Towards Open Science Related Policies, Infrastructures and Practices: the case of Lithuania

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Abstract: Open Science has entered the global research area bringing about not only opportunities but also challenges that range from national to institutional in terms of policy-making, infrastructure development, academic culture and other issues. We need to embrace these challenges today to be able to use the opportunities of Open Science tomorrow. The aim of the paper is to survey the status quo of Open Science related policies, infrastructures and practices in HE institutions in Lithuania.
The paper starts with a review of Open Science concept and initiatives. Then it addresses the recent Open Science related policy developments on the international level. The third part of the paper discusses the general preconditions for the implementation of Open Science, whereas the fourth part focuses on how these preconditions are manifested in Lithuania. Reference is made to the results of the survey on the research data management infrastructure that was carried out in April and repeated in November 2017 at the institutions of higher education in Lithuania. The survey consisted of questions on the policy documents and infrastructure for Open Access publications and data at the institutions of higher education. The results of this survey serve as a background for the account of Open Science related policies, infrastructures and practices at institutions of higher education in Lithuania.

Keywords: open science, open access, open access policy, infrastructure, repositories, research data management

1. Introduction

Knowledge creation, using and sharing is essential for the performance of the contemporary society. Science has been relatively closed and oriented towards a specific discipline or field for a long time. Significant changes that have happened in the recent decades make science more accessible, open and interdisciplinary, as Open Science has the potential to strengthen and enhance science by facilitating more transparency, openness, networking and collaboration, and by fostering interdisciplinary research (Bartling & Friesike, 2014; European Commission, 2017b). In being open, science will be fully

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accountable for its use of public resources (European Commission, 2016). These changes have been determined by the development of digital technologies that provide new tools for creating and storing information, sharing and communication, also by the need for innovation and social changes in the contemporary society (Almeida, Borges, & Roque, 2017). Open Science involves areas related to scholarly communication and education from open access to publications and research data to open source software, models, methods and process of open peer review. Research funding institutions require open access not only to publications by publishing them in open access journals and / or depositing in open access repositories, but also to research data. This is a way to accelerate the development of science and use of knowledge for economic as well as scientific development.

The potential of Open Science to enhance research quality, reliability, integrity and societal impact has been referred to as revolutionary and widely discussed in academia and policy (European Commission, 2018b). The documents by the European Commission point out that the transition to the system of Open Science determines countries' competitive advantage, accelerated development and innovations, involvement of the society into knowledge creation and usage (European Commission, 2017a; Schmidt et al., 2016; The Council of the European Union, 2016). In seeking progress, the results that come from publicly funded research should be publicly accessible and reusable. In spite of the support for open science from different stakeholder groups, the implementation of Open Science is a slow process that encounters different obstacles and barriers (Gargouri et al., 2012; Harnad, 2011).

The European Commission recommends adopting OA requirements in all member states of the EU (European Commission, 2012, 2018a), but the situations and processes of implementing Open Science are different. Therefore, a relevant question is how the ideas of Open Science are implemented in different countries.

The aim of the paper is to survey the status quo of Open Science-related policies, infrastructures and practices in higher education institutions in Lithuania.

It will address the following objectives:

- to review the concept and initiatives of Open Science;
- to review the recent Open Science related policy developments on the international level;
- to discuss the general preconditions for the implementation of Open Science;
- to discuss how Open Science is implemented in Lithuania by drawing on the results of the survey on the research data management infrastructure that was carried out in April and repeated in November 2017 at the institutions of higher education in Lithuania.

2. Open Science initiatives: a review

The need for an open and unrestricted access to research literature was highlighted in the documents of different open access initiatives: the Budapest Open Access initiative (2002), the Bethesda Statement on Open Access Publishing (2003), and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (2003). These documents provide definitions of "open access" and are the most central and influential for the OA movement. In the recent decades, the need for open access not only to publications but also to research data, source codes and other research results has been growing. Open access to research results is a means to avoid duplicate research, mistakes and scientific fraud. The documents by the European Commission (European Commission, 2016) on the importance of Open Science and innovations, Open Science is defined as "a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools. The idea captures a systemic change to the way science and research have been carried out for the last fifty years: shifting from the standard practices of publishing research results in scientific publications towards sharing and using all available knowledge at an earlier stage in the research process" (p. 33). Open Science is concerned with all the elements of the research cycle, starting from data collection, review, analysis, conceptualisation to publishing and use of research results, also with the way this cycle is organized (European Commission, 2016). The idea of Open Science is implemented through different interrelated activities and initiatives: open access, open data, open peer review, open code software, open government, alternative methods of research evaluation, open science infrastructures, etc. (Knoth & Pontika, 2015).

In broad terms, Open Science is about researchers' collaboration to share knowledge and to open it for the global research community. Open Science "is gradually reaching the agenda of policy makers and research funders which move on to include open science-related topics from open access to publications and research citizen science, evidence-based policy making, alternative research metrics and e-infrastructures for open science data" (Schmidt et al., 2016). There is a change in the way institutions relate to business and society towards more accessible new knowledge, its impact on economic and societal development, societal involvement into knowledge creation and use. According to Moed (2016), Open Science changes the research methods to make them more open, inclusive and interdisciplinary. Thus Open Science fosters open access to research data and publications by ensuring a high level of research integration" (The Council of the European Union, 2016)

Open Science aims to encourage collaboration and contribution to knowledge creation by ensuring open access to research data, research protocols and other research processes for dissemination, re-usability, replicability, societal involvement in the knowledge creation and dissemination, fostering innovation,

etc. (European Commission, 2017a). The most important benefits, according to researchers and other stakeholders, are "more collaboration and new forms of collaboration, breaking down discipline barriers, interactions with actors outside the research community, interest in new ways to disseminate findings, and a public demand for faster solutions to societal challenges (European Commission, 2015b).

Open Science, by providing access to research results and granting transparency of research and quality assurance processes, fosters scientific progress and innovations (Schmidt et al., 2016). The idea of Open Science is making a profound change in our understanding how science is performed, researchers collaborate, knowledge is shared, and science is organized. Three major aspects of Open Science have been identified: 1) its relation to digital technologies; 2) the idea that it explores changing research practices and their impact on the research system; 3) the fundamental importance of "a certain vision of science as a community of practice" (European Commission, 2015b).

Open Science as a global movement and transformation of research practice that is concerned with research performance and methods of research organization impacts the processes of dissemination, sharing and collaboration and ensure transparency and reliability of research results.

3. Policy documents on Open Science: international perspective

At the beginning of Open Science initiatives, the requirements for open access as a constituent element of Open Science, were recorded in the 3B Declarations that later served as a background for documents on open access to research publications and, eventually, research data, adopted by individual institutions and funding organizations. The first department-level institutional OA mandate was implemented by the University of Southampton School of Electronics and Computer Science in January 2003 (Xia et al., 2012). Later, the first institution-wide OA mandate was adopted by Queensland University of Technology (2004) and Harvard University (2008). The Faculty members granted the University a "non-exclusive, irrevocable, paid-up, worldwide" license, permitting the University to exercise "any and all rights under copyright relating to each of his or her scholarly articles" (Albanese, 2008). OA mandates were adopted by many universities and government agencies, making the provision of Green OA not wholly dependent on publishers' permission (Tennant et al., 2016).

In 2005 the major research funding institutions announced their plans for publishing research results open access: the Welcome Trust announced its OA plans, the Research Councils UK (including the UK Medical Research Council) released their position statement on access to research outputs in 2005 ("RCUK revises statement on access to research outputs," 2006), the NIH announced its policy on enhancing public access to archived publications. A significant

milestone in the UK was the 2014 policy in relation to research assessment after the 2014 REF (Research Excellence Framework) ("REF2014," n.d.)

The requirements for open access by funding institutions and organizations influences researchers' behaviour and scholarly communication processes. Among authors who had not published in OAJs, 69% indicated that they would self-archive willingly if their employers or funders required them to do so. Swan and Brown (Swan & Brown, 2004), However, Xia et al. (Xia et al., 2012) found that only 54% of repositories showed an increase in the number of deposited items after their OA mandates went into effect.

Since 2003, an increasing number of institutions, funding bodies and government agencies have released mandatory policies to promote OA. As of April 2018, a total of 926 OA policies have been registered on the ROARMAP website ("The Registry of Open Access Repository Mandates and Policies (ROARMAP)," n.d.). Among these, 701 were policies issued by research organisations, 75 by institutional departments, 83 by funders, 56 by funders and research organisations together and 11 by multiple research organizations. A majority of the policies were from Europe (576), followed by Americas (216), Asia (65), Oceania (40) and Africa (26) ("The Registry of Open Access Repository Mandates and Policies (ROARMAP)," n.d.)

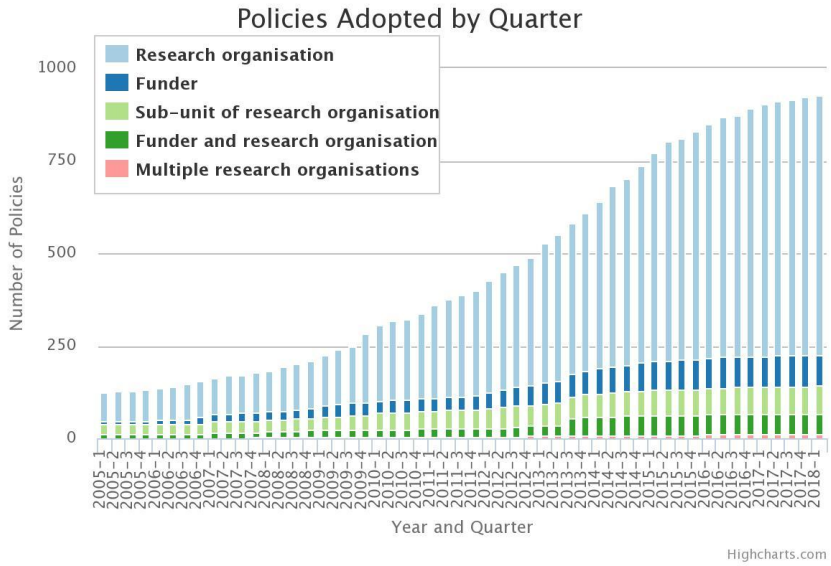

Figure 1. OA policies adopted by research organization and funders (ROARMAP, 2018)

According to Suber (2012, pp. 77–78), "funding agencies and universities are discovering their own interests in fostering OA. These non-profit institutions make it their mission to advance research and to make that research as useful and widely available as possible". The number of open access policies has been increasing since 2002. This was mainly determined by open access oriented recommendations and mandates of funding institutions, in particular the Guidelines on Open Access adopted by the European Commission in 2008 (European Commission, 2008) and in Horizon 2020 programme ("Guidelines on Open Access to Scientific Publications and Research," 2017).

The programme Horizon 2020 requires open access not only to research publications but also to research data. The data of publicly funded research should be made publicly available if there are no reasons related to intellectual property, personal data protection, confidentiality, security, etc., to keep them closed; i.e. the data should be "as open as possible, as closed as necessary" (The Council of the European Union, 2016). Therefore, documents issued by funding institutions may be supplemented by statements on accessibility of research data. However, policies on open access to research data are less developed across EU countries than policies and strategies on open access to research publication (European Commission, 2015a). Most of them are recommendations rather than mandates.

Even though OA mandate policies are one of the most important factors in determining researchers' behaviour, no less important OA elements are infrastructures, tools and "relevant education and assistance, incentives to use repositories, as well as the inclusion of self-archiving into the faculty evaluation system have been recommended as measures accompanying OA mandates" (Hua, Shen, Walsh, Glenny, & Worthington, 2017). Therefore, seeking for Open Science requires coordinated activities of different stakeholders.

4. Preconditions for the implementation of Open Science

The need to share and open new knowledge in the form of research publications and data have been one the key topics in the discussions among different stakeholders. Open Science tends to be supported by both research administrators and researchers but there are institutional and cultural barriers to opening research results. Lack of investment in knowledge and data infrastructures is also a barrier to the development of Open Science. Furthermore, the requirements by funding institutions, intellectual property and copyright may function as barriers limiting access to research publications and data.

Across different scientific disciplines barriers for sharing knowledge emerge between different research fields, also researchers and the society. Because of differences in data types, data formats and their size in different research fields, there are different needs for data storage and preservation infrastructure.

Barriers are also determined by institutional factors (differences in institutional requirements), personal approach and attitudes towards Open Science.

The study by the European Commission has shown that "the barrier for individual scientists, concerns about quality assurance of new and non-traditional research outputs. For institutions, the main barrier was a perceived lack of awareness of Science 2.0, in addition to concerns about quality assurance. Some stakeholders cautioned against what they perceived to be a trade-off between publicity (facilitated by Open Science) and scientific quality and excellence, and they queried how to maintain scientific standards in an Open science context" (European Commission, 2015b). The list of barriers also includes cultural resistance to change among stakeholders, a lack of incentives to engage with Open Science, a lack of strategic management and limited coordination among stakeholders, a lack of skills among researchers and academics at all career stages, and legal constraints (European Commission, 2015b).

Most researchers are willing to have access to data produced by others but very few do not mind to open their own data. Therefore, the requirements by research institutions and funding bodies are very important: "to ensure and spur progress in data-sharing, journals and universities should continue to take the lead" (Andreoli-Versbach & Mueller-Langer, 2014).

Researchers' decision to share data also depends on research evaluation schemes that give opportunities of career, reward and competitive advantage (European Commission, 2015b; Gerber, 2014). Formal systems of evaluation that prevail in most countries do not provide incentives for sharing knowledge with peers, as the evaluation process tends to involve high impact publications, whereas other criteria of evaluation, e.g. altmetrics, have little impact on evaluation results. Authors still seek to publish their papers in the highest-quality journals whose peer-review standards they can meet, but it is paradoxical that all or most authors are not yet seeking to top up those papers' usage and impact metrics by going on to make them OA (Gargouri et al., 2012). Developing and maintaining technical infrastructure is also a prerequisite for implementing the idea of Open Science. Recently, the European Open Science Cloud (EOSC) initiated activities towards facilitating integration in the area of European e-Infrastructures and connected services between the member states, at the European level and internationally. The main purpose of EOSC is to remove all the technical, governmental and human barriers in order to accelerate the re-use of research data and to support the access to services without any social or geographical borders. The elements for success for the EOSC are the following: open, publicly funded and governed, research-centric, comprehensive, diverse and distributed, interoperable, service oriented, social (Giannoutakis & Tzovaras, 2017).

To ensure openness of research data, they should meet the principles of FAIR: findable, accessible, interoperable, re-usable ("The FAIR Data Principles | FORCE11," n.d.; Wilkinson et al., 2016). For long-term preservation of data, their metadata should be creating in line with international standards.

Issues of data management are part of the data opening process. Data management requires relevant knowledge, experience and specialists (of data managers, analysts, experts) who are able to organize data in accordance to FAIR principles. The skills needed for Open Science cover a broad span from data management to legal aspects, and include also technical skills, such as data stewardship, data protection, scholarly communication and dissemination (including creating metadata).

Adequate management and organization of research data, research support are not the end in themselves but a prerequisite for data discoverability and innovations (Wilkinson et al., 2016). The survey results show that "the increasing costs related to open access publications and data, and more particularly uncertainty regarding who should bear them, were also mentioned as a significant barrier" (European Commission, 2015b).

Even though the idea of Open Science is attractive and promising for the research progress, national developments, also supported by many stakeholders, its implementation encounters different barriers. The successful steps in overcoming them, first of all, "depend upon elaborate research policies, convenient research tools, and, not least, the participation of the researchers themselves" (Fecher & Friesike, 2014).

Consequently, the "building blocks" of preconditions fostering and empowering the development of Open Science are the following:

- strategic guidelines and their implementation (EU, national and institutional legislation);
- infrastructure (research literature and data repositories) and services;
- competence (competence to publish your research results, manage your research data, generic professional competence; citizen science).

5. Implementation of Open Science in Lithuania

The major European research funders European Commission and the European research Area (ERA) have adopted the OA guidelines and mandates. The Seventh Framework Programme for Research and Technological Development 7BP (2007-2013) involved Open Access Pilot for research publications in seven research areas. Horizon 2020 programme includes an OA mandate in all research areas and also Open Research Data Pilot ("Guidelines on Open Access to Scientific Publications and Research," 2017). The EU countries have recommendations to implement OA guidelines on the national level.

In Lithuania the requirement to make the results of publicly funded research public is recorded in the Law on Higher Education and Research (2009, revised in 2015 and 2016) stipulates that "the results of all research works carried out in state higher education and research institutions must be communicated to the public" (Law on Higher Education and Research of the Republic of Lithuania, 2009)

However, as noted in the EC report, "the Lithuanian legal and institutional system is favourable but not mandatory for the implementation of OS policy (European Commission, 2018b). This Article is not a directive, as Lithuanian research and study institutions are autonomous legal bodies that make decisions on access to their research results. Institutional guidelines on open access are adopted by individual institutions. According to the EC report, almost all biggest Lithuanian state universities in web-pages declare support to the EU policy on opens access to research information and some of them adopted internal documents like guidelines on open access to scientific publications and data (European Commission, 2018b).

On 29 February 2016, the Research Council of Lithuania (RCL) approved a set of "Guidelines on Open Access to Scientific Publications and Data" (Research Council of Lithuania, 2016) that addresses publications and data from research funded by the Council. The Guidelines say that the data must be preserved for a period no shorter than years after the completion of the project and that a data management plan must be included in the project proposal. They also include the statement: "to establish the transitional period for the implementation of the Guidelines by 31 December 2020".

In spite of quite prominent attempts to promote Open Science in different fields on the national and institutional levels, Open Science initiatives are not popular among researchers. The most important reason for this is that "there are currently no specific rewards or incentives for Open Science. Although Lithuania is lacking prominent role models promoting Open Science ideas, its research institutions are trying to establish their own policies regarding Open Access and Open Science" (European Commission, 2018b).

The Registry of Open Access Repository Mandates and Policies (ROARMAP) ("The Registry of Open Access Repository Mandates and Policies (ROARMAP)," n.d.), as in April 2018, involved 10 OA policy documents.

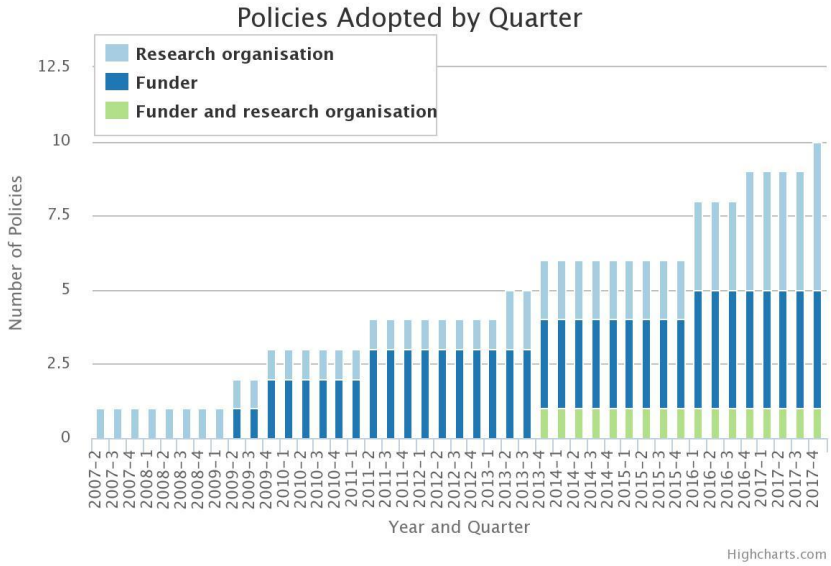

Figure 2. Open access policy documents adopted by Lithuanian HE and funding institutions

The analysis of institutional OA policy documents on the ROARMAP has shown that institutions provide inaccurate data, e.g.: there are 3 references to the policy by the funding institution and only 4 institutions provide links to policy documents. Other institutions even though they have institutional policies have not registered them on the registry ROARMAP.

To find out what infrastructure is used for preserving research and study results, the information provided on the OpenDOAR registry ("The Directory of Open Access Repositories - OpenDOAR," 2006) was examined. For Lithuania, this registry includes 12 OA repositories: 1 subject repository, 2 national repositories, 8 institutional repositories, 1 data repository. There 5 data repositories registered on RE3DATA.org: 1 national research data archive and 4 subject repositories. Most of them have very limited number of data sets: from 13 to 300 records.

To evaluate the real background situation for the implementation of Open Science in research and study institutions, a survey was carried out in March 2017. The respondents were 21 institution: 12 universities, 6 universities of applied sciences, 2 research institutions and 1 institution of other type. The responses have shown the institutional preparedness to meet the guidelines on OA by the European Commission. Policies on OA to research publications have been adopted by 8 out of 21 institutions, whereas policy statements on OA to research data have been released by 3 of them. The analysis of policy

documents has shown that the institutional policies both on research publications and data are aligned with the policy documents by the EC and the main national funder, the Research Council of Lithuania (Research Council of Lithuania, 2016). Most documents mention the period of transition until 2019-2020. The current requirements in the policy documents are recommendations rather than mandates.

Research publications in open access repositories are deposited in 14 institutions. Most of them are using the national repository the Lithuanian Academic Electronic Library eLABa("Lietuvos akademinė elektroninė biblioteka eLABA," 2010). Some of them have their own institutional repositories. Most of the institutional repositories have been created on the basis of the national repository and function as its subsets.

There are 3 data repositories that have been developed as a result of projects. As the projects are over now and no more funding is available, the maintenance of the repositories depends on the initiative and efforts of the developers. Support for researchers in organizing data and making them open access is limited.

The survey was repeated in November 2017 but no major changes were noted.
Another important precondition for the implementation of Open Science is developing researchers' data management competence. Since 2005, wide promoting events for open access to research output were organized by the Lithuanian Research Library Consortium. Most of them were supported by EIFL (Electronic Information for Libraries) (Tautkevičienė, Petrikaitė, & Eidukevičiūtė, 2013). Kaunas University of Technology, one of the biggest HE institutions in Lithuania, has been among partner institutions of the FP7 project OpenAIRE as a National Open Access Desk (NOAD). Information dissemination and support for researchers is part of NOAD activities in the frame of the project OpenAIRE ("OpenAIRE," n.d.). Events like an annual conference on open access, roundtable discussions, workshops and training sessions are organized.

On the institutional level, there are some initiatives but so far only a few graduate schools (e.g., Kaunas University of Technology, Lithuania) cover open science topics systematically (Schmidt et al., 2016). One of the recent initiatives was developing a module "Research Data Management" for doctoral programmes. Starting from 2018/2019 it will be offered as an elective for students of 18 doctoral programmes. In other institutions, OA initiatives and development of researchers' competence take place as stand-alone activities, often as part of the Open Access Week. Competence development in research data management is not prioritized on institutional level, whereas the implementation of data management plans is at an introductory stage.

6. Conclusions

The preconditions fostering and empowering the development of Open Science are the following: strategic guidelines and their implementation (EU, national and institutional legislation); infrastructure (research literature and data repositories) and services; competence (competence to publish your research results, manage your research data, generic professional competence; citizen science).

On the national level, the research and study institutions have a mandate recorded in the Law on Higher Education and Research to open research publications and data if this does not contradict intellectual property and other laws. Most institutions have institutional OA policy documents that are recommendations rather than mandates. The national funder recommends to open research data but only a few institutional OA documents refer to open research data.

The members of Lithuanian research and study institutions may use the open access infrastructure for publications. It is funded and administered on the national level. Several institutions have institutional repositories. The use of data repositories is very limited; one of the reasons for this is limited or lacking funding.

The development of competence for open access and research data management in the research community may be described as stand-alone activities, even though a module of formal education has been developed at one institution.

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