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Promoting Open Access in Research-Performing Organizations: Spheres of Activity, Challenges, and Future Action Areas

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Abstract: Open access (OA) has become a critical issue in science policy and affects a wide range of activities in universities and research labs. Research-performing organizations (RPOs), defined as publicly funded universities and research institutions, face significant challenges in shaping the OA transformation. This article examines the spheres of activity available to RPOs for shaping the OA transformation, using a categorization of 22 spheres of activity related to OA. These spheres of activity include strategy and communication, services and infrastructures, business relationships with publishers, and collaborations. Current challenges and future action areas in promoting OA are also described, providing support for RPOs in handling OA and highlighting key issues. The categorization can serve as a tool for systematically assessing OA activities at RPOs and shows that OA is a cross-cutting issue in these organizations. Collaboration on OA activities, both within and beyond organizations, presents a challenge. To effectively promote OA, it is crucial to strengthen the interaction between funding agencies and RPOs. Libraries are critical stakeholders, playing a vital role in advancing OA at the local, national, and international levels in partnership with RPO management and other partners in faculty, administration, and information technology.

Keywords: open access; research-performing organizations; universities; science policy; open science; libraries

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1. Introduction

Open access (OA) means making scholarly publications accessible and reusable online without financial, technical, and legal barriers. The definition of Budapest–Bethesda–Berlin (BBB) characterizes OA: At three conferences in Budapest (2001), Bethesda (2003), and Berlin (2003) in the early 2000s, new approaches to digital scholarly communication were discussed, which led to a basic understanding of the term OA among the scholarly community [1].

In the 1990s, researchers such as Stevan Harnad (1990) [2], Paul Ginsparg (1994) [3], Harold Varmus (1999) [4], and others formulated concepts and practices to advance scholarly communication. These considerations formed the foundation for the BBB definition.

The implementation of OA is pursued through two complementary strategies, referred to as OA Green and OA Gold, which ensure that scholarly publications are accessible "gratis" (free of charge) or "libre" (free of charge plus additional reuse rights) so that third parties can reuse them [1].

While OA Green refers to making publications openly accessible as pre- and post-prints on OA repositories, the term OA Gold refers to publications in OA journals. These journals make peer-reviewed articles openly accessible and reusable at the time of publication. These journals are typically funded directly by research-performing organizations (RPOs), research-funding organizations (RFOs), libraries, or societies, and/or use the finance and business model of Article Processing Charges (APCs). In the context of OA Gold, variations such as Hybrid OA (the publishing of an article in a closed-access journal for the payment

of an APC), Bronze OA (the publishing of an article without an open license), or Diamond OA (OA journals that operate without the use of APCs) have emerged. Nevertheless, in practice, these terms are occasionally employed interchangeably and inconsistently.

1.1. Policies on the OA Transformation

Significant for the discussion on the OA transformation at RPOs in Europe has been the publication of the "Vision on a Globally Competitive ERA and its Road Map for Action" by the European Heads of Research Councils (EUROHORCs) and the European Science Foundation (ESF) in 2009. Whereas previous position papers of RPOs mainly addressed the goal of OA, the two European organizations defined the goal of transforming journals from closed to open: "The aim is a system of scientific publications in which free access to all (published) scientific information is guaranteed. This involves a move toward Full Open Access". Furthermore, both associations also positioned themselves on the question of financing OA: The current "reader-paid publication system" is to be replaced by an "author- or institution-paid" system [5]. This declaration can be understood as the beginning of the institutionalization of the OA transformation in Europe.

Another important stakeholder addressing the issue at the European level from 2007 onwards is the European University Association (EUA). This association published its first set of recommendations in 2008 [6]. In 2017, the association of universities presented its recommendation "Towards Full Open Access in 2020", calling for a short transformation phase, which, according to the EUA, should ideally already be completed by 2020 [7].

The positions of RPOs regarding OA align with the political support for OA provided by the European Commission. With the "Recommendation on access to and preservation of scientific information" from 2012 and 2018, a call for the EU member states to foster the OA transformation and to ensure that "all scientific publications resulting from publicly-funded research are made available in OA as from 2020 at the latest" was issued [8].

The academic libraries within RPOs are playing a pivotal role in shaping the open access transformation. This is evident, for instance, in how the subject is approached within position papers by library associations at both the national and international levels [9–11].

During the Dutch presidency of the Council of the European Union in 2016, the topic was widely discussed on the political stage. Flanked by the call "Christmas is over. Research funding should go to research, not to publishers!" by the League of European Research Universities (LERU) [12] and the "Amsterdam Call for Open Science" [13], the issue was brought up in 2016 among the European Council. In a "dramatic statement" [14], the Council advocated a "full scale transition towards open access". This goal, although without a specific schedule, is also supported by the OA2020 initiative, which was launched by the Max Planck Society (MPG) in 2016. The aim of the initiative was "to transform a majority of today's scholarly journals from subscription to OA publishing". In a statement of interest, the institutions declared: "We will pursue this transformation process by converting resources currently spent on journal subscriptions into funds to support sustainable OA business models. Accordingly, we intend to re-organize the underlying cash flows, to establish transparency with regard to costs and potential savings, and to adopt mechanisms to avoid undue publication barriers" [15].

With the publication of Plan S, then, the cOAlition S, a group of RFOs, addressed the challenges of the OA transformation. In this "[r]adical open-access plan" [16], the RFOs responded to the protracted process of OA transformation. It was announced in 2018 and updated in 2019 that cOAlition S would anchor OA in their funding conditions so that from 2021 onwards, publications arising from funded projects could only be published according to the standards of Plan S [17].

1.2. The Challenges of the OA Transformation

Currently, a vital discussion about the design of OA is gaining importance. At its core is the question of who controls scholarly communication and on what terms. With the adoption of the "Council conclusions on high-quality, transparent, open, trustworthy, and

equitable scholarly publishing" by the Council of the European Union in 2023, EU member states emphasized the role of scholarly led OA models beyond APCs, highlighting the "importance of not-for-profit, scholarly open access publishing models that do not charge fees to authors or readers" [18].

This discussion is fueled by the questionable business practices of publishing giants such as Elsevier, Springer Nature, and Wiley. The (1) monopolization of journal publishing [19], the (2) high profits of commercial publishers [20], (3) their data-tracking activities [21], and the (4) growing criticism of the APC business model [22–24] are currently shaping the discourse about the future of OA. Two guiding principles can be discerned here:

(1) The proponents of an idealistic paradigm of OA associate the OA transformation with the concern for a profound change in the field of scholarly communication. They emphasize that science can organize the publishing system itself. The idealistic OA proponents thus formulate their claim in initiatives such as the Fair Open Access Association (FOAA) [25] or the Radical Open Access Collective [26].

(2) The representatives of a pragmatic paradigm of OA propose a narrower understanding of the OA transformation. For them, the focus is on shaping the transformation with the already established stakeholders. Activities that can be assigned to this model are DEAL in Germany [27] and SCOAP3 in particle physics [28].

1.3. The Role of RPOs in Fostering OA

The term RPOs refers to publicly funded universities, non-university institutions, or departmental research institutions. These institutions organize research, teaching, and knowledge transfer and thereby contribute to the global innovation system.

Depending on the national science system there are different types of RPOs. In Germany, for example, the following types can be distinguished: universities, research institutions of the Fraunhofer-Gesellschaft, the Helmholtz Association, the Leibniz Association, and the Max Planck Society, as well as the departmental research institutions of the federal and state governments. Generally, all these RPOs operate academic libraries that have taken up the cause of OA over the past 20 years. Additionally, other service facilities within the RPOs are also engaged with the topic of OA, such as the offices for research services.

As organizational units of scholarship, RPOs create space and infrastructure for academic work. The framework for this work is academic freedom and the associated high degree of self-administration, which varies in the different types of institutions. Negotiating positions in committees of academic self-government at the local, national, and international levels, as well as in individual or multiple disciplines, is an essential characteristic of science that must be considered in the design of the OA transformation. This characteristic is both an opportunity and a challenge. The opportunity lies in the fact that the promotion of OA must be implemented from within the RPOs. The challenge lies in the fact that the OA transformation is a cooperative task that must be designed globally. It is essential to bear this tension in mind. In practice, this means that collaboration among RPOs is crucial. RPOs can facilitate discussions about OA, promote positions, communicate information, provide infrastructure, offer services, and influence their services through their business relationships with publishers. OA affects a large number of organizational units within an institution, as outlined by the following six examples: (1) The management of a RPO adopts an OA policy and communicates the policy externally. (2) The researchers at a RPO publish OA and shape the transformation towards OA, e.g., by serving on editorial boards of OA journals. (3) The library of a RPO embeds OA in its business relations with publishers and operates an OA publication platform. (4) The office for research services supports the researchers in dealing with the RFO's OA policies. (5) The advisory service for doctoral students offers courses on publishing in the context of OA and thus contributes to anchoring the topic in the training of early career researchers. (6) The press office refers to the freely accessible versions of closed-access articles in press releases on current research

results and thus supports the communication of research results generated at the RPO to the media.

Despite the plethora of studies on OA, there are only a few systematic considerations of the options for action available to RPOs. In 2012, a presentation of fields of action for RPOs in Germany was published [29]. Engeszer and Sarli (2014) provide a concise systematization of the tasks of libraries [30], while Horstmann's study (2017) on the subject of OA, aptly titled "[f]rom collecting to connecting", offers the most comprehensive description of library tasks in this area [31]. The EUA has created a highly useful checklist for promoting OA at universities [32]. Ayris et al. (2018) were commissioned by LERU to create a comprehensive roadmap entitled "Open Science and its role in universities", which focuses on the broader topic of Open Science and identifies key tasks for promoting OA [33].

Considering this context, this study undertakes a methodical examination of the realms of engagement aimed at bolstering OA within RPOs. The objective is to provide guidance to professionals in science policy, science management, and research support services at RPOs, including academic libraries and offices for research services, assisting them in formulating and evaluating initiatives to advocate for OA.

2. Research Questions

Based on the existing body of research, this article examines the spheres of activity open to RPOs for shaping the OA transformation. The following three research questions (RQs) will be addressed below:

- RQ1: What are the spheres of activity that RPOs can engage in to shape the transformation towards OA?
- RQ2: What challenges arise in each of these spheres of activity?
- RQ3: What potential future action areas exist in the spheres of activity?

3. Methods

To address RQ1, a comprehensive categorization of spheres of activity was developed, which is based on a systematic literature review and the author's extensive experience in promoting OA within a large scientific organization. The author has been deeply involved in promoting OA at a RPO in Germany for many years and has played an active role in shaping the evolution of OA within a dedicated service facility focused on fostering OA.

The categorization is based on individual spheres of activity, classified into four thematic areas, with a detailed description provided for each activity to elucidate its scope and purpose. The four thematic areas are: (1) strategy and communication, (2) services and infrastructures, (3) business relationships, and (4) cooperation. The categorization, presented herein, provides a comprehensive overview of the options available to RPOs to promote OA and can be utilized as a tool for a systematic review of OA activities at RPOs.

To tackle RQ2, the challenges encountered by RPOs in each sphere of activity were identified and analyzed. These challenges are described for each sphere of activity.

To answer RQ3, potential future action areas in the field of OA were identified and described. These areas present opportunities for RPOs to continue shaping and driving the transformation towards OA.

This article adopts a European perspective, with particular attention paid to examples and case studies from Germany. The findings presented in this article have implications for RPOs and other stakeholders in the field of OA, offering practical guidance in the areas of action, challenges, and opportunities associated with the OA transformation. The primary emphasis lies on identifying the prospects for action that emerge for academic libraries and other stakeholders in the field of research support services.

The following sections describe the options in the four areas. Each option for action is defined, and current challenges in addressing them are described.

4. Results

The spheres of activity presented in this article show a wide range of possibilities for activities in RPOs to shape the OA transformation. Depending on the profile and mission of an institution, the relevance and organization of individual actions varies.

The research questions are answered as follows:

- RQ1: Here, 22 spheres of activity were identified for promoting OA transformation at RPOs (see Figure 1). These were clustered into four thematic fields.
- RQ2: Challenges have been identified for each of the 22 spheres of activity. All activities are interdependent, with a particular emphasis on the strong influence of the strategy and communication activities on the other three thematic areas. Hence, OA emerges as a pervasive concern that impacts multiple stakeholders at a RPO.
- RQ3: Future action areas have been identified for all 22 spheres of activity. Coordinated alignment of individual activities and consideration of their interactions are central to this effort. Categorization of the fields of action enables the placement of each activity within the broader framework of OA. The future activities for each of the 22 identified areas are outlined.

Figure 1. Categorization of open access (OA)-related spheres of activity into four thematic areas at a research-performing organization (RPO).

The following section provides a detailed account of the results pertaining to all four thematic areas.

4.1. Strategy and Communication

The subsequent section presents spheres of activity in the area of strategy and communication within a RPO. What these activities have in common is that they provide a framework for the OA activities of an institution. Strategic positioning and communication activities impact the spheres of activity described in the sections on services and infrastructures, business relationships, and cooperation. This area is significant in shaping the OA transformation at RPOs.

4.1.1. Policy

Description: An OA policy at a RPO helps specify whether and how scholarly publications of the institution's members are to be made openly accessible. Establishing such a policy creates a coordinated and reliable framework for implementing operational mea-

sures to promote OA in the RPO and thus forms the basis for further activities. The Registry of OA Repository Mandates and Policies (ROARMAP) listed 878 regulations of RPOs as of March 2023.

Challenges: In their studies on the effectiveness of OA policies in the context of the OA Green, Swan et al. (2015) [34] and Vincent-Lamarre et al. (2016) [35] point to two factors that are important for the successful implementation of the guidelines and policies: (1) requiring researchers to store their articles in an OA repository, and (2) linking storage in the repository to research evaluation activities.

When introducing and implementing an OA policy at a RPO, the following four guiding principles should be taken into account: (1) formulation of the policy in a participatory process, (2) harmonization of the policy with other relevant regulations, (3) supporting through services and infrastructures, and (4) reflecting on the implementation process.

Future action areas: In the future, it will be vital to promote the dissemination of binding and harmonized policies on OA. In doing so, the integration of guidelines and directives into the overarching theme of Open Science should be taken into account.

4.1.2. Transformation Strategy

Description: The term transformation strategy refers to a RPO's strategy for shaping the transformation to OA. It is closely related to the institution's OA policy but goes beyond the mere definition of goals. An example is the "Open Access Strategy of Forschungszentrum Jülich" [36]. With this, Forschungszentrum Jülich has published a strategy characterized by a high degree of concretization—the planned measures include concrete activities to shift funding from subscription to OA. A quantitative indicator describes the target share of OA publications. The research center's central library communicates the implementation status via a public "Barometer" [37].

Challenges: Considering the global scientific system, the challenge lies in the international coordination of the OA transformation. The responsibility of a RPO is to ensure coordination with other institutions while also taking local conditions into account in formulating a transformation strategy. By formulating a transformation strategy, a RPO can define paradigms for the design of OA and address aspects such as transparency, competition, sustainability, economic viability, and pluralism [38] in scholarly communication.

Future action areas: So far, such strategies do not seem to be widespread. In the future, the role of RPOs in the transformation of OA and its integration into national and international initiatives should be discussed. To promote conversations at a RPO, dialogue forums should be created and stimulating initiatives promoted so that more institutions can implement OA as a strategic field of action.

4.1.3. Responsibilities

Description: To facilitate the effective management of OA at a RPO, it is crucial to establish clear delineation of responsibilities related to this topic. Therefore, defining the stakeholders and their respective tasks holds great significance. With the creation of the position of an OA officer, a new job profile has emerged in the history of OA in Germany. The term OA officer is used here to describe the job profile of a member of the respective institution who is appointed by the institution's management to oversee the development of OA [39]. To support researchers in publishing OA, many libraries maintain dedicated scholarly communications teams that specifically address the operational aspects of OA implementation.

Challenges: As a key actor, the OA officer plays an internal coordinating role in implementing the measures outlined in the OA policy or a transformation strategy and represents the institution's position externally. For the position to be effective, it must be integrated into a governance structure that allows for strategic shaping of the issue. If the role of the OA officer is not situated within the library, it is important to ensure effective collaboration with scholarly communications teams within libraries. Additionally, ensuring

cooperation with relevant departments in administration, such as the office for research services, is also essential.

Future action areas: Effective governance is crucial in shaping the OA transformation at a RPO. Local structures must be taken into account in this field of action. The tasks of OA officers are diverse and include practical, strategic, and policy aspects. This task profile highlights the cross-cutting nature of OA, which requires cooperation between research, administration, and the information infrastructure. Libraries are well-positioned to play an active role in this area. With the growing significance of Open Science, there is a need to consider whether the responsibilities of the OA officer should be extended to encompass Open Science. This would ensure the synergy between Open Research Software and Open Research Data with OA.

4.1.4. Education and Training

Description: Due to the relatively short and dynamic history of the topic and the dynamics of digital scholarly communication, imparting knowledge about the genesis of OA as a concept and movement is significant. The challenges of dealing with predatory publishers illustrate the need to support researchers in identifying suitable publication venues so that they can make informed publishing decisions.

Challenges: The topic of OA education is currently inadequately addressed in academic programs. For example, a study by O'Carroll et al. (2017) found no broad diffusion of OA in the education and training of researchers [40]. However, there are promising examples and initiatives on how to address this. The UNESCO Open Access Curriculum has been an international curriculum since 2015, describing how OA can be integrated into the teaching of scholars. The curriculum consists of five modules covering learning units around digital scholarly communication, copyright, research evaluation, and OA publishing [41]. The FOSTER portal, which aggregates teaching and learning materials on Open Science and provides them as Open Educational Resources (OER) within the framework of an EU project, is a valuable resource [42].

Future action areas: A sensible approach to knowledge transfer would be to incorporate OA into the training of scholars in postgraduate courses. Related courses could be incorporated into the European Credit Transfer Systems (ECTS) [43]. For PhD students in particular, it is vital to offer obligatory courses on scholarly publishing that include OA-relevant topics. This option offers libraries the opportunity to play an active role in the dissemination of knowledge. Such offerings—digital or analog—open up the possibility of actively communicating an institution's institutional policies, infrastructures, and services related to OA. Here, too, there are intersections with other training initiatives related to Open Science.

4.1.5. Public Relations

Description: Communicating the opportunities and challenges of the OA transformation to the public is becoming increasingly relevant as the attention to OA in science policy grows. Discussions on OA in the press, parliaments, and other forums shows the need for RPOs to contribute their positions to public debates. In this context, the term public relations refers to the communication efforts of RPOs aimed at conveying the institution's position on OA to the general public and specific sub-publics, including the institution's funding bodies. The International Open Access Week (OAW) serves as a substantial platform for this purpose, offering a framework for communicating about OA through diverse activities and events at RPOs. A website is dedicated to providing information on the events taking place as part of OAW.

Challenges: The communication of the topic to the public and the associated representation of the scientific community's views on OA is essential, mainly because of the lobbying of the publishing industry on OA policies. Public discussions regarding OA are often characterized by several myths (e.g., that the majority of OA journals charge APCs) [44], some of which have been deliberately promoted by the publishing industry [45]

and have led to various public debates. The challenges of the OA transformation are also being discussed in parliaments. Hearings and expert discussions by parliamentary committees and parties can be named as examples in this context.

Future action areas: Due to the growing prominence of Open Science in science policy, it is essential for RPOs to communicate their stance on OA and the associated opportunities and challenges. Especially when the topic is being discussed in parliamentary committees, such as science committees, it is relevant to participate in the discourse concerning the financial and legal frameworks of OA.

4.2. Services and Infrastructures

To achieve the goals described in a policy or transformation strategy, it is necessary to support researchers with a portfolio of services and infrastructures. This section deals with organizational and technical measures that RPOs can use to promote OA.

4.2.1. Research Information

Description: The documentation and evaluation of the research activities carried out by a RPO, its organizational units, and affiliated researchers provide valuable information on the research output of the institution. This information is significant, for example, to the institution's management.

Capturing research information, and particularly monitoring publication output, is crucial in the context of the OA transformation as it provides essential data for management processes. In this context, monitoring publication output is a central activity. The basis for these analyses is information systems for managing data about the institutions' publications. Such information systems include publication databases, OA repositories managed by libraries, and Current Research Information Systems (CRIS) operated by research service offices. In addition to local information systems, RPOs also use commercial databases, such as Clarivate Analytics' InCites or Elsevier's SciVal, to obtain information about an institution's publication activities. Persistent Identifiers (PIDs) for authors such as ORCID and for RPOs such as ROR support the management of research information and enable automated data flows.

Challenges: With the anchoring of targets in the area of OA policies and associated strategies, institutions must devote themselves to monitoring the volume of publications. Only if the proportion of OA publications at an institution's publication output is known can OA activities be quantitatively assessed.

Future action areas: Activities in the field of research information are closely linked to the creation of cost transparency in the area of OA transformation. To record the OA status of an article, information about the legal, technical, financial, and organizational status and information about the contractual assignment of an article need to be recorded [46]. The term Scholarly Communication Analytics is used to discuss the professionalization of these activities [47].

4.2.2. Consulting

Consulting researchers on OA has become a task that libraries and research service offices have undertaken in recent years. Two main consulting services can be highlighted: (1) general publication consulting, which focuses on providing information on OA to researchers in their role as authors or editors, and (2) specific consulting on funding conditions in order to ensure compliance with the OA requirements of funding organizations.

Publication Consulting

Description: As the transformation towards OA continues, there is a growing need for OA consulting services at RPOs. The term publication consulting is understood here as a service that aims to answer researchers' questions and concerns about publishing at an institution and thus promote publication practice in the sense of OA. Libraries play an

active role in providing information services on OA, for example, by offering websites and courses [48].

Challenges: However, individual consultation is assigned particular importance, where individual researchers or organizational units such as working groups, institutes, or sections are given specific advice on OA based on their publication practices.

Future action areas: The direct dialogue with researchers in the context of OA consultations also allows for promoting and discussing the concrete transformation of individual subscription journals associated with an institution. Libraries, with their expertise in digital publishing, are well-equipped to play a much more active role in this regard in the future and proactively enter a dialogue with researchers on OA.

Compliance with Funders

Description: With the anchoring of OA in research funding, there is a need to support researchers in dealing with funding conditions for OA by providing consulting services and corresponding services and infrastructures. In this context, the term compliance is used to describe adherence to OA requirements of RFOs. Since the inclusion of OA requirements in the 7th EU Framework Programme for Research in 2008 [49], funder compliance has gained special relevance in Europe. In RPOs, funder compliance also touches the area of responsibility of research support offices and libraries, especially regarding the practical accessibility of publications from funded projects in repositories or acquiring publication grants for OA publication costs.

Challenges: This topic is expected to be accelerated by compliance monitoring measures by RFO. For example, some RFOs have started to establish monitoring procedures on OA to track the implementation of their funding conditions, e.g., the National Institutes of Health (NIH) in the USA with the NIH Public Access Compliance Monitor [50]. Other RFOs, such as the Bill and Melinda Gates Foundation, use digital tools that go beyond compliance monitoring and reach into digital knowledge communication. For example, the Gates Foundation uses ChronosHub software. Using ChronosHub, journal articles from funded projects can be submitted directly to journals that comply with the Gates Foundation's OA requirements [51,52].

Future action areas: The involvement of some research-funding organizations (RFOs) in the operation of OA journals is expected to significantly increase the demand for compliance-related consulting services at RPOs. Through Plan S, certain RFOs have developed consistent OA requirements. In the future, it will be necessary to enhance the coordination between RPOs and RFOs and encourage the alignment of OA policies and strategies.

4.2.3. Dealing with Publication Costs

With the entry of commercial publishers into OA publishing, RPOs are faced with the urgent task of addressing the economic dimension of OA. In this context, an institution's financial relationships with publishers need to be reflected upon, and a strategy for dealing with the resulting costs needs to be developed. This strategic approach is essential to shape the transformation to OA in the interests of science.

It should be noted that the organization of financial resources for information supply and OA publishing represents a significant challenge for RPOs. In the following, two options for action are described: OA publication funds and their further development into information budgets.

Publication Funds

Description: Due to the growing relevance of APCs, RPOs have begun to establish OA publication funds. Publication funds are a financing and control instrument [53] of RPOs in dealing with OA publication fees. They serve as a practical implementation of the goals and measures stated in an OA policy or strategy for dealing with publication costs at a RPO.

Challenges: In practice, the library, as the publication fund operator, must communicate with researchers, publishers, and RFOs. This resource-intensive activity, which is increasingly being subsumed under the term APC management [54,55], must be taken into account when planning measures to promote transformation at a RPO. In this context, it is also important to clarify the interaction between publication funds and transformative agreements.

A publication fund has an impact both on researchers and on the business relationship between RPOs and publishers. The advancement of standards in this area is necessary to enhance data flows between RPOs, RFOs, and publishers. The Efficiencies and Standards for Article Charges (ESAC) initiative was established to formulate workflow requirements between RPOs and publishers [56].

Future action areas: The professionalization of processes, standards, and information systems for managing publication costs, and the further development of publication funds in the context of OA transformation, are critical aspects to consider when exploring publication funds. These areas offer numerous connections to the topic of research information. However, there is an increasing criticism of the APC model. The Ivy Plus Libraries Confederation (2023) has even deemed it "antithetical" as it hinders the advancement of equality in the global scientific community [57]. Considering this, the question arises as to how libraries can utilize their publication funds to facilitate the development of alternative financing and business models beyond the APC.

Information Budget

Description: Considering the variety of funding strategies for APCs, the array of cost types for scholarly publications (subscriptions, OA APCs, hybrid APCs, color charges, excess charges, cover charges, licensing fees for illustrations, expenses for consortia and local OA infrastructures), and the urgent need for data monitoring to promote cost transparency, an integrated view of the financial dimension of the OA transition at a RPO is needed. The term information budget refers to a financial management tool used to manage all incomes and expenditures attributable to the publishing and reception of scholarly information at RPOs [58]. The concept of information budgeting is new and is currently being discussed in Germany [59–61].

Challenges: As part of the RPO's budget, the information budget enables the management of all financial resources for services and products of scholarly communication. Depending on a RPO's profile, these financial resources can consist of the library budget, third-party-funded OA publication funds, publication grants for third-party-funded projects, and publication funds in organizational units such as departments or sections of a university or research lab [46]. A future challenge in establishing an information budget is designing and implementing it in collaboration with all stakeholders of an RPO. When centralizing funds, a high level of cooperation is required from leadership, academia, administration, and libraries.

Future action areas: The German Council of Science and Humanities (Wissenschaftsrat) has recommended the establishment of information budgets at RPOs in its "Recommendations for the Transformation of Scientific Publishing to Open Access" [58]. In the future, it is essential to further refine the concept of the information budget and implement it based on the organizational circumstances of an RPO. This is especially to enhance the transparency of the financial relationships between RPOs and their organizational units with publishers and other publication service providers.

4.2.4. Information Infrastructures

Digital information infrastructures support science as technical and organizational services and are operated by RPOs. In the context of OA, these can be, for example, repositories, publication databases, and platforms on which scholarly publications are made free or openly accessible.

The application of standards in the operation of information infrastructures is of essential importance due to the decentralized landscape of OA infrastructures. Since publications

are thus stored and published on distributed infrastructures, these infrastructures must be interoperable.

Institutional Repositories

Description: Lynch's (2003) widespread definition of an institutional repository as a "set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members", makes it clear that repositories are an essential service that serve to manage and disseminate knowledge generated at a RPO [62]. In March 2023, the Directory of Open Access Repositories (OpenDOAR) listed 6005 repositories worldwide. Repositories also play an essential role in promoting the OA transformation. This is illustrated by the example of the DeepGreen repository service in Germany: from September 2019 to June 2021, more than 35,000 publications from 8 scholarly publishers were distributed to more than 65 repositories [63].

Challenges: Repositories face a challenge in their interaction with CRIS systems [64,65], and certain institutions have started utilizing them for managing APCs, thereby placing new demands on the repositories' management [55,66]. New repository tasks are also emerging in research data management. For example, some RPOs use institutional repositories to store and make research data accessible [67]. COAR's Next Generation Repositories (NGRs) initiative highlights the technological perspective of repositories [68].

Future action areas: The development and refinement of institutional repositories within the framework of Open Science will be a crucial area in the future. To achieve this, it is imperative to address and overcome the challenges outlined above.

Institutional Presses

Description: The term institutional press refers to a publishing house operated by a RPO that enables the publication of works written by members of the institution. The operation of university presses has a long tradition in the Anglo-American world [69]. Hybrid publishing is a commonly adopted practice among institutional presses in Germany [70], whereby publications are released in both print and in OA, simultaneously. Some presses use their institution's institutional repository as a publishing platform. At the European level, university presses collaborate in the Association of European University Presses (AEUP), which also operates a catalog for its members. In addition, many of the publishers make their OA books discoverable via the Directory of Open Access Books (DOAB).

Challenges: While the number of RPOs that operate their own presses appears to be limited, they possess the potential to establish close ties with the scientific community at a RPO. Considering that institutional publishers must cater to the entire spectrum of their respective institutions it becomes challenging for them to establish a subject-specific profile.

Future action areas: In addition to publishing OA books, there is significant potential for publishers in the publication of OA journals. To achieve this, the focus on publication services for the members of the RPO that operates the presses needs to be overcome. Collaboration frameworks among RPOs present significant prospects for institutional presses within the OA context. A pioneering cooperation model is being implemented in Germany: In 2022, the Berlin Universities Publishing (BerlinUP) was launched as a joint OA publisher by and for all Berlin universities [71]. The provision of such collaborative OA publishing services can bolster scholar-led publishing [26,72].

Publication Platforms

Description: In the field of OA, the term publication platform covers a wide range of digital information infrastructures that RPOs use to make publications openly accessible. These can be infrastructures for operating journals, publishing books, or making digital collections openly accessible. Within the realm of textual publications, publishing platforms frequently facilitate quality assurance mechanisms through standardized review processes that exceed the capabilities of institutional OA repositories. The Open Journal Systems

(OJS) software [73] for operating OA journals is widely used. Worldwide, over 34,000 OA journals use the open-source software Open Journal Systems (OJS). Frequently, they position themselves under the label of scholar-led publishing as an alternative to commercial journals that finance their activities through APCs.

Challenges: At times, challenges can arise in maintaining the continuous operation of these platforms [74]. Therefore, it is important to operate these platforms sustainably according to established standards [75]. Guidelines for operation are formulated by, for example, the "DINI Certificate for Open Access Repositories and Publication Services" [76]. Promoting the implementation of such standards is crucial.

Future action areas: To ensure the sustained operation of these platforms and the affiliated publication venues, it is necessary to devise operational and financial models that take into account the interplay between libraries as platform operators and the scientific community responsible for editorial management.

Theses

Description: Even before the term OA became established, universities began to test concepts and procedures for the open publication of dissertations [77]. DART-Europe aggregated more than 1,326,800 doctoral qualification theses from 579 universities from 29 European countries in March 2023. On an international level, the Networked Digital Library of Theses and Dissertations (NDLTD) will enable the search of more than 6 million university theses with its Global ETD Search in March 2023. Today, managing university publications at universities is a clearly defined task of libraries, which is also reflected in the legal framework, such as, e.g., PhD regulations.

Challenges: The publication of cumulative dissertations involves legal questions about the subsequent use of journal articles. In this context, the legal situation of an article must be examined. If an article has already been published in an OA journal using a free license (especially CC BY), then the secondary publication of this article in a dissertation is possible without further clarification of rights.

Future action areas: Accounting for the increasing significance of Open Research Data, the issue of how to ensure accessibility of the data that form the foundation of a thesis has become a pressing concern. To address this matter, certain universities have taken steps to establish explicit policies regarding access to research data used in theses [78]. One such example is the Berlin School of Library and Information Science (IBI) at Humboldt Universität zu Berlin, which has implemented a "Guideline for Handling Research Data in Theses" [79] that applies to data originating at the school.

Search Services

Description: Search and discovery services, which are operated in various forms in RPOs, are dedicated to the discoverability of OA publications. Academic search engines operated in RPOs in the context of OA can be divided into: (1) general, (2) subject-specific, and (3) institutional search services. (1) General search services: These search services index publications from all scientific disciplines. BASE, operated at Bielefeld University in Germany [80], is to be emphasized here. (2) Specialized search services: These search services index publications from one scientific discipline. Examples are INSPIRE in high-energy physics [81] or the Astrophysics Data System (ADS) for astronomy and physics [82]. (3) Local discovery services: These search services index publications according to the profile of a RPO [83].

Challenges: RPOs encounter the difficulty that their own (OA) publishing services are being included in these search services' indexes. Consequently, the interfaces of repositories and publication services must be devised based on established standards. One standard, for example, is the "OpenAIRE Guide for Managers of Literature Repositories" [84].

Future action areas: The distributed infrastructure of the science-driven OA publication infrastructures will increase the importance of discovery services in the future.

4.3. Business Relations

The development of OA goes hand-in-hand with a reorientation of the business relationships between RPOs and publishers. This reorientation is taking place as a process in which researchers, RPOs, libraries, RFOs, publishers, and other actors are redefining their positions, and thus their relationships to each other. This process is still in full swing. It is, therefore, not surprising that the MPG, as the initiator of the "Berlin Declaration", once again emphasized in the mission statement of the eleventh Berlin Conference adopted in 2013: "It is time to return control of scholarly publishing to the scholars" [85]. This position-setting process is most evident in negotiations between publishers and RPOs and has so far culminated in Germany with Project DEAL. In March 2023, DEAL contracts were concluded with Springer Nature and Wiley. These so-called Publish and Read (PAR) contracts guarantee reading and OA publishing in the three publishing portfolios under transparent pricing [27]. As of March 2023, the ESAC Transformative Agreement Registry showed 559 subscription agreements between RPOs and publishers that include statements on OA. However, the degree of these elements and their contribution to an actual transformation of entire journal portfolios from closed access to OA widely varies. Nevertheless, this figure indicates a growing penetration of OA in journal licensing.

4.3.1. Criteria

Description: If an academic institution wishes to actively influence the design of publishing services, criteria must be formulated that set out the institution's understanding of OA. Thus, these criteria are closely related to an OA policy or strategy. They are to be understood as the basis of the relationship between an institution and a publisher.

Challenges: If negotiations are conducted at the level of a consortium, such criteria should be jointly developed with the consortium members. In Germany, "Recommendations for Transformative Journal Contracts with Publication Service Providers" have been published in 2022. These recommendations serve as a common framework for RPOs in Germany for negotiations with publishers. The recommendations address the following aspects: journal transformation, pricing, transparency, workflow, pre-prints, metadata and interfaces, statistics, tracking, and waivers [86]. One challenge lies in the practical implementation of these recommendations, as many contracts are still negotiated locally. Enhanced collaboration among institutions, akin to the model of DEAL, would be exceedingly beneficial.

Future action areas: The more institutions agree on such common criteria, the more significant the impact of these criteria is on the publishing landscape. With the Plan S of various RFOs, an attempt is being made to actively shape the OA transformation through common criteria for funding action. In the general "Technical Guidance and Requirements" [87] for publication infrastructures and the special "Criteria for Transformative Journals" [88], the RFOs of cOAlition S have formulated their requirements for the OA transformation.

4.3.2. Contract Types

Description: The business relationship between scientists and publishers on OA is legally organized by different types of contracts between researchers and/or their institutions and publishers. The focus is on the publishing agreement, in which the conditions of publication are laid down between the author and publisher. The focus here is on copyright agreements related to the publication. In addition to the publishing agreement, a wide variety of contracts are concluded between RPOs and publishers in the context of OA. These types of contracts are constantly being developed.

Challenges: Examples of contracts such as these are: (1) Offsetting—within the framework of a subscription contract, an agreement is made regarding the OA publication fees for articles by the institution's researchers. (2) Contract on secondary publication—Within the framework of a subscription contract, an agreement is made regarding the secondary publication of the articles of the institution's authors. In Germany, this type of contract is often

referred to as an 'alliance license'. (3) Membership—In the context of an OA contract, an agreement is reached regarding the OA publication fees for articles by the institution's publishers. This type of contract is often referred to as a membership. (4) Type SCOAP3—Within the framework of an OA contract, an agreement is made to transform journals from subscription to OA. Examples of such activities are the SCOAP3 consortium in high-energy physics or the Open Library of Humanities (OLH) in humanities and social sciences. (5) Other contract types—In addition, a large number of contracts are negotiated between RPOs and publishers based on individual requirements. One such very recent type of contract is being discussed, for example, under the slogan 'Subscribe to Open' [89]. This is based on the traditional logic of the business relationship between libraries and publishers. Here, the conversion of journals is implemented via consortia financing.

The types of contracts outlined here, and their development, indicate that libraries require in-depth expertise to evaluate publishers' offers and their implications. The main activity in this field of action continues to be the analysis of existing contract types and their further development in the context of negotiations with publishers. Depending on the type of contract there are various specific challenges to consider. An overarching challenge lies in assessing individual contracts and their implications. For example, the effectiveness of offsetting agreements, which are sometimes also referred to as transformative agreements, seems to ensure a flip of journals only in a few instances [90].

Future action areas: This underscores the influence of OA on library organization. The fields of digital publishing and licensing in libraries are still regarded as distinct domains. To maximize the collaboration of competencies in both areas, the rigid boundaries between them must be abolished. Attaining this objective requires further progress in the organizational structures of libraries.

4.3.3. Monitoring Costs

Description: For a sustainable transformation to OA, RPOs face the challenge of creating cost transparency. In practice, RPOs need to have a complete overview of the financial flows between them and publishers and other service providers. Monitoring is intricately connected to the operations pertaining to services and infrastructures, particularly those involving the management of publication costs.

Challenges: To determine the OA-related costs at a RPO, it is essential to conduct analyses of the expenses for scientific information. The identity costs are to be set in relation to the publication output of a RPO. The goal should be to be able to price each article. In doing so, an institution will be confronted with various types of costs. In the area of transformation, the costs of subscription and the costs of OA, in particular, must be considered together, and their relationship to each other must be examined. The institution's task is to bring together the distributed information at an institution on expenditures and, if necessary, revenues. The following cost types are to be considered: (1) expenditure for subscription, (2) expenditure for APCs for OA Gold, (3) expenditure for APCs for hybrid options, (4) expenditure for publication fees for closed access (e.g., color charges or excess charges), (5) expenditure for licensing of images, (6) expenditure for consortia OA infrastructures, and (7) expenditure for local OA infrastructures [46].

The recording and analysis of the types of costs at a scientific institution are central prerequisites for promoting cost transparency. This transparency is necessary to negotiate the costs of the OA transformation with publishers on an equal footing.

Future action areas: The creation of cost transparency is a central prerequisite for evaluating the economics of the OA transformation. Therefore, in addition to monitoring costs, disclosure of expenditures should also be sought. As of March 2023, 391 institutions worldwide participated in the OpenAPC initiative, through which information on paid APCs is made openly available. This information enables analyses of the costs of OA publishing.

In addition to establishing monitoring procedures for recording and analyzing costs in the area of publishing at RPOs, it is important to promote the disclosure of cost data in scholarly communication to advocate transparency.

4.3.4. Journal Flipping

Description: Another option for action for RPOs arises in the transformation of closed-access journals that are closely associated with an institution. Since some RPOs are active as editors and operate publishing platforms and self-publishing houses through their libraries, know-how about the options for transforming individual journals to OA is often also available in institutions, especially in libraries.

Challenges: For RPOs in general and their libraries in particular, this means that there is a need for action in terms of consulting and support for transformation projects. A prerequisite for such activities is the identification of journals that are associated with a RPO. In this context, there are also links to the field of research information. Knowledge of the membership status of researchers affiliated with a RPO on editorial boards of academic journals can aid in promoting journal flipping.

Future action areas: Engaging in a systematic dialogue with journal editors at RPOs offers significant potential for discourse regarding the advancement of publishing and the definition of RPOs' roles.

4.4. Cooperation

Cooperation between RPOs and their coordination with funding organizations and other stakeholders is essential to promote a joint positioning on OA and to develop a coordinated framework for cooperative implementation strategies.

In the following sections, the options for actions of RPOs in interdisciplinary networks, disciplinary initiatives, and subject-specific repositories are considered.

4.4.1. Networks

Description: In recent years, a variety of OA networks have emerged in which RPOs have joined forces to work on OA transformation beyond the local level. The field of activity of these networks is highlighted here.

In the USA, SPARC, an association of libraries, began dealing with digital scholarly communication in 1997. In 2001, a European branch of this coalition was founded under the name SPARC Europe [91]. SPARC's active lobbying in the USA in the context of several legislative initiatives, such as the Federal Research Public Access Act, can be seen as a model for activity in the field of advocacy by RPOs for OA. For all these legislative initiatives, SPARC activated multiple activities in the USA. In this regard, the formation of the Alliance for Taxpayer Access (ATA) by SPARC, an alliance of libraries, patient associations, and universities, which demands OA to the results of publicly funded research, should be highlighted.

At the European level, in addition to SPARC Europe, COAR (from 2009) [92] and LIBER (from 1971) [93] are vital associations in driving the topic of information infrastructure in debates on OA. In the higher education sector, EUA and LERU act as European forums. Science Europe, an alliance of RPOs and RFOs, which has set up a working group on OA, has become one of the most visible actors in the European science policy arena through its contribution to Plan S [16].

Challenges: These networks promote the exchange of information between institutions through events. Further expanding cooperation between research institutions to achieve consensus on implementation strategies is an essential, if not the greatest, challenge for the OA transformation.

Future action areas: Therefore, it is crucial to pay more attention to this area of activity in the future. The OA2020 initiative, in particular, has great potential to strengthen international cooperation between scientific institutions on OA [15]. However, such a

project can only succeed if a broad alliance of RPOs and other stakeholders acts together. Especially, the interaction between the local and global levels must be ensured.

4.4.2. Subject-Specific Initiatives

Description: Complementary to the interdisciplinary initiatives, the thematic block of networks includes subject-specific initiatives. In this field of action, players from different disciplines cooperate to promote OA. Due to the international nature of science and its distributed structures, these initiatives face the challenge of developing cooperative organizational and financing models. This task is critical to developing funding strategies beyond the APC model.

Probably the most notable effort in this field of action is the SCOAP3 consortium, which involves 3000 RPOs and their libraries from more than 40 countries and an intergovernmental organization to convert core journals in high-energy physics to OA with consortium funding [28]. This initiative ensured that more than 17,600 articles were published in OA between 2014 and 2017 [94]. Another flagship project in the area of professional initiatives is the OA journal eLife. In an effort to counterbalance the "luxury journals" [95] such as Nature and Science and their relevance in the life sciences, the Howard Hughes Medical Institute, MPG, and the Wellcome Trust funded the founding and establishment of the OA journal to the tune of GBP 43 million between 2012 and 2022 [96].

Challenges: In this field of action, domain-oriented RPOs can contribute by using their structures and networks for professional initiatives for OA transformation. These activities can range from dialogue forums to the operation of publication platforms.

Future action areas: RPOs have the potential to play a role in the development of domain-specific OA initiatives, based on their subject expertise. It is recommended that these activities be intensified. Subject-specific research institutions, in particular, can play an important role here due to their proximity to the subjects and the societies active there.

4.4.3. Subject Repositories

Description: As operators of subject-specific repositories, RPOs provide an information infrastructure for OA Green in a scientific field. Subject repositories are operated by institutions that act as service providers for the respective subject community and support these communities in scholarly communication following their institutional mission.

In 1991, Paul Ginsparg implemented the OA repository arXiv at Los Alamos National Laboratory, where in the early days especially pre-prints from the field of high-energy physics were made freely available [3]. Similar repositories have also been developed in other disciplines, such as CogPrints in cognitive science [97], NCSTRL in computer science [98], and the decentralized repository system RePEc in economics [99]. In the life sciences, PubMed Central, a repository focused on making post-prints accessible, has been created and is closely linked to the NIH OA policy [100].

Challenges: With the growing popularity of pre-print servers, there are signs of dynamism in this area. The COVID-19 pandemic highlighted the potential of these repositories [101].

Future action areas: The implementation of a pre-print mandate at eLife [102] highlights the increasing importance of subject repositories. This development also gives rise to questions regarding the management of pre-prints at RPOs. An impending task is to ensure interaction between subject repositories for pre-prints and institutional repositories.

5. Discussion

Based on the categorized spheres of activity, four principal and pressing issues can be discerned as indispensable for the future evolution of OA at RPOs. Key recommendations are derived for each of the four issues:

(1) OA transformation strategy. It is recommended that institutions develop strategies for OA transformation based on guidelines and directives developed through participatory processes at RPOs. It is advisable to ensure alignment with RFO strategies and establish governance structures for effective management of OA. Libraries could also consider

strengthening their role as central service providers for OA. As a cross-cutting issue, it is important to consider the impact of OA on all organizational units and stakeholders of an institution.

(2) Organization of OA transformation. It is recommended to enhance national and international cooperation on OA. This can be achieved by initiating forums for harmonizing OA transformation strategies and pursuing joint activities based on coordination. It is suggested that contract negotiations for OA take place primarily at national and international (mainly European) levels, based on international criteria for funding OA costs. Professionalization of training programs on OA is advisable, and attention should be paid to compliance with funding requirements. It is essential to build on the widespread use of OA repositories and strengthen their links to the management of research information and Open Science (for example, in the areas of Open Research Data and Open Research Software). Additionally, it is suggested to strengthen scholar-led publication infrastructures.

(3) Financing the OA transformation. To facilitate discussions on financing OA transformation, it is important for institutions to conduct a comprehensive analysis of their publication volumes and associated costs. Improving analytical capabilities and creating cost transparency in the OA transformation process can support this effort. It may be worth considering the development of OA publication funds into information budgets and recognizing the significance of consortium-funded OA publication infrastructures.

(4) Future of the OA transformation. It is recommended to clarify the role of RPOs in the OA transformation process, including their potential participation in national and international initiatives and their interaction with RFOs. The discussion process should go beyond defining the position of RPOs and consider the objectives of OA transformation. Connected to this is also the necessity to understand OA more strongly as a part of Open Science [103]. The linkage of OA publications with the underlying research data, as well as research software and other materials, can only be sustainably realized on an open infrastructure that is driven by scholarly communities and implemented using open formats and standards.

6. Conclusions

This study shows that OA is a cross-cutting issue at RPOs, and collaboration on OA-related activities presents a challenge both within and beyond organizations. The developed categorization can be used as a basis for a systematic assessment of OA activities at RPOs. To effectively promote OA, it is crucial to strengthen the interaction between RFOs and RPOs. Libraries are critical stakeholders and, in partnership with RPO management and partners in faculty, administration, and information technology, play a crucial role in advancing OA at the local, national, and international levels.

In future library and information science research, addressing the discrepancy between aspiration and reality in shaping the OA transformation seems necessary. Various research questions arise in this context. Addressing this set of questions could provide insight into the possibilities and limitations of the options for action. With a view on the internationality of science, research questions also arise about embedding local and national activities in the global discussion about the shaping of the OA transformation. In this context, it is crucial to address the tension between privatization and the values of scholarly knowledge and information as a commons.

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