Open-Source Software Adoption in Academic Libraries: An Inevitable Path Forward

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1 Abstract

Academic libraries are dynamic entities, constantly evolving to meet the changing needs of students, researchers, professors, and the broader academic community. As a Research Data Management Specialist at EPFL and ex researcher, I have observed the transformative impact of free and open-source software (FOSS) on both academic libraries and the research community. This pre-print paper explores the multifaceted aspects of FOSS, considering its benefits, challenges, and broader impact on various stakeholders, including librarians, IT professionals, government bodies, research funders, and university departments.

2 FOSS Adoption in Academic Libraries

2.1 OSS vs. FOSS: Implications for Universities

The distinction between Open-Source Software (OSS) and Free and Open Source Software (FOSS) is not merely semantic; it carries significant implications for universities. Although both OSS and FOSS offer opportunities for customization and collaboration, their licensing terms can differ, affecting commercialization prospects. FOSS emphasizes both the open nature of the code and the freedom to use, modify, and distribute the software, whereas the broader category of OSS refers to software with publicly accessible source code that can be modified and shared. While OSS promotes collaboration and customization, it does not necessarily imply that the software is free

of charge. Universities must navigate complex interactions between OSS or FOSS licensing and institutional policies on intellectual property and commercialization. The choice between OSS and FOSS may also reflect broader institutional values and goals, such as promoting openness, accessibility, and public benefit. Careful consideration of these factors is essential for universities seeking to harness the full potential of open-source software in alignment with legal, ethical, and strategic objectives. In the following of this paper, I refer always to FOSS, but most of the statements also align with OSS.

2.2   Budget Constraints and the Rise of FOSS

The library technology industry experienced significant shifts in 2019, with Ex Libris's acquisition of Innovative Interfaces being a prime example. This consolidation in the industry underscores the growing importance of open-source solutions in academic libraries, as they navigate an evolving technological landscape and seek innovative, cost-effective solutions[5]. Especially in this era of shrinking budgets and increasing demands, academic libraries are under pressure to find cost-effective solutions. FOSS, free from licensing fees and customizable by nature, offers a viable alternative: this often makes it an attractive option for organizations with budget constraints [6, 20, 3]. For instance, library-specific tools like Koha or Evergreen have enabled libraries to provide tailored services without additional direct costs[20, 18]. Productive suites and other FOSS software of course follows the same or similar business models. In this context, software administration (HR costs) and IT infrastructure can be seen as indirect costs, unless specific personnel and technical measures are to be deployed for a particular software. The possible budget or equivalent allocation deriving from instructing the personnel on the use of a software is debatable, because all new software, being it FOSS or proprietary to any degree, or all new recruit, would need some formal or informal training. Thus the shift towards FOSS is to be considered not as merely a passing trend, but as a strategic necessity, driven by financial constraints and the imperative to maximize resources.

2.3   Data Privacy, Governance, and Compliance

With the growing concern for data privacy and governance, academic libraries must navigate complex regulations like GDPR. Platforms like Dataverse and CKAN facilitate compliance and ensure data privacy[7, 12]. These platforms are indeed used for data management and can be configured to comply with various regulations, including GDPR. These tools are essential for managing and sharing data responsibly, aligning with global data governance standards,

and meeting public institutions' requirements[14]. The role of IT professionals and legal experts within the library setting becomes crucial in ensuring that these standards are met.

2.4   Research Data Management Services (RDS) in Academic Libraries

The emergence of data-intensive science has led academic libraries to develop research data services (RDS), with a growing focus on adopting FOSS. A study by Tenopir et al. [19] reveals that North American libraries are in the early stages of offering RDS, with technical RDS being less common than informational ones, and librarians expressing a need for more technical training. A technical kind of training is not only needed for internal work, but to support researchers and students, depending on the needs. The adoption of FOSS enhances both internal library operations and services to researchers, enabling tailored advisory and consultancy services and positioning libraries to influence institutional policy changes[8]. Academic libraries play a crucial role in advancing Open Science. They provide essential services, infrastructure, and expertise that support researchers in sharing their work openly. Libraries are central in promoting open access to publications, data, and other research outputs[1]. Curty et al. [9] underscore the importance of perceived efficacy and efficiency in encouraging data reuse, for which the adoption of FOSS tools in academic libraries can provide targeted support related to data management, assisting researchers with funding agencies' requirements[15].

By utilizing FOSS tools and platforms, libraries can create concrete demonstrations to showcase the practical value of data reuse, and build policies for appropriate attribution and formal citation of datasets, further legitimizing data sharing and reuse. Institutions are recognizing their responsibility to support researchers in light of top-down initiatives, with proficient infrastructure and training. For example, 72% of researchers indicated that they would rely on internal resources like libraries for help with managing or making their data openly available[17]. This strategic alignment with FOSS reflects a response to modern challenges and sets a baseline for future developments in academic libraries. The integration of FOSS in RDS offerings represents a significant opportunity to enhance both the efficiency and efficacy of library services, aligning with the broader goals of data management, Open Science, and institutional policy. Understanding data sharing practices within academic communities is nuanced, encompassing epistemic dimensions such as incentives for sharing/reuse and governance/accountability. Integrating these dimensions into academic libraries' strategies, as highlighted by re-

cent research[4], can foster collaboration and transparency, aligning with the broader goals of Open Science.

FOSS has the potential to revolutionize services offered to researchers. Tools like OpenRefine, Zotero, and DSpace enhance research workflows and foster collaboration[3, 16]. The integration of these tools reflects a broader trend towards Open Science and the need to adapt to researchers' evolving requirements[18]. The collaboration between librarians, researchers, and IT professionals is key to implementing these tools effectively.

2.5   A Global Perspective for Different Countries

Not only the countries considered as developed are driven by innovation, customization, and alignment with Open Science principles[14, 16]. Tools like R and GitBook, for instance, are part of a larger strategy to enhance library services, support research communities, and foster collaboration and transparency[14, 18]. University departments and services are actively involved in this process, ensuring that FOSS aligns with institutional goals and academic standards.

In developing countries, the adoption of FOSS in university libraries is often driven by the need for affordable and customizable solutions[18]. Libraries in regions like Islamabad are embracing FOSS to provide state-of-the-art services without significant financial investment[20]. Government bodies and research funders play a vital role in supporting this transition, recognizing the potential of FOSS to democratize access to information. This claim aligns with common perceptions of FOSS adoption in different economic contexts, particularly in developing countries where affordability is a key concern. For example, in India, a surge in the awareness and utilization of open source digital repository software has been observed among academic librarians[13]. Notably, DSpace and Greenstone digital library software stand out as the most recognized and employed DRS. A pivotal factor bolstering this trend is the participation of librarians in specialized workshops and seminars. Such educational events have shown a strong correlation with the increased adoption and effective use of such tools in academic settings.

In a global context, the situation in Beijing offers other valuable insights into the challenges and potential of FOSS adoption by academic libraries. Despite the FOSS worldwide momentum, research and academic libraries in certain regions, like Beijing, still show a strong preference for commercial software. This inclination can be attributed to gaps in professional FOSS knowledge and technical expertise. Even with a genuine interest in FOSS, librarians may hesitate due to perceived risks, governmental disinterest, and a lack of specialized training. Such challenges underscore the importance

of comprehensive professional development, support by the governance, and community engagement in promoting FOSS. As libraries worldwide consider transitioning to FOSS solutions, the experiences of Beijing's library professionals highlight the need for organized workshops, curriculum enhancements, and active roles by library associations in championing FOSS[10].

3 The Future of FOSS in Academic Libraries

3.1 Advantages

1. **Cost-Effectiveness:** FOSS eliminates licensing fees, allowing libraries to allocate resources elsewhere[6, 20], for example in IT, HR and training. For the library as an institution, this may translate into significant cost savings, freeing up funds for other essential resources or initiatives, especially if existing HR and IT infrastructures can be leveraged.

2. **Customization and Flexibility:** Both librarians and the library as a whole can tailor FOSS to meet specific needs. This adaptability ensures that open solutions are tailored to the requirements and workflows of the service, benefiting both individual librarians and the broader institution.

3. **Skill Development:** For librarians, adopting FOSS provides opportunities to expand their expertise, enhancing their professional profile, offer improved RDS, and possibly contributing to their personal growth in the realm of digital literacy.

4. **Collaboration:** FOSS fosters a culture of knowledge sharing and cooperation among librarians, research groups, other university services, and consortia of libraries. This collaborative spirit extends to the wider academic community and even reaches political stakeholders.

5. **Access and Preservation:** Because of the backed-in interoperability, accessibility and openness of the formats and protocols used in FOSS products, open-source tools facilitate long-term data preservation and promote wider accessibility of research outputs. Both individual librarians and the library as an institution play a role in ensuring the longevity and accessibility of data.

6. **Alignment with Open Science:** FOSS promotes transparency, collaboration, and reproducibility. Both librarians and the library as an

institution can align their efforts with Open Science principles, ensuring a cohesive approach to promoting transparency and open access in research.

3.2 Challenges

1. **Learning Curve:** The adoption of FOSS may require time and effort. Both librarians and the library as an institution face the challenge of learning and adapting to alternative tools or formats compared to the ones previously used. The upskill of the personnel can be done via training, but also pointing out the need for some software knowledge in the hiring process of new collaborators.

2. **Technical Expertise:** While individual librarians may need specialized skills to manage and customize FOSS, the library as an institution might face challenges in obtaining or providing support for open solutions.

3. **Integration Issues:** Both librarians and the library as an institution might face challenges in integrating FOSS with existing tools, infrastructure, and workflows, especially when considering the needs of research groups and other university services. For example, the danger of over-customized settings that are no longer interoperable with other systems introduces the need of thinking in terms of infrastructure and tool ecosystems.

4. **Support and Maintenance:** Unlike commercial software, FOSS may lack formal support. This challenge extends from individual librarians relying on community support to the library as an institution ensuring the long-term sustainability of adopted open solutions.

5. **Institutional Alignment:** Balancing personal preferences, institutional requirements, and the needs of research groups, other university services, consortia of libraries, and political stakeholders can be challenging.

3.3 Integration with Open Science

The integration of FOSS with Open Science practices is fundamentally reshaping academic libraries, mirroring a broader European perspective on the role of libraries within the Open Science landscape[2]. The UNESCO Recommendation on Open Science [21], adopted in November 2021, delineates

shared values and principles for Open Science. It aims to bring citizens closer to science, emphasizing the pivotal roles of open access, open data, and the global dissemination of scientific knowledge.

This recommendation accentuates the indispensable role of academic libraries in championing and bolstering open science practices. Tools like AIIDA and Akantu are paramount for the modernization of library services, bolstering interdisciplinary research, and ensuring alignment with Open Science principles[7, 16]. Collaboration between librarians, researchers, IT professionals, and university departments ensures a cohesive approach to this integration, embracing the multifaceted roles of libraries in fostering Open Access, Research Data Management, and Citizen Science[2]. The insights from Cox et al. [8] and Curty et al. [9] underscore the vast potential for libraries to delve deeper into RDM practices, expanding their support mechanisms to cater to the intricate needs of a data-intensive, interdisciplinary research landscape. This alignment is further reinforced by the increasing acceptance of open data among researchers, as revealed by a recent survey[4].

Academic libraries can leverage this trend to create more effective and user-centric data management services, reflecting global trends and the evolving needs of the research community. Researchers' motivations for data sharing, such as increased citation and visibility, further align with the overarching goals of Open Science, presenting academic libraries with an opportunity to amplify FOSS adoption[17].

3.4 Continuous Skill Upgrading

Investment in continuous training and skill development is vital for harnessing the full potential of FOSS, including areas like Open Access, Open Data, and Citizen Science [6, 14, 2]. Specialized skills also align academic libraries with researchers' needs in tackling specific data management needs[15]: libraries must equip staff with the necessary skills to manage and utilize FOSS effectively, in line with the Open Science movement, reflecting the growing need for engagement in areas such as Research Data Management and Citizen Science, and aligning with the broader European practice of defining the role of libraries in Open Science[6, 2]. This involves collaboration with educational institutions, professional organizations, and industry experts, as well as strategic planning for the integration of Research Data Management (RDM) services[11].

The need for continuing education, as highlighted by Tenopir et al. [19], emphasizes the importance of training and professional development in harnessing the full potential of FOSS and RDS. In light of the increase in national mandates and top-down initiatives for open data, libraries have an

essential role in providing guidance, support, and training for open data sharing. Encouragingly, recent data suggests an improvement in the guidance and support provided by institutions for open data sharing, reflecting a growing commitment to building supportive communities and facilitating compliance with open data policies[17].

3.5   Collaboration and Community Building

FOSS fosters collaboration and community building within libraries, reflecting the European practice of defining libraries as central hubs for collaboration and community engagement in the Open Science landscape[14, 16, 2]. Tools like Mastodon and Datasette enhance the library's ability to serve patrons and contribute to the broader academic community[7, 12, 2]. The role of librarians as facilitators, educators, and collaborators becomes central to this process, leveraging FOSS tools to enhance collaboration within the academic community and aligning with the broader goals of Open Science[2]. Scientific publishers, higher education institutions, and academic libraries are increasingly subject to top-down initiatives and mandates for Open Research Data (ORD), and libraries play an essential role in the progression and adoption of ORD practices[17]. ORD includes software and code produced by students and researchers for their academic work. In this context, a better alignment of academic libraries with FOSS would also respond to the possibility for researchers to rely on internal resources for help with their RDM and ultimately their ORD practices. This highlights the vital role of libraries in streamlining the action of possible supportive communities around open data and FOSS, enabling them to assist researchers with compliance to data management policies and the grant proposal process[15]. Whether they are communities of interest or communities of practice, this does not mean that libraries need to be the creators or maintainer of such communities, something which nonetheless often happens with initiatives such as Data Champions or Data Stewards, but that their central institutional role can be leveraged to make a community thrive.

4   Conclusion

The integration of open-source software in academic libraries is a complex yet rewarding process, symbolizing a strategic response to contemporary challenges such as financial constraints, legal compliance, alignment with Open Science principles, and the burgeoning need for research data management services[19, 8, 9]. While the path may be laden with obstacles, the potential

benefits are substantial. The open-source movement is more than a fleeting trend; it's a transformative wave with academic libraries leading in innovation, collaboration, and service to the research community[16]. Collaboration across various stakeholders—including librarians, IT professionals, students, researchers, professors, government bodies, research funders, and university boards and departments—is pivotal to this vision's success. By understanding researchers' perspectives on open data and aligning with the multifaceted dimensions of data sharing, academic libraries are positioning themselves to reflect a holistic approach to data management and open science practices, further solidifying their role as vital contributors to the research ecosystem[4].

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