN database. However, it does provide information on all journals published in Lithuania, with publishers being asked to report on journal activity voluntarily. Furthermore, Google Scholar is not a reliable database for this purpose as it automatically indexes a variety of content deemed to be academic writing by its algorithms. Nevertheless, it offers an almost exhaustive list of potential sources, as it indexes various materials, including repositories.

One of the most suitable sources for determining the number of scholarly journals is *Dimensions*. This database indexes journals using data from *Crossref*, *PubMed*, *PubMed Central*, *arXiv.org*, and over 160 publishers directly. However, it does not cover papers without Digital Object Identifiers (DOIs), and some journals in Lithuania do not assign DOIs to their papers. Additionally, certain journals lack a digital version or publish issues collectively as a volume, without separating them into individual papers. In our quest for the most precise data possible, we additionally employed the *de visu* method for data collection. To compile a comprehensive list of sources, we began with the ISSN agency database and *Dimensions*, supplemented by the institutional repositories of universities, the Association of Lithuanian Serials member list, The Wroblewski Library of the Lithuanian Academy of Sciences database of scholarly journals, and the catalogues of the Martynas Mažvydas National Library of Lithuania.

The process unfolded as follows:

1. The initial step involved gathering titles from the aforementioned sources, utilizing both print and electronic resources. In total, we managed to collect 515 titles.
2. The subsequent step entailed verifying the ISSN information to identify any instances of duplication. It is noteworthy that certain databases list journals with different titles, often in both Lithuanian and English versions.
3. The third step involved confirming the country of origin of the publisher, as our research was focused on Lithuania-based journals.
4. The fourth step comprised a meticulous manual examination to determine whether each journal had published an issue in 2020. We thoroughly inspected the websites of all the titles and cross-referenced the gathered data with other databases. Additionally, we contacted publishers individually via email to ensure the accuracy of the information.

Following the implementation of these steps, we narrowed down the selection to 225 titles. These titles were not only based in Lithuania but also published an issue in 2020. We collected data on scholarly journals that published an issue in 2020 at the start of 2022. We observed that some journals publish issues with a delay, such that issues from 2020 are sometimes published in early 2021, or even in the autumn of 2021. As we aimed to

collect data on all active journals for that year, we selected 2020 instead of 2021 due to the previously mentioned lag in publishing new issues.[1]

In this study, rather than following a specific, predefined methodology, we adopted a more flexible and intuitive approach to data analysis, relying on our own previous experience and adhering to the principles of good practice in descriptive research. This approach emphasizes the exploratory nature of our work.

Our data analysis was conducted using SPSS software. We utilized frequency analysis to identify the number and percentage of Lithuanian journals utilizing specific software, complemented by descriptive statistics to ascertain the overall usage patterns of software.

Additionally, crosstab analysis was employed to draw comparisons between software usage across various research fields. This allowed us to discern any field-specific trends or preferences in software selection, which could be indicative of differing practices across disciplines.

Our approach was not grounded in any singular theoretical framework. We focused on generating descriptive insights that can serve as a foundational data set for further theoretical research. We provide a broad overview of the current landscape rather than testing specific hypotheses or theories.

By establishing a clear picture of the current state of software usage in Lithuanian scholarly publishing, we lay the groundwork for future research that may wish to delve deeper into the causes, implications, and potential strategies for technological advancement in this field.

Results

Presentation of the Technologies Used in Journal Publishing in Lithuania

Eight software variants used for scholarly journals in Lithuania have been identified. A succinct summary of these variants is provided below.

OJS3. OJS3 is an open-source software specifically designed for publishing scholarly journals and managing the publishing process, including a peer-review management subsystem. The concept to develop such software was introduced by John Willinsky, who established the Public Knowledge Project (PKP) in 1998 (Public Knowledge Project, 2023). PKP is the developer of the OJS software, first released in 2002 by Memorial University of Newfoundland, Canada. In 2005, PKP signed an agreement with Simon Fraser University Library to advance OJS, and the second generation of OJS was published in the

[1] In scholarly publishing, such delays are quite common; to mitigate their effects, we allotted a one-year buffer. Data was collected in 2022, concerning journals that published an issue in 2020, enabling us to account for potential publication delays. The study's objective was to gather information on all active journals for the year 2020, and the decision to collect data a year later included those journals which may have issued late publications for various reasons. While this approach may not entirely eliminate potential inaccuracies arising from publishing delays, it significantly reduces them, thereby enhancing the accuracy and representativeness of the 2020 data. We acknowledge the imperfections of this methodology and suggest that future research could focus on refining it or developing new strategies to address the time lag in issue publication.

same year. The third generation of OJS was introduced in 2016. OJS is among the most commonly used software tools for managing and publishing scholarly journals, with its use expanding significantly in recent years. According to Khanna, Ball et al. (2022), almost 10,000 journals were using OJS in 2015, and by 2020, more than 25,000 journals in 136 countries had adopted it. In Lithuania, 195 OJS deployments were recorded in 2020. Some of these deployments are used for nonactive archived journals. The software is particularly popular among open-access publishers, with as many as 84% of such journals using OJS.

Institution website. This option is often selected for journals focusing on print publications, with the digital version typically published later. The journal's page forms an essential part of the publisher's website, and this mode of publication is characterized by the absence of an article landing page. Such a page usually displays specific metadata, including the author's name, affiliation, article title, abstract, keywords, and DOI, which, in this case, is often only accessible from a PDF file. Typically, these pages feature a list of journal issues, with the selection of a specific issue leading to the table of contents and links to PDF files of article titles. In some rare instances, there are efforts to emulate professional journal publishing platforms by adding features like tracking article downloads or visits and developing article landing pages.

Publimill. Developed by VTeX, a Lithuanian company founded in 1991, *Publimill* is proprietary software commercially available since 2020. It offers options to integrate peer review and production management modules. Used by three publishers in Lithuania, VTeX also developed a peer review management subsystem, distributed under the EJMS brand.

Other. The "Other" category includes publishing platforms and locations not fitting into any listed categories. Typically, this involves cases where contacting publishers for clarification was infeasible, and evaluations were made solely from a user perspective.

OJS2. The second iteration of the OJS software was released in 2005. A more detailed analysis of OJS is available in the section discussing OJS3.

ScholarOne Manuscripts. A *Clarivate* product, renowned for its *Web of Science* bibliographic database, *ScholarOne Manuscripts* is proprietary software designed for managing manuscript submissions and peer reviews (Ehrlich, 2016). *Clarivate* states that over 8,000 journals use this software, which began development in 2006 following *Clarivate's* acquisition from a private developer (Hagan, 2006).

Sciendo. One of De Gruyter's subsidiaries, was established in 2018 to provide publishing services (*Sciendo*, 2020). In 2020, *Sciendo* published 600 journals. The standard business model of *Sciendo* involves taking over the publishing of journals, thereby becoming the primary publisher. This is done in exchange for a fee, which includes access to proprietary software for publishing, peer review management, and production management.

MDPI. MDPI, a publishing company specializing in open access journals, was established in 1996. It is common practice for MDPI to take over the publishing of journals and become the main publisher. The company offers proprietary software for manuscript acceptance, peer review, and production management.

The list of technologies used in Lithuania is limited, while the global supply of software is quite extensive (Daraghmi et al., 2021; Kim et al., 2018; Maxwell et al., 2019).

While the Lithuanian context is distinguished by the use of long-established products, individual publishers are also experimenting with newcomers to the market that offer a new approach to publication management. However, no pioneering products based on blockchain technology have been documented in Lithuania (Daraghmi et al., 2021).

In summary, the Lithuanian scholarly journal publishing landscape, featuring eight identified variants including open-source options like OJS and proprietary software such as *Publimill* and *ScholarOne Manuscripts*, reflects global trends, albeit on a smaller scale. Notably, a considerable number of journals continue to rely on basic publishing methods via institutional websites, potentially limiting their global reach and interoperability. As our exploration of this topic progresses, we will next examine the frequency of use of these technologies within Lithuania's scholarly journal publishing sector. Initially, we present data on the various technologies employed in scholarly journal publishing, providing a comprehensive overview of the most prevalent tools and platforms. Subsequently, we offer a comparative analysis of the usage frequencies of these technologies across different research fields, thereby shedding light on the nuanced patterns of technological adoption in various academic disciplines.

Frequency of technologies used for publishing

Nearly half of the journals published in Lithuania that released an issue in 2020 utilized OJS3 for publishing (104, 46%) (see Table 1). Seven journals (3%) continued to use the outdated OJS2 version, which was superseded by OJS3 in 2018. It is important to note that the developer no longer recommends the use of OJS2 due to its outdated nature. In total, 111 journals (49%) in Lithuania used the OJS software. OJS remains the only open-source publishing platform utilized in Lithuania. Worldwide, there are 52 open-source publishing platforms for journals (Maxwell et al., 2019).

One-third of the journals (76, 33%) were published on institutional websites, which, in most cases, are unsuitable for scholarly dissemination.[2] Lithuanian publishers also use other proprietary publishing software, excluding institutional websites and unidentified publishing sites (other), utilized by 12% of journals (27 titles).

[2] One might question why institutional websites are generally unsuitable for scholarly dissemination. In our opinion, effective scholarly dissemination typically necessitates specialized tools like peer review systems, citation tracking, indexing, and access to research databases – features that institutional websites often lack. Moreover, institutional websites may not achieve the same level of visibility as those published in established journals or databases. Their lack of integration with academic databases and search engines further impedes the discoverability of research. Additionally, these websites may not enforce specific formats, citation styles, and publishing standards as rigorously as academic journals, leading to inconsistencies in presentation.

Many institutional websites also lack the necessary infrastructure for the long-term digital preservation of academic research. Consequently, publications on these websites might not undergo the same rigorous quality control and editorial processes as those in professional academic journals. In summary, while it's feasible to replicate the interface of professional software on an institutional website, the internal functionality of such a site typically falls short in integrating with contemporary scholarly communication infrastructure. Although some databases accept metadata submissions in formats like Excel, many now require specific metadata formats that cannot be implemented on ordinary websites.

Table 1. **Journal publication software/location**

Publication software/location	Number	Percent
OJS3	104	46.2
Institution website	76	33.8
Publimill	14	6.2
Other	11	4.9
OJS2	7	3.1
ScholarOne Manuscripts	7	3.1
Sciendo	5	2.2
MDPI	1	0.4
All	225	100

Determining the number of active scientific periodicals worldwide is a complex issue due to differing interpretations of what constitutes a scientific periodical in various countries and the imperfections of global registers, such as the ISSN database, where journals that are no longer active are not deregistered. Accurately estimating the number of journals in open-access databases is also challenging, as the number of articles and citations is usually limited to the number of articles. In this study, we refer to the number of journals generated in the *Dimensions* database in 2022 (Khanna, Ball et al., 2022). In 2022, 72,990 journals were captured in *Dimensions*. The period being compared differs by two years from the period analyzed in the study, so the comparison is subject to a certain margin of error. Another study (Singh et al., 2021), found that as of May 2020, 77,471 journals were indexed in the *Dimensions* database. The number of journals differs by 6% between the two sources.

55% of journals indexed in *Dimensions* are using OJS. Looking at the global situation, we can see that Lithuania's frequency of the OJS use (49%) is almost in line with the global trend.

The situation is somewhat different when examining the scenario by country income category. In 2020, 18.7% (4,785 titles) of journals using OJS were published in high-income countries (Khanna, Ball et al., 2022). According to the World Bank's income groups, Lithuania is classified as a high-income country (*World Bank Country and Lending Groups*, 2023). In the case of Lithuania, the frequency of the OJS use is 30% higher than the global trend. One possible reason for the high use of OJS in Lithuania is that open-source software has been in use for a long time. Changing publishing software is not an easy task, and publishers are hesitant to switch unless there are compelling reasons, especially if other alternatives at a similar level usually require fees. In Lithuania, OJS was promoted more actively and was prepared for deployment and use in 2011 (Grigas, 2023). During this period, Lithuania was classified as a middle-income country (*World Bank Country and Lending Groups*, 2023). If Lithuania had remained at the same income level, the difference in the frequency of the OJS use between the world and Lithuania would have been smaller at 23%. In middle-income countries, 26% of all OJS deployments in 2020 used OJS.

Higher than average percentages of OJS usage were observed in the fields of agriculture (50%), technology (70%), and social sciences (55%) (see Table 2).[3]

Higher than average percentages of proprietary software usage (MDPI, *Publimil*, *ScholarOne Manuscripts*, *Sciendo*) were observed in the fields of technology (17%) and natural sciences (25%).

Higher than average percentages of institutional website usage were observed in the fields of agricultural sciences (50%), Performing and Visual Arts (100%), Medical and Health sciences (48%), interdisciplinary studies (50%), and Humanities (41%)

Table 2. **Journal publishing platform/location by scientific field**

	Institution website	**Other**	**MDPI**	**OJS***	***Publimill***	***ScholarOne Manuscripts***	***Sciendo***
Agriculture sciences	5	0	0	5	0	0	0
Technological sciences	3	1	0	21	0	5	0
Social sciences	21	5	0	42	6	0	2
Performing and Visual Arts	2	0	0	0	0	0	0
Medical and Health sciences	11	2	1	7	0	1	1
Other	6	0	0	6	0	0	0
Humanities	23	3	0	23	5	0	2
Nature sciences	5	0	0	7	3	1	0
All	76	11	1	111	14	7	5
Percent	33.8%	4.9%	0.4%	49.3%	6.2%	3.1%	2.2%

* Considering that certain scientific fields have a limited number of journals, our observations do not aim to draw far-reaching conclusions. Instead, we simply aim to provide a statement about the current situation in these fields.

Globally, OJS is most commonly used in the social sciences (46%), technology (18%), medicine and health (15%), the humanities (14%), natural sciences (6%), with the remaining 1% of journals classified in other fields (Khanna, Ball et al., 2022). When compared to the global situation, similar trends are observed in Lithuania, where the social sciences and technology are the most frequent users of OJS. However, a clear

[3] At the time of conducting our study, access to the Dimensions analytics tool was unavailable to us, primarily because it is accessible only to subscribers, and the subscription fees are prohibitively high for individual researchers.

comparison is not possible due to the different categorization of science fields.[4] We have adapted the grouping of science fields presented in Khanna et al.'s paper to the one used in this study, but it is not very precise. Some of the fields listed in Khanna et al.'s study are categorized as separate fields in Lithuania, such as language research in the humanities and communication in the social sciences.

It is apparent that open-source software, particularly OJS3, is widely adopted across many disciplines, accounting for nearly half of all journals. However, a significant portion of journals still rely on institutional websites for publication, a method that may limit their reach and efficiency. Notably, the use of OJS in Lithuania surpasses the global trend, suggesting a predisposition towards open-source solutions within this context. The next section will delve into the frequency with which these technologies are used for the specific task of manuscript retrieval.

Frequency of technologies used to retrieve manuscripts

OJS facilitates manuscript submission and is utilized by 32% (72) of the journals (see Table 3). Email is the primary technology employed by 98 (44%) journals for receiving manuscripts. For 25 (11%) journals, the manuscript submission technology remains unidentified or takes the form of a website. Proprietary software is employed for manuscript retrieval in 30 (13%) journals. A comparison between the frequency of software employed for publication and the technology used for submissions indicates a decrease in the use of OJS (from 111 to 72 journals) and an increase in the use of proprietary software (such as MDPI, *Publimil*, *ScholarOne Manuscripts*, and *Sciendo*) (from 27 to 30 journals).

Table 3. **Technology (service) for obtaining manuscripts**

Manuscript delivery technology (service)	Number	Percent
Email*	98	43.6
OJS	72	32
Other	25	11.1
ScholarOne Manuscripts	15	6.7
EJMS	14	6.2
MDPI	1	0.4
All	225	100

* "Email" is categorized as a technology in this context because it acts as a tool employed by some journals to receive or 'retrieve' manuscript submissions from authors. Although it is not a specialized manuscript management system, email provides a straightforward and accessible means for authors to submit their work and for journals to receive these submissions.

[4] Although the comparison is not exact, it offers a framework for contextual analysis, situating the study within a broader international perspective. This comparative approach, despite its lack of precision, serves as a starting point for understanding the landscape of journal categorization across various fields and can inform more detailed investigations in the future.

According to a study by Kim et al. (2018) OJS and *ScholarOne Manuscripts* are globally the most commonly utilized manuscript delivery software. The study revealed that journals in the fields of technology (43%, 13 journals) and social sciences (37%, 28 journals) exhibited above-average usage of OJS for manuscript delivery (refer to Table 4). In contrast, proprietary software such as MDPI, EJMS, and *ScholarOne Manuscripts* was more frequently employed by journals in technology (33%, 10 journals) and social sciences (38%, 6 journals) for manuscript retrieval.

Regarding alternative methods, the study found that email was a preferred medium for manuscript delivery in several fields at rates higher than the average: agriculture (70%, 7 journals), Performing and Visual Arts (100%, 2 journals), Medical and Health Sciences (48%, 11 journals), interdisciplinary studies (67%, 8 journals), and Humanities (61%, 34 journals).

Table 4. **Technology/service for delivering manuscripts by scientific field**

	EJMS	Email	Other	MDPI	OJS
Agriculture sciences	0	7	0	0	3
Technological sciences	0	5	2	0	13
Social sciences	6	26	13	0	28
Performing and Visual Arts	0	2	0	0	0
Medical and Health sciences	0	11	5	1	5
Other	0	8	1	0	3
Humanities	3	34	1	0	18
Nature sciences	5	5	3	0	2
All	14	98	25	1	72
Percent	6.2%	43.6%	11.1%	0.4%	32%

In conclusion, a diverse range of technologies is employed by journals for manuscript retrieval, with email being the primary method used by 44% of the journals. However, the study indicates a decrease in the use of OJS and an increase in the adoption of proprietary software. Furthermore, the findings suggest that OJS and *ScholarOne Manuscripts* are the most commonly utilized retrieval software globally. The next chapter will delve into the frequency of technologies used for review management.

Frequency of technologies used for review management

OJS offers a peer review management option, which is utilized by 31% of journals (69 titles) (see Table 5). This number represents a reduction by 18% compared to the number of journals that use OJS for publishing their content.

Email and Excel remain the primary technologies for managing peer review, with 107 journals (48%) utilizing these tools. Another 21 journals (9%) could not be categorized according to their technology preference.

Proprietary software is employed by 28 journals (12%) to manage the peer review process.

A comparative analysis of the frequency of software used for publication and technology used for peer review management revealed a decrease in the use of OJS from 111 journals to 69 journals, while there was a slight increase in the utilization of proprietary software such as MDPI, EJMS, *ScholarOne Manuscripts*, and *Sciendo*, from 27 journals to 28 journals.

Table 5. **Technology (service) for managing peer review**

Peer review management technology (service)	Number	Percent
Email, Excel*	107	47.6
OJS	69	30.6
Other	21	9.3
EJMS	14	6.2
ScholarOne Manuscripts	13	5.8
MDPI	1	0.4
All	225	100

* Although email is not a dedicated review management system, it offers a simple and accessible method for authors to submit their work and for journals to receive it. Email and Excel are both common, accessible tools employed for managing manuscript submissions in the absence of a dedicated review management system. While Excel and similar technologies can be costly and highly functional, they are not specifically tailored to meet the unique needs of the publishing process. Consequently, these general purpose tools may not facilitate the publishing process as efficiently or effectively as dedicated publishing software.

A higher proportion of journals in Technology (43%, 13 journals) and Social Sciences (38%, 28 journals) utilize OJS for peer review management compared to the average usage rate (see Table 6). Conversely, journals in Technology (33%, 10 journals) and Nature (31%, 5 journals) make use of proprietary software, such as MDPI, EJMS, and *ScholarOne Manuscripts*, for managing peer review at a higher-than-average rate.

Email and Excel are more commonly employed by journals in Agricultural Sciences (80%, 8 journals), Performing and Visual Arts (100%, 2 journals), Medical and Health Sciences (61%, 14 journals), Interdisciplinary Studies (67%, 8 journals), and Humanities (64%, 36 journals) for peer review management, compared to the average rate.

In conclusion, while OJS is utilized by 31% of journals for peer review management, there has been a decrease in its usage compared to its use for publishing content. Email and Excel remain the primary tools for managing peer review, with a significant proportion of journals relying on these technologies. Additionally, proprietary software is employed by a notable portion of journals for review management. The next chapter will delve into the frequency of technologies and services used for production management.

Table 6. **Technology/service for managing peer review by discipline**

	EJMS	Email, Excel	Other	MDPI	OJS3
Agriculture sciences	0	8	0	0	2
Technological sciences	0	5	2	0	13
Social sciences	6	29	10	0	29
Performing and Visual Arts	0	2	0	0	0
Medical and Health sciences	0	14	3	1	4
Other	0	8	1	0	3
Humanities	3	36	2	0	15
Nature sciences	5	5	3	0	3
All	14	107	21	1	69
Percent	6.2%	47.6%	9.3%	0.4%	30.6%

Frequency of technologies/services used for production management

OJS provides production management, which is utilized by 24% of the journals (53 titles) (see Table 7). This number represents a 25% decrease in comparison to the number of journals that use OJS for publishing their content.

Email and Excel are the primary technologies for production management, with 115 journals (51%) employing these tools. Another 56 journals (25%) could not be categorized according to their technology preference.

Only one journal (0.4%) uses proprietary software for managing production. It is possible that proprietary solutions for production management fell under the category "Other." When publishers were unable to identify their production management approach or were not interviewed directly, the "Other" option was selected, which was the case for most publishers surveyed.

A comparative analysis of the frequency of software used for publishing and technology employed for production management indicated a significant 47% reduction in the use of OJS for production management, declining from 111 journals to 53.

Table 7. **Technology (service) used to manage editing, layout, graphic processing**

Production management	Number	Percent
Email, Excel	115	51.1
Other	56	24.9
OJS	53	23.5
MDPI	1	0.4
All	225	100

The analysis showed that a higher proportion of journals in Technology (40%, 12 journals), Social Sciences (26%, 20 journals), and Interdisciplinary Sciences (25%, 3

journals) utilize OJS for production management, surpassing the average usage rate (refer to Table 8). In contrast, journals in Agricultural (80%, 8 journals), Social Sciences (51%, 39 journals), Medical and Health Sciences (52%, 12 journals), Interdisciplinary (67%, 8 journals), and Humanities (54%, 30 journals) fields more frequently employ Email and Excel for production management, exceeding the average rate. Moreover, journals in Technology (30%, 9 journals), Medical and Health Sciences (30%, 7 journals), Humanities (27%, 15 journals), and Natural Sciences (44%, 7 journals) were observed to use OJS for production management more frequently than the average rate.

Table 8. **Technology (service) used to manage production by discipline**

	Email, Excel	**Other**	**MDPI**	**OJS**
Agriculture sciences	8	0	0	2
Technological sciences	9	9	0	12
Social sciences	39	17	0	20
Performing and Visual Arts	2	0	0	0
Medical and Health sciences	12	7	1	3
Other	8	1	0	3
Humanities	30	15	0	11
Nature sciences	7	7	0	2
All	115	56	1	53
Percent	51.1%	24.9%	0.4%	23.5%

In conclusion, although OJS is utilized by 24% of journals for production management, there has been a notable decrease in its usage compared to publishing content. Email and Excel continue to be the primary tools for production management, with the majority of journals depending on these technologies. The use of proprietary software for production management remains minimal. The next chapter will offer overall conclusions and discuss the implications of these findings.

Discussion and Conclusions

The ecosystem of scientific journals in Lithuania has not yet reached the minimum level of technological advancement where all journals use professional software for publishing. Almost 34% (or 76 titles) of journals in Lithuania continue to publish their content on institutional or other websites, which are poorly suited for scholarly periodicals. Interestingly, Lithuanian publishers of scientific journals have been significantly more active, by 30%, in using open-source software for publishing compared to the global trend observed in high-income countries. Thus, Lithuania, classified as a high-income country, uses OJS 2.5 times more than the global average. This may be attributed to the fact that only a minority of Lithuanian journals charge authors for publication or other fees, and

they rely on often unstable sources of income such as university budgets or projects. The success of the Open Journal Systems (OJS) can be attributed to the fact that when many Lithuanian journals made a decision on transition to electronic publishing in 2011,[5] the EIFL initiative[6] and financial support offered the opportunity to start using this software, and training was provided to administrators (Grigas, 2023).

In the context of publishing technologies in Lithuania, the study identifies a limited variety, with only eight different cases identified. It is worth noting that there are potentially numerous open-source and proprietary solutions available for this purpose (Maxwell et al., 2019). However, none of them can boast a user community globally as wide as OJS (*Number of Journals Using Open Journal Systems*, 2019). Nearly half of the journals in Lithuania (49%) use an open-source solution for publishing, with OJS second or third generation software being the most popular. Looking at the global situation of OJS usage, we can see that Lithuania's frequency of usage is almost in line with the global trend (55%) (Khanna, Ball et al., 2022). Consequently, journals using OJS seek low-cost software options, and OJS meets their requirements as it is free to use, with only minor costs associated with server, domain, and IT maintenance.[7] The majority of journals in Lithuania fund publishing from often unstable sources of income, such as university budgets or projects (Atkočiūnienė, 2009; Petrauskaitė & Pauža, 2015; Švietimo mokslo ir sporto ministerija, 2022).

When comparing the frequency of the OJS use by discipline, the social sciences and technology are the most frequent users of OJS, both in Lithuania and abroad.

It is worth noting that there are four main stages in the publication of scholarly journals, and different solutions are used to implement them: publication, manuscript delivery, peer review management, and production management. The use of professional software in Lithuania declines progressively from publication to production management. While 66% of the journals employ professional software for publishing, this figure drops to just 24% for production management. This leaves 51% of production management tasks relying on Excel, Email, and other miscellaneous tools. These 'other' tools encompass various professional software solutions not named amongst the eight predominantly used for publishing.

It has been observed that the frequency of the OJS use for manuscript delivery and

[5] Due to the necessity of transitioning to an electronic environment and Lithuanian journals' aspirations to integrate into the international scholarly communication ecosystem, it became imperative to expand beyond merely distributing printed volumes to libraries. This digital transition was crucial for these journals to be effectively indexed in appropriate databases and search engines.

[6] EIFL (Electronic Information for Libraries) collaborates with libraries to facilitate access to knowledge for education, learning, research, and sustainable community development. Their vision champions a world where all individuals have the knowledge required to reach their full potential. Key objectives of EIFL's Open Access Programme include promoting a fair and sustainable transition from paywalled to open-access content and advocating for the establishment and upkeep of open public infrastructures. These infrastructures are essential for the publication and sharing of research in open-access journals and open repositories.

[7] For example, the annual cost of operating one journal using OJS software is approximately up to 500 Euros for a small collection of journals. Thus, while there is an associated cost, it remains significantly more affordable compared to commercial software, which generally starts at around 1000 Euros per year for each journal.

peer review management is decreasing due to the increased use of proprietary software. It is surprising to see a significant reduction in the use of OJS for manuscript delivery despite the manuscript delivery module being an integral part of OJS that does not require additional installation to activate it. One reason for this may be that OJS is only used as a substitute for a website. For example, it is not uncommon to find that authors are required to send manuscripts by email or even traditional mail, despite OJS being used to publish the journal. Another reason for choosing an option where OJS is used for publishing, but manuscripts are delivered using other software, may be to use software that is familiar and acceptable to authors, reviewers, and editorial board members to attract them. While OJS is capable of handling a wide range of functions, certain publishers might prefer tools that are more tailored to specific aspects of the publishing process, like advanced analytics, specialized layout design, or enhanced peer-review systems. Certain fields of science, mainly highly-ranked journals indexed in the *Web of Science*, use *ScholarOne Manuscripts* (a *Clarivate* product).

The use of OJS is also declining due to a shift towards technologies such as Email and Excel or similar tools. In comparison, 44% of journals used Email, Excel, and other similar technologies for manuscript acceptance, rising to 48% for peer review and 51% for production management.

This demonstrates that journal editorial boards and publishers are not fully utilizing the possibilities offered by professional publishing software. Out of 225 journals, only 54 (24%) are utilizing the identified professional tools in all four stages (publication, manuscript delivery, peer review, and production boards) of journal publishing. This is a relatively low figure, given that professional technologies for managing these stages of publishing have existed for decades. In Lithuania, OJS has been widely used in publishing since 2011 (Grigas, 2023). However, 12 years on, the adoption rate is still comparatively low.

When examining the use of software by discipline, it was found that publishers of journals in agriculture, technology, and social sciences were more likely than average to use OJS. Disciplines that charge publication fees, such as technology, life sciences, medicine and health sciences, were more likely than average to opt for proprietary (i.e. paid) publishing software.

Overall, this study contributes to studies of scholarly infrastructure by taking a disciplinary perspective of scholarly journal publishers in Lithuania with a focus on technological advancement therein. The findings highlight the adoption of open-source solutions, particularly OJS, in Lithuania and the factors influencing software selection. However, it is evident that there is room for improvement in fully utilizing the capabilities offered by professional publishing software. The study's results emphasise the importance of examining software usage by discipline and considering the budgetary constraints faced by different entities in scholarly journal publishing.

The widespread adoption of OJS in Lithuania's academic publishing represents a positive stride towards more equitable, open, and high-quality scholarly communication. The preference for OJS in Lithuania mirrors a commitment to cost-effective and acces-

sible publishing solutions, fostering positive social practices in infrastructure services, particularly in promoting open access (*Developing Institutional Open Access Publishing Models to Advance Scholarly Communication*, 2022; *Open Access*, 2024). As a result, it highlights the potential of professional publishing software to transform academic practices, making them more inclusive, collaborative, and globally connected. However, despite the benefits and availability of such professional software, there is a noted gap in its full utilization. Many academic journals continue to depend on basic tools like Excel and Email for certain publishing tasks. This finding indicates a need for promoting awareness and training to foster higher professional level practices and establishing more advanced technologies as part of scholarly infrastructure for publishing.

Researchers and journal staff can leverage the study's findings to recognize the importance of adopting professional software for various stages of publication. The findings can encourage journals to enhance their technological infrastructure, moving from traditional tools like Excel and Email to more sophisticated publishing platforms. This shift can streamline the publication process. For journals aiming to improve their international presence, the study underscores the importance of using professional software to adhere to international standards. This is crucial for enhancing the quality, credibility, and global reach of Lithuanian scholarly publications.

The insights from the study can also inform the development of policies and guidelines at institutional and national levels to standardize practices across journals and ensure adherence to high-quality standards in scholarly publishing.

Further research through interviews and surveys can provide deeper insights into the factors driving the adoption of professional journal publishing software in Lithuania.

Recommendations

The study holds significant value in the field of scholarly communication, particularly concerning the usage of tools for submissions, peer review, production management, and publishing. It could be beneficial for service providers to identify journals not yet using professional software, as these journals represent potential customers. Policymakers might find this data insightful for understanding the potential of Lithuanian journals for unified solutions, such as automatic data collection from journals to national institutional repositories. If journals don't employ professional software, their ability to adapt swiftly or provide data automatically in certain formats via API may be hindered, as they might use tools lacking an internal system for data tagging in standardized formats. For publishers, understanding the software in use and the available options is crucial.

By offering these recommendations, we aim to address the study's identified practical value, enhancing the technological infrastructure of scholarly publishing in Lithuania. This enhancement will promote efficiency, standardization, and broader accessibility of academic research:

- To improve the quality and efficiency of scholarly communication in Lithuania, it is vital for journals to adopt professional software for submissions, peer review,

production management, and publishing. This is crucial not only for maintaining high standards but also for ensuring adaptability and compliance with data format requirements.
- With OJS being widely adopted in Lithuania, it is essential to fully exploit its capabilities. Utilizing all aspects of manuscript handling, from submission to peer review and production management, can streamline the publication process.
- As most search engines, databases, and institutional repositories use automated algorithms for data acquisition, employing professional publishing software could streamline data aggregation and enhance the distribution and accessibility of scholarly work.
- Aligning with international benchmarks, as indicated by Jacksi (2015), is important for maintaining the quality and credibility of publications on a global scale.

Limitations

Several limitations must be acknowledged in the conclusions of this study. Firstly, the analysis is entirely based on quantitative data. Conducting phenomenographic research could enhance our understanding by providing a more profound interpretation of the data. Secondly, while it is significant that nearly half of Lithuanian journals utilize OJS as their publishing software, it is unclear whether this reflects the software's popularity or merely the lack of affordable alternatives. The study observes a higher frequency of OJS usage in Lithuania compared to other high-income countries. However, due to the lack of qualitative data, we couldn't delve deeply into the reasons behind this discrepancy. Thirdly, the study notes a decrease in the usage of OJS for manuscript delivery and peer review management. This trend might be influenced by various factors, such as the availability of proprietary software, preferences of authors and reviewers, or the practices of editorial boards. Unfortunately, we couldn't investigate these factors comprehensively or provide an exhaustive explanation for this trend, and our insights are limited to speculative assessments based on our experience in the scholarly publishing industry. Lastly, given the study's focus on Lithuania, its findings may not be universally applicable to other countries or regions, thus serving only as a specific instance of professional software use in scholarly journal publishing.

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