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# POLITIKA OTVORENE NAUKE U SRBIJI KAO ASPEKT ODGOVORNOG ISTRAŽIVANJA I RAZVOJA

# OPEN SCIENCE POLICY IN SERBIA AS AN ASPECT OF RESPONSIBLE RESEARCH AND INNOVATION

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***Rezime:*** *Otvorena nauka i odgovorno istraživanje i razvoj su koncepti koji unose promene u istraživačke i inovacione politike širom sveta, a naročito u Evropi. Ovi koncepti uključuju nove elemente u dizajn, sprovođenje i evaluaciju istraživanja, kao i u predstavljanje naučnih saznanja. Ovaj rad sumira različita razmatranja odgovornog istraživanja i razvoja, a takođe objašnjava otvorenu nauku kao jednu od njegovih dimenzija. Cilj istraživanja je da predstavi indikatore otvorene nauke u Republici Srbiji i uporedi ih sa relevantnim EU državama. U radu je dat pregled broja publikacija sa otvorenim pristupom, broja otvorenih repozitorijuma i nacionalnih politika u domenu otvorene nauke.*

***Ključne reči:*** *Otvorena nauka, Odgovorno istraživanje i razvoj, Istraživačka i inovaciona politika, Srbija.*

***Abstract:*** *Open science and responsible research and innovation are emerging concepts which introduce changes in research and innovation policies around the world and especially in Europe. Those concepts include new elements in research design, performance, evaluation and communication of scientific knowledge. This paper summarizes different considerations of responsible research and innovation and also explains open science as one of its dimensions. The purpose of this study is to present open science indicators in the Republic of Serbia and compare it with relevant EU countries. It offers an overview of open access publications, open access repositories and national open science policies.*

***Keywords:*** *Open Science, Responsible Research and Innovation, Research and Innovation Policy, Serbia.*

## 1. INTRODUCTION

Research and innovation are the most important driving forces of socio-economic development. They have huge potential to cope with global challenges, including those identified in the Sustainable Development Goals. Research and innovation policies are focused not only on increasing results, but also on managing risks and ethical issues which emerge in the modern era. Technological development and scientific advances open up various questions related to responsibility, governance and openness of scientific communities, processes and outputs.

The concept of responsible research and innovation (RRI) was developed by the European Union as a policy approach in science and technology, in order to link scientific advances and expectations of the wider society. It involves several dimensions: public engagement, gender equality, science education, ethics, open access and governance. Responsible research and innovation is implemented in the EU programme Horizon 2020, and especially in the “Science with and for Society” objective. Responsible research and innovation is conceived as a dialogue between all actors participating in the innovation process in order to enable benefits for researchers, policy makers and society in general.

Open science as one of the RRI dimension enables better knowledge sharing and fosters innovation in public and private sector. It is a broad concept which includes various activities focused on removing barriers in sharing different results, data or methodology. There are different terms which can be classified under open science: open access to publications, open source software, open research data, open peer review, open educational resources, open monographs, citizen science, research crowdfunding and other.

## 2. CONCEPTS OF RESPONSIBLE RESEARCH AND INNOVATION AND OPEN SCIENCE

According to the European Commission responsible research and innovation is "an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation" (European Commission, 2014). The definition also implies the necessity that all actors involved in research and innovation process collaborate so that their results become more useful for the society as a whole.

Rome Declaration from November 2014 has identified the ways in which the benefits of RRI go beyond alignment with society: it includes new individuals and new ideas; it contributes to smart and sustainable solutions; it builds trust between citizens and R&I institutions; it helps in accepting innovative products and offers useful tools in risk management (European Commission, 2014). Also, this declaration calls on all relevant organisations in the European Union to consider RRI as a central objective in shaping relevant policies and actions.

Responsible Research and Innovation (RRI) can be defined as a "transparent and interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products - in order to allow a proper embedding of scientific and technological advances in our society" (Von Schomberg, 2011). Therefore, responsible innovation contributes to the sustainable development. However, this definition of RRI has been a subject of criticism due to its imprecise language and therefore the possibility to have several meanings (Loureiroa & Conceição, 2019).

It can be identified three key dimensions of responsible innovation: 1) innovations must avoid harming people and the planet as a whole; 2) innovations need to "do good" by offering new products, services or technologies that foster sustainable development; 3) responsible global governance is necessary for achieving the first two requirements (Voegtlin & Scherer, 2015).

In order to foster the development of RRI, in 2014 the European Commission funded the RRI Tools project. The project involved over 25 different institutions across 30 countries and it provided a universal guide for policymakers, researchers, industries, civil society organisations and educators on questions related to responsible research and innovation. The starting point of the RRI Tools project was that research and development should be considered from a wider perspective - not only within the scientific institutions, but also from the viewpoint of the environment and society. The project defines responsible research and innovation as "a dynamic, iterative process in which all stakeholders in research and innovation become mutually responsive and share responsibility for both the process and its outcomes". Also, the following aspects of RRI are identified:

- Ethics - how to promote research integrity.
- Gender equality - guidance on creating gender-sensitive research contents, teams and decision bodies.
- Governance - how to create structures for implementing RRI.
- Open science - how to incorporate open access into research practice.
- Public engagement - how to foster multi-actor engagement.
- Education - how to introduce RRI in inquiry-based education projects (RRI Tools Consortium).

Open science includes free access to research results and data. One of the main ideas of open science is to make publicly funded research accessible to the general public. There is no formal definition of open science, but there are different attempts. It can be considered as a "transparent and accessible knowledge that is shared and developed through collaborative networks" (Vicente-Saez & Martinez-Fuentes, 2018). The OECD describes open science as „making the primary outputs of publicly funded research results – publications and the research data – publicly accessible in digital format with no or minimal restriction as a means for accelerating research" (OECD, 2015). The open science is based on a premise that digital technologies enable different ways of sharing knowledge and establishing collaborations. The concept in its broad sense includes applying principle of openness to the whole research cycle and not only on research results.

Although open science is one of the key priority areas of the European research and innovation policy, there is still a challenge related to lacking of evidence in this field. One of the attempts in monitoring open science indicators was made by RAND Europe and its partners—Deloitte, Observatoire des Sciences et des Technologies, Altmetric and Digital Science. This monitor was developed on behalf of the European Commission, DG Research and Innovation. The most important characteristics of open science which are selected in this monitor are open access, open research data and open communication activities. Each of these characteristics is linked with several indicators which measure the progress made. Figure 1 illustrates how the proposed indicators (presented in the outside circle) align with each of the three core open science characteristics (presented in the inner circle). It is important to have in mind that open science is more than

the three characteristics chosen in this monitor, but they represent the core features which are the most developed and available for tracking (Smith, Gunashekar, Lichten, Parks & Chataway, 2016).

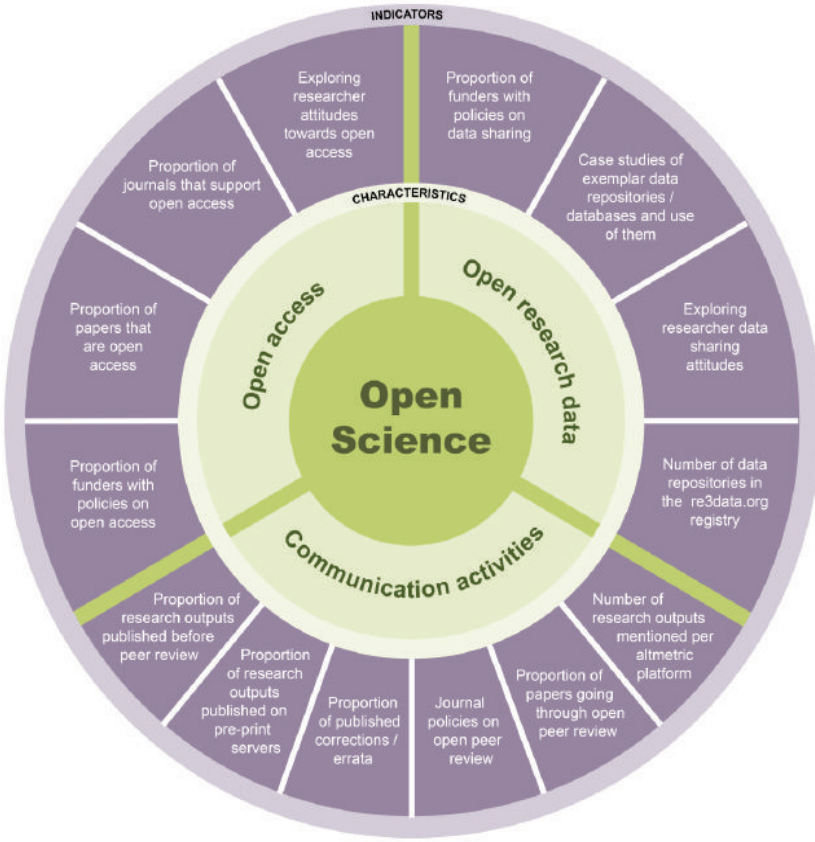


**Figure 1**: Alignment of proposed indicators with core open science characteristics to be monitored
**Source**: Smith, et al, 2016.

Since the RRI concept has several dimensions, its benefits are very broad and include societal, democratic and economic aspects. The benefits should be also considered as driven and reinforced by several RRI dimensions. Open access enables creating research environment in which research products are accessible as inputs for future research (benefit for science) or as knowledge useful for other users (societal or economic benefits). It offers an efficient way for using valuable resources and creating more responsive R&I system (European Commission, 2018).

## 3. OPEN SCIENCE POLICIES IN SERBIA

National open access policy in the Republic of Serbia was introduced in 2018 and it is titled Open Science Platform. The Ministry of Education, Science and Technological Development has created and published this open access policy. The main goals of this policy are open access to research literature, research data and methodology, as well as development of digital infrastructure for achieving it.

The main elements of Serbian open access policy are:

- Open access must be provided to an electronic copy of the published version (if allowed by the publisher's policy) or the peer-reviewed version (accepted for publication) of every scholarly publication.

- Open access to the full text of the published research outputs must be enabled immediately, if possible, and certainly no later than 12 months after the date of publication in case of physical and medical sciences, and engineering, or no later than 18 months in case of social sciences and humanities.
- It is supported Green Open Access, i.e. depositing published research outputs in digital repositories with full respect to copyright and rights granted to publishers.
- Universities and research institutes should define and adopt their open science platforms within six months, in accordance with the platform (Open Science Platform, 2018).

The new Law on Science and Research, adopted in 2019, recognizes open science as a crucial principle of scientific and research activities. The Law states that the open science and optimal use of scientific research infrastructure will increase the quality and visibility of scientific results. Also, the principles of open science and open access to scientific publications and research data are based on the recommendations of the European Commission and international best practices. According to the one of the articles, the data from the Register of Research Organizations and the Register of Researchers in Serbia are publicly available on the website of the Ministry in a machine readable format, ready for use and re-use (The Law on Science and Research, 2019).

Even before introducing official open access policies, Serbian researchers had certain experience in this field. According to the survey on open science awareness in Serbia from 2017, around 34% of the respondents were involved in a research project that had some form of regulation regarding open science. The explanation for this relatively high percentage is that some project teams had their own policies regarding open access or that some researchers had misperceptions about the principles of open access publishing. About 18% of participants in this research stated that most of their publications include open access, while 35% have published only a minor portion in open access regime (Čolović & Pajić, 2017).

## 4. OPEN SCIENCE INDICATORS IN SERBIA

Serbia is participating in OpenAIRE project which offers various information and data, and supports open science in different European countries. OpenAIRE is a network of open science experts promoting and providing training in this field. At the same time, it is a technical database collecting outputs from various data providers.

According to the OpenAIRE statistics, number of open access publications shows an upward trend in period 2000-2016, and especially after 2010 (Figure 2). Although it is visible decrease of open access publications after 2017, it is expected the continuation of the increasing trend due to the national measures undertaken.

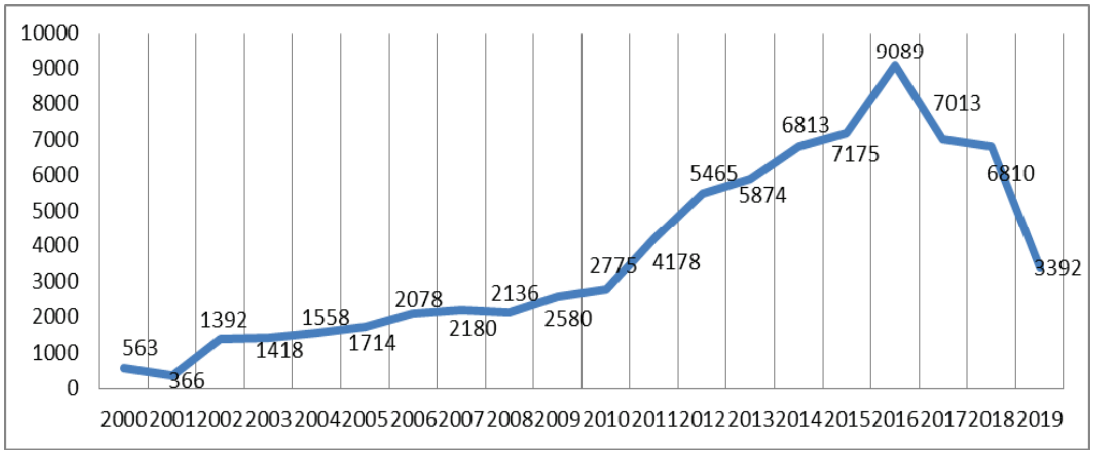


**Figure 2**: Number of open access publications in the Republic of Serbia
**Source**: OpenAIRE statistics (https://www.openaire.eu/item/serbia)

In period 1990-2019, Republic of Serbia had 77.860 open access publications in 174 repositories. The Table 1 presents 10 repositories with the highest number of open access publications. Around 23% of all open access publications are in Serbian Citation index and National Repository of Dissertations in Serbia.

**Table 1**: Open access repositories in the Republic of Serbia

| Repository | Number of OA publications |
|---|---|
| SCIndex | 9.038 |
| National Repository of Dissertations in Serbia (NARDUS) | 8.966 |
| Digital Archive of the publications of the Serbian Academy of Sciences and Arts | 5.411 |
| Repository of the Vinča Institute of Nuclear Sciences | 3.371 |
| Thermal Science | 2.806 |
| Journal of the Serbia Chemical Society | 2.654 |
| Vojnosanitetski pregled | 2.559 |
| RADaR | 2.448 |
| Serbian Archives of Medicine | 1.881 |
| Archives of Biological Sciences | 1.842 |

**Source**: OpenAIRE statistics (https://www.openaire.eu/item/serbia)

When comparing to the selected EU countries, Serbia has lower number of open access publications than Croatia, Slovenia and Austria. On the other hand, Serbia has better results in this field in comparison with Bulgaria, Romania, Slovakia and Hungary (Figure 3).

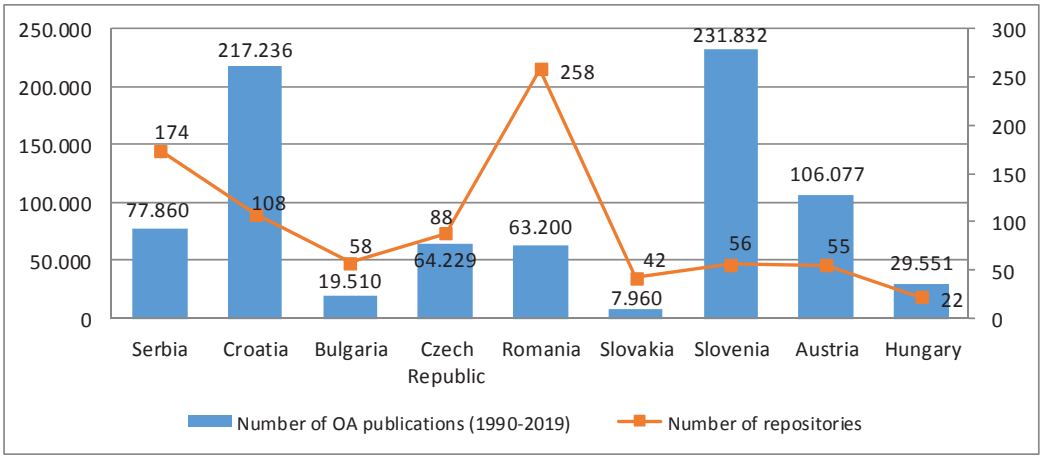


**Figure 3**: Open access publications and repositories in selected countries
**Source**: OpenAIRE statistics (https://www.openaire.eu/item/serbia)

The Figure 3 also presents number of repositories of open access publications. It is visible that Serbia has more repositories than majority of selected countries. Namely, only Romania has higher number of open access repositories.

## 5. CONCLUSION

Open access to research data, results and methodology is one of preconditions in developing knowledge based economy. Principles of open science are considered as very important on the European and national level since they enable more responsible and efficient research and innovation. Promoting the idea of open science is especially beneficial in developing countries since it improves relevance of scientific results and increases cooperation between business and academic sector. Therefore, open science should not be

considered as a goal, but as a tool to achieve excellent science, increased collaboration and higher impact of research activities.

Republic of Serbia adopted a national open access policy in 2018 and it is called an Open Science Platform. The devotion to the open science is also reflected in several articles in the new Law on Science and Research. In period 1990-2019, Republic of Serbia had 77.860 open access publications in 174 open access repositories. It is visible an increasing trend in open access publication. In a comparative perspective, Serbia has significant open science results and in some cases they exceed achievements of certain selected EU countries.


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## REFERENCES


[1] Čolović, P. & Pajić, D. (2017). Survey on open science attitudes and experiences among Serbian scholars. BeOpen project report. Retrieved from: http://www.beopen.uns.ac.rs/documents/35a4f18a51b8b1b54a9dec74afea72a3/Survey%20on%20open%20science%20awareness%20in%20Serbia.pdf

[2] European Commission (2014). Rome Declaration on Responsible Research and Innovation in Europe, pp.1–2.

[3] European Commission, Horizon 2020, Responsible research & innovation. Retrieved from: https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation

[4] European Commission. (2018). Monitoring the evolution and benefits of responsible research and innovation. Luxembourg: Publications Office of the European Union.

[5] Loureiroa, P.M. & Conceição, C.P. (2019). Emerging patterns in the academic literature on responsible research and innovation. Technology in Society, Volume 58.

[6] OECD. (2015). "Making Open Science a Reality", OECD Science, Technology and Industry Policy Papers, No. 25, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jrs2f963zs1-en

[7] Open Science Platform (2018). Retrieved from: http://open.ac.rs/svevesti/87328781babfe70aad60429fad8f4feb/Open-Science-Policy-Serbia.pdf

[8] OpenAIRE statistics (https://www.openaire.eu/item/serbia)

[9] RRI Tools Consortium, A Practical Guide to Responsible Research and Innovation - Key lessons from RRI Tools. Retrieved from: https://www.rri-tools.eu/documents/10184/16301/RRI+Tools.+A+practical+guide+to+Responsible+Research+and+Innovation.+Key+Lessons+from+RRI+Tools

[10] Smith, E., Gunashekar, S., Lichten, C., Parks, S. & Chataway, J. (2016). A framework to monitor open science trends in the EU. OECD Blue Sky III Forum, Informing science and innovation policies: Towards the next generation of data and indicators. 19– 21 September 2016, Ghent, Belgium

[11] The Law on Science and Research (2019). Official Gazette of the Republic of Serbia, No 49/2019.

[12] Vicente-Saez, R. & Martinez-Fuentes, C. (2018). Open Science now: A systematic literature review for an integrated definition. Journal of Business Research, Volume 88, pp. 428–436.

[13] Voegtlin, C. & Scherer, A. (2015). Responsible Innovation and the Innovation of Responsibility: Governing Sustainable Development in a Globalized World, Journal of Business Ethics:1-17.

[14] Von Schomberg, R. (2011). Prospects for technology assessment in a framework of responsible research and innovation, in: Technikfolgen abschätzen lehren: Bildungspotenziale transdisziplinärer Methode, P.39-61, Wiesbaden: Springer VS.