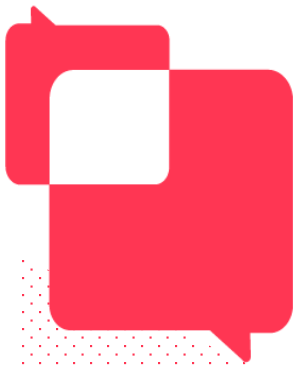

D2.1: Submitted scientific paper on the social and legal implications and challenges related to OS

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Responsible Open Science in Europe

ROSiE

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Social and Legal (IP rights) Challenges and Implications of Open Science

Signe Mežinska, Ilze Mileiko, Teodora Konach

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Introduction

Open Science (OS) is mostly conceptualized as an open, dynamic, transnational, and multi-partner framework for science and knowledge creation, valorisation and dissemination that reflects societal needs and applies existing technical means (ALLEA, 2022; Ardil, 2007; Commission, Centre, Triaille, Barbarossa, & Grande, 2017; EARTO, 2020; Kunst & Degkwitz, 2019; Smart et al., 2019). Lately, it is being broadened up to endorse all stages of these processes as a new paradigm, easily adjustable to the needs and tools of the digital age. Its main rationale is improving science through collaborative and open ways of producing and sharing data and knowledge throughout the entire research cycle. As a novel, dispersed and to some extent self-governed movement, OS operates within various frameworks and through diverse channels and tools.

OS practices are influenced by and influence societal processes, local and global cultures, beliefs, values, and norms in the scientific community and society in general, as well as challenge the existing legal framework and many established legal concepts, including human and cultural rights, ethical aspects, and privacy. In this article, the interconnectedness between OS practice, social processes, and the intellectual property (IP) rights system will be discussed based on an analysis of publicly available reports from relevant EU-funded research projects and scientific literature.

Methods

To map the social implications and challenges of OS in the European science ecosystem, we performed a non-systematic critical interpretive review (McDougall, 2015) of the publicly available reports from relevant EU-funded research projects and scientific literature. This approach emphasizes relevance and quality of insights rather than quantity for its own sake. In the research process, we looked for the answers to the following questions:

- What social challenges are brought about by OS processes?
- What social challenges arise by involving new actors in the scientific process?

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- What are the attitudes towards OS in the scientific communities?
- What are the roles of different actors in the process of implementation of requirements of research ethics and research integrity in the context of OS?

The analysis was performed from December 2021 to June 2022. The review of project reports has been performed in an iterative manner, using the initial research questions flexibly and continuously to refine them in accordance with the results of the searches. We started with identifying relevant EU-funded projects in the CORDIS database[1] and searched for projects focusing on OS by using the keywords: "open science", "FAIR data", "transparency", "citizen science" and "Plan S". The projects initially included in the analysis were: PRINTEGER, EnTIRE. TRUST, MoRRI, RRI-Practice, OPENAIR, ORION, FOSTER, ON MERRIT, EOSC-PILLAR, OPENAIR-ADVANCE, FEDORA, FAIR4HELTH, GRECO, ALLINTERACT, PRO-RES, SHERPA, I-CONSENT, GRRIP, NEWHorrizon, FIT4RRI, Path2integrity, ResAGorA, GENDERACTION. All these projects have established web pages including project results, reports, and publications. After screening the web pages of included projects, three projects were excluded from further analysis during the initial screening of search results. Two projects (FOSTER and EOSC-PILLAR) were aimed at developing research tools or digital platforms and have not developed reports including social aspects of OS. The FEDORA project started in 2021, and its results were not publicly available at the time of performing the search.

From the web pages of the included projects, 138 documents were selected for analysis based on their titles and abstracts. During the coding process, 37 documents were excluded from the analysis, because they did not include information relevant to the research questions. Reference lists of included documents were checked to identify relevant research studies answering research questions. For performing content analysis of the documents, the Dedoose web application[2] was used.

The initial analysis of the data gathered from the project reports showed that social issues in the context of OS are closely connected to the IP rights system. It introduced an additional research question:

- What are the current developments and main trends in the OS and IP rights?

[1] https://cordis.europa.eu/
[2] https://www.dedoose.com

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To analyse and synthesise the developments in the OS and IP rights a non-systematic literature review was employed. Scientific and scholarly papers have been reviewed, as well as primary legislative resources, declarations, recommendations, statements and policy documents, complemented by the findings of relevant EU-funded projects and the ROSiE project deliverables and working documents. The critical analysis helped in the identification of the main challenges, inconsistencies, and contradictions in the current systems of OS practice and IP rights regimes.

Results

Cultural differences and economic disparities

The cultural context consists of values, traditions, norms, beliefs, and social and political structures that directly or indirectly influence and shape the research process and thus impact scientific practice and attitudes towards OS in society and the scientific community. Cultural differences are defined as "*the integrated and maintained system of socially acquired values, beliefs, and rules of conduct which impact the range of accepted behaviours distinguishable from one societal group to another*". (Jackson & Guerra, 2011)

Research studies show that there are differences between countries in scientists' attitudes towards OS. (Joo, Kim, & Kim, 2017; Tenopir et al., 2011) Zuiderwijk et al. suggest that these differences may be caused by various socioeconomic and cultural factors. (Zuiderwijk, Shinde, & Janssen, 2019) The authors of the RRI-Practice report mention examples showing that in societies like the Netherlands and Norway, ideas of OS seem to be *"particularly well aligned with the way in which these societies are perceived and organized"* (Hennen, 2019), while in some other countries, e.g., Bulgaria these ideas are more unfamiliar to the scientific and innovation community. (Hennen, 2019) Also, the concept of OS itself is complex and includes various aspects of openness that may be differently interpreted in different cultural contexts:

> *"Open Science is such a diverse and broad thing that, even if you liaise or collaborate with someone in Open Science doesn't mean that you are precisely talking about the same things. [..] So, the challenge here was to bring everybody to the same line into what we are trying to do."* (ORION, 2021b)

At the same time, the analysed EU project reports point to the fact that there are fewer differences in understanding of OS than research ethics and responsible research and

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innovation (RRI) issues because in the case of OS there are strong international and especially EU policy initiatives promoting OS. (van Lente, 2018) Similarly, the RRI-Practice report mentions influence of national cultural contexts on the practice of OS, however also in this report the authors emphasize that this influence is less traceable than in case of RRI and ethics because *"Open Access and OS are, to a significant extent, the product of international policy discourses and regulations".* (Hennen, 2019) When looking at cultural barriers to the implementation of OS, the RRI-Practice report mentions *de facto* academic culture as one of the significant barriers for research funding organisations in their efforts to introduce OS where, for example, *"OA [open access] is seen as an impediment to career progression - given the emphasis on impact factors - while OA publications are frequently viewed as being of lesser quality."* (Hennen, 2019)

Although the reports and studies referred to in the reports do not clearly classify the attitudes of researchers towards OS, they show a general tendency that there are differences in attitudes towards OS related to various factors, e.g., gender, age, career stage, as well as field of science or type of OS activity. Various studies point to gender and age differences in attitudes and practices towards OS, however, the results are controversial. (Delikoura & Kouis, 2021; Lakomý et al., 2020; Zhu, 2020) According to some studies, men are more supportive of OS and are more likely to practice it. Zhu explains these results by referring to a more positive general attitude towards new technologies in the male population and the possibility that males in higher academic positions have more experience with OS. (Zhu, 2020) Females, according to some studies, are more concerned about negative aspects of OS and young women in an early carrier stage are less likely to share their data. Zhu also states that gender and age have a larger impact on attitudes towards data sharing in natural sciences and engineering than in medical and life sciences, arts and humanities. (Zhu, 2020) At the same time, a study from Australia shows that age and gender do not have a statistically significant impact on researchers' attitudes and the authors of this study note that attitudes based on age and gender should be interpreted with caution. (Lacey, Coates, & Herington, 2020) Similarly, Zuiderwijk et al. explain that gender and age do influence attitudes in some cultures but do not work in that way in others, and thus it can be related to cultural differences. (Zuiderwijk et al., 2019)

Several studies conclude that academic career stage has a significant impact on attitudes and practice of OS, e.g., a survey among members of the German Psychological Society

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showed that those scientists who have not yet completed their PhD studies and who do not feel confident about their position are more sceptical OS practices. (Abele-Brehm, Gollwitzer, Steinberg, & Schönbrodt, 2019) However, also here, like with gender and age, the data should be interpreted with caution, and it should be considered that there might be other cultural and socioeconomic factors involved. For example, in some contexts academic career stage has a link with gender, and those with a higher or more stable position are most likely males.

The GRECO project report based on the research data states that scientists have different attitudes towards various types of OS activities, e.g., there are more positive attitudes towards open data sharing and open publishing than towards public engagement and science communication that may not be viewed as the responsibility of scientists. (Barbosa, 2020) The attitudes may be negatively influenced by a lack of skills and knowledge necessary for practising OS (Zhu, 2020) or a negative experience with practising OS. (Hopp & Hoover, 2019)

Project reports and research studies refer also to differences in attitudes and readiness to engage in OS between different fields of science. For example, a review on attitudes towards open access publishing shows that *"the natural and technical sciences show the highest OA [open access] prevalence rates amongst all disciplines*". (Severin, Egger, Eve, & Hürlimann, 2018) The RRI-Practice report mentions that the degree of awareness of OS and attitudes towards it varies across scientific disciplines. (Hennen, 2019) Differences between scientific disciplines are explained by differences in technical skills, traditions, data characteristics (e.g., qualitative, quantitative, sensitive, personal), history of practising OS in the scientific discipline etc. There might be differences in attitudes related to the perception of data, where some scientists may see the research material and data as their personal property. (Borgerud & Borglund, 2020) Also, ethical issues in the case of human subject research may affect researchers' willingness and ability to share data. Medical and social science researchers involving human participants in their studies may be reluctant to share research data because of privacy issues and data protection. (Zhu, 2020) Some scientific disciplines such as genetic genealogy, atmospheric science, and oceanography have well-developed traditions in OS and data sharing and have developed the necessary infrastructure and databases, whereas other disciplines may lack this experience, traditions and infrastructure. (Zuiderwijk et al., 2019) In some disciplines, for example, in astronomy the infrastructures like

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observatories are so expensive that researchers must share them to practice science. Publishing of preprints has a long tradition in physics, mathematics, astronomy, and information technology, nevertheless this practice is new for many other disciplines. (Severin et al., 2018)

In the FIT4RRI project report, cultural attitudes of the actors involved in OS and institutional culture are mentioned as a potential barrier to the implementation of OS practices. The authors of the report emphasize that scientists or institutions may lack motivation and opportunities to change existing power relationships, traditions, practices and unwritten norms in science. (L. d'Andrea, Berliri, M., Federico M., 2018) In some social contexts, researchers' unwillingness to change and introduce new OS practices is justified by expressing concerns about academic freedom of individual researchers, policymaking autonomy of academic institutions and research organisations, and unwillingness to change academic culture. (L. d'Andrea, Berliri, M., Federico M., 2018) Social barriers to OS practices may include also personal and cultural resistance towards openly facing criticism after giving open access to data or practising open peer review which in some researchers' view may be "*tainted by personal biases and grudges*". (Segado-Boj, Martín-Quevedo, & Prieto-Gutiérrez, 2018)

One way how cultural attitudes can be actively shaped and developed is by introducing OS policies. Research shows that there are significant differences in OS policies even between EU countries. The lack of OS policies is a significant barrier to the implementation of OS. (Bodlos & Wezel, 2020) Reports also mention a lack of knowledge and skills on how to proceed from ideas to practice in OS (Bernstein, 2017; ORION, 2021a), most importantly *"the knowledge about existing infrastructures and the know-how for data sharing*". (Zenk-Möltgen, Akdeniz, Katsanidou, Naßhoven, & Balaban, 2018) For example, information about existing OS infrastructures and practices is mentioned as crucial for the successful implementation of OS. (Bernstein, 2017)

Some reports show that there may be cultural resistance towards the re-organization of the scientific process and towards the promotion of significant changes in the existing ways of doing research. In case of cultural resistance, targeted management to change academic culture at the institutional level and to shape personal attitudes become a crucial incentive to promote OS. (Hennen, 2019) The social barriers to the implementation of RRI including OS identified by the FIT4RRI project include: 1) overall cultural attitudes of the actors and institutions involved (resistance to change, risk

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aversion, protection of academic freedom, researcher specialisation, value systems of actors and training approaches); 2) interaction between the actors concerned (stereotypes; lack of a collaborative culture; diverging visions of societal benefits; conflicts between local; national and international cultures); 3) existing priority schemes (Open Access vs IP/patenting, pressure to publish, creating growth and making a profit); 4) the dynamics of RRI and OS incentives (lack of material incentives, lack of scientific recognition, lack of incentives for actors outsid research and innovation field, unclear benefits). (L. d'Andrea, Berliri, M, Marta, LF, 2018)

One of the significant social challenges for the integration of OS into national research and innovation ecosystems is caused by economic disparities between countries, both between EU countries and globally. In the report developed by the NewHoRRIzon project based on the analysis of the situation in Widening countries[3], the authors conclude that there is *"a big disparity among the analyzed institutions/countries*" (Griessler). When looking at countries outside the EU, the situation is even more imbalanced. A literature review by Zuiderwijk et al. points to economic factors and lack of infrastructure as significant barriers to open data sharing and practising OS in developing countries, providing an example of laboratories in Kenya and South Africa where researchers *"experience a lack of available resources, equipment and infrastructure that altogether slows down the pace of research and that makes it even more important to only share research data openly once the related publication is out"* (Zuiderwijk et al., 2019)

Among the main obstacles to embedding RRI, including OS, in developing countries, the authors mention insufficient R&D investment. They emphasize that social responsibility increases in the process of development and in a situation where there is a lack of basic scientific resources and infrastructures "*RRI and the three O´s are not a priority yet*". (Griessler) Power relationships and economic disparities between countries often manifest in relations between researchers from different countries. Researchers from more economically developed countries may significantly benefit by doing research in developing countries, while research results are not returned to societies and research communities of these countries. (Andanda, 2017)

[3] Widening countries are EU countries with low participation rates in projects funded by the European Commission and less performing in terms of research and innovation.

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The economic disparities between countries are directly linked to the implementation of OS. On the one hand, OS may bring economic benefits for countries, and societies, however, on the other hand, several reports mentioned costs emerging in the context of OS, which can be a significant economic barrier for developing countries and institutions experiencing financial struggles, e.g., funding needed for the development of OS infrastructure, open publishing, implementation of citizen science, additional training of researchers. (Andanda, 2017; Kennedy, 2018)

Trust and public engagement

Several of the analysed project reports emphasize the existence of a gap between society and science and the need to increase public trust in science. OS is aiming to change the approach to science by bringing science and society closer together, changing the image of science, making science more integrated into society and involving society in scientific processes, e.g., by practising citizen science. OS next to RRI is suggested as one of the approaches implying to build trust by increasing openness towards external actors: *"Responsible Research and Innovation (RRI) and Open Science (OS) share the same basic aim: to modify the consolidated social model of science towards a science fully embedded in society."* (Gottschling, 2020) OS and public engagement in research are considered a positive development since they promote science to be more focused on the needs of society, be included in the policy-making process and allow *"making scientists more aware of societies' concerns and values."* (L. d'Andrea, Berliri, M., Federico M., 2018) Public engagement is also fostered to integrate public opinion into research practice and to disseminate research results. (Griessler, 2017) At the same time, the existing gap between science and society creates a situation where science may be not sufficiently taken into account in the policy-making or decision-making process, e.g., because of "*different speeds and styles of policy-making and research and development*" (L. d'Andrea, Berliri, M., Federico M., 2018).

Next to the undeniable benefits, research reports also identify several challenges for public engagement. RRI-Practice and FIT4RRI reports point out that the existing diversity of approaches and definitions for public engagement may confuse the scientific community. (L. d'Andrea, Berliri, M., Federico M., 2018) The RRI-Practice report emphasizes the importance of clarifying definitions and strengthening the culture of public engagement. (Hahn, 2017) The FIT4RRI project report mentions that some researchers have difficulties in finding a direct link between their research and the

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current needs of society, necessary for meaningful public engagement. There also may be time constraints, lack of funding and resources, passivity of decision makers, lack of political framework and will to invest in openness and public engagement. (L. d'Andrea, Berliri, M., Federico M., 2018) Societal engagement also requires a set of new skills, e.g., communication and managerial skills, which researchers may not have, so training is needed. (L. d'Andrea, Berliri, M., Federico M., 2018) The authors of the RRI-practice national case report for Norway mention that the barrier to public engagement is lack of normative and administrative structures that promote social engagement and a lack of incentives "*leaving this aspect of responsibility to personal interest and personal engagement*" of the researcher. (Egeland, 2018) Some researchers have concerns that adapting to external expectations, e.g. to requirements regarding public engagement activities, poses threat to their autonomy. (Egeland, 2018) One more concern is not valuing public engagement activities by excluding them from the system of research assessment and leading to the situation where "*societal engagement is under pressure and not valued enough in the assessment of researchers*". (van der Molen, 2018)

In some situations, there is a lack of balance in the engagement of different stakeholders, e.g., some approaches may tend to exclude industry and focus solely on citizens, however other approaches may *vice versa* focus on industry and exclude citizens. (L. d'Andrea, Berliri, M., Federico M., 2018) Additionally, some reports mention the risk to over-engage certain types of societal actors, often representing the same social group. Therefore, there should be a targeted strategy on how to involve diverse societal actors in citizen science and other public engagement activities to avoid the situation where inequalities existing in society are replicated in activities of public engagement.

On the other hand, there may also be a situation where a lack of motivation on the side of societal actors and stakeholders can be observed. RRI-Practice report states that "*scepticism that different stakeholders have toward RRI and Public Engagement [..] produces a "motivational deficit" hindering these stakeholders from taking part in the implementation of RRI*." (L. d'Andrea, Berliri, M., Federico M., 2018) Also, the gap between the interests of societal actors, stakeholders and scientists, as well as lack of knowledge and skills on how to engage in science may be barriers to public engagement. Therefore, an essential prerequisite for successful public engagement is science education, which is broadly addressed, e.g., in the RRI-Practice national and joint reports. Citizen science among

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other approaches is seen as an important driver of science education. Better science education makes it easier to involve the public in communication with scientists, especially if the educational and communication activities aim to involve societal actors in dialogue and are not one-sided, as noted by some project reports. (Bernstein, 2017)

OS and particularly open access publications are considered as a part of the solution for improving science education, however, the RRI-Practice report mentions that there still are several difficulties even in countries where the OS principles have been included in policy documents, such as the fact that publications are written by using very specific scientific terminology and may not be understood by the general public, as well as it is difficult to change existing publishing practices. (van der Molen, 2018) Even if data and publications are technically available to the public, these may be barriers to the re-use or free use of knowledge, therefore *"'making science accessible to society' requires a much more active role of the researcher, inviting stakeholders to meetings or publishing brochures, infographics or other material explicitly aimed at non-scientists*." (L. d'Andrea, Berliri, M., Federico M., 2018)

Several project reports emphasize that public engagement may require significant changes in the prevailing attitudes when the scientific community looks at the societal actors as passive partners. The ORION project report mentions open communication and public dialogue as tools for interacting with the public and recommends that communication should include not only information but also discussions on ethical and social aspects of research where everyone has the right to ask questions, express their views and get answers. The authors of the ORION report refer to Eurobarometer data confirming the willingness of societal actors to engage in dialogue with scientists. (ORION, 2020)

Inequalities and competition in the scientific community

The analysed project reports point out that there exist different types of inequalities among researchers and inside scientific communities, mirroring inequalities in society and influencing opportunities to practice OS. Most often reports mention gender inequalities**,** also ethnicity and age-related inequalities, and inequalities related to a career path in science (e.g., early career vs. senior scientists). These inequalities may take the form of limited opportunities to practice OS, unequal access to funding or an unfair payment system which in turn creates excessive competition and may lead to risks to

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academic integrity. Inequalities may have a negative impact on researchers' career path with a particularly negative impact on female scientists and early career researchers. In some cases, inequalities are observed between researchers working in the industry and academia where researchers working for the industry may experience inequalities because of having fewer opportunities to practice OS, e.g., because of restrictions put by industry sponsors usually operating under a more closed model of data management (Zuiderwijk et al., 2019)

Gender equality is a "*three-dimensional construct whereby gender equality is reached 1) when women and men are equally represented in all disciplines and at all hierarchical levels, 2) gendered barriers are abolished so that women and men can develop their potential equally, and 3) when the gender dimension is considered in all research and innovation activities*". (van der Molen, 2018) The RRI-Practice case report from Norway admits that even in Norway as a country where *"gender equality is perceived to be a national, cultural value, gender equality in research and innovation is not necessarily perceived to be of massive interest or importance to the public*." (Egeland, 2018) The reports link the barriers to achieving gender equality and diversity in science with a variety of factors, such as gender bias, masculine academic culture, uneven distribution of male and female scientific staff, particularly in the higher scientific positions and male dominance in management of science (van der Molen, 2018), lack of understanding of gender aspects, gender balance in the research groups, problems in introducing diversity management (Egeland, 2018), insufficient state or institutional support, such as a lack of specific regulation on parental leave (Yandong, 2018), the 'glass ceiling' phenomenon. (Hennen, 2019)

An open question is why and how gender inequalities impact practising of OS and vice versa and seems that this aspect still needs further research. A rare exception analysing gender issues in several key areas of OS and open innovation (OI) is a report developed by the GENDERACTION project. (GENDERACTION, 2018) However, also this report puts forward the main conclusion that *"current OS/OI policies and expert studies tend to be gender blind and do not in any way address gender issues*" (GENDERACTION, 2018). This report states five priorities: 1) creating a policy synergy between the gender equality and OS agenda; 2) advancing knowledge and awareness of gender issues in OS; 3) addressing evaluation and assessment practices; 4) publication practices, and 5) innovative processes and firms. (GENDERACTION, 2018) The report also mentions some examples of potential problems regarding gender equality in the practice of OS:

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> *"For example, studies may use both males and females in their samples but do not report results by sex; data reuse could be an avenue to obtain results segregated by sex/gender as relevant and contribute to understanding sex/gender differences in various disciplines. Another aspect relates to citizen science initiatives that consider the gender perspective and/or focus on issues relevant to women's health and lives." (GENDERACTION, 2018)*

Other reports mention a lack of understanding of the complexity and opportunities the gender diversity perspective comes with and note that it might be unclear for researchers how to reflect on gender issues in research proposals in a new, meaningful and more creative way *"than simply suggesting a female project manager or recruiting a female PhD-student*". (Egeland, 2018) The gender aspect remains poorly understood and is often simplified as just gender balance in research teams. (Gianni, 2017)

Some reports also point to a need to address further diversity dimensions, e.g., ethnicity (van der Molen, 2018), age, socio-economic status (Pols, 2018), disability (Egeland, 2018), and to develop broader Diversity Action Plans in academic and research institutions including aspects related to OS. Inequalities between early career and senior researchers are mentioned in the FIT4RRI project report. The report refers to the manifestation of inequality in situations where PhD students and postdocs may be "*not perceived at all as "research actors" while they play a pivotal role in the research systems*" and where there is "*increased pressure on young researchers to make more in less time*". (L. d'Andrea, Berliri, M., Federico M., 2018) These situations, as well as limited opportunities to apply for grants for early career researchers, may influence their opportunities to responsibly practice OS.

Also, the values of different groups and generations of researchers may differ (van Buggenhout, 2017); however, it would be a mistake to look at responsibility, research integrity and ethics just as a generational problem. Nevertheless, situations, where research misconduct has been committed by senior researchers, have been reported as more difficult to deal with because of the power imbalance in academia where *"junior researchers can find it particularly difficult to raise issues with more senior members of staff; even in situations where there is a clear violation of research integrity."* (Kennedy, 2018)

Several of the research reports refer to the high competition for research funding, the existing inequalities in the scientific community and other factors leading to hyper-

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competitive practices in the field of science, increasing the potential of breaches of research integrity and not encouraging to practice OS. (Breit, 2016; Evans, 2018; Kennedy, 2018) Pressure to raise external funding and pressure to publish are also mentioned among the reasons for the lack of willingness to be involved in OS, as, for example, publishing in open access has been viewed by some scientists and groups of scientists as a risk to career progression and successful communication of the research results. (Pols, 2019)

The FIT4RRI report mentions concerns expressed by scientists that the assessment system of scientific results is not effective and refers to, e.g., increased use of quantitative indicators - citation indexes, impact factors, the fact that quantitative indicators cannot measure quality effectively, quality of peer review, problems in the use of impact factor etc. (L. d'Andrea, Berliri, M., Federico M., 2018) Among barriers related to the implementation of RRI, including OS, the FIT4RRI report mentions the existing priority schemes preventing ethics, openness and transparency from becoming a priority in the assessment system. It is in line with results from other projects pointing at "*a hidden opposition between excellence and RRI, viewed as two competing priorities*" and the fact that the existing system of assessment is usually based on excellence and not on social impact. (L. d'Andrea, Berliri, M., Federico M., 2018) The existing system for assessing scientific performance promotes publishing in English language journals with high impact factor and fast publication schedules, rather than choosing a journal based on social impact, openness and responsibility towards society. Accordingly, open access may be viewed as a barrier to achieving excellence in science by researchers. The ENTIRE project report notes that researchers see open access and open data as tools to change the existing priority schemes and to increase openness and transparency in science; however, they also see the risk for research integrity posed by OS tools. (Evans, 2018)

The implementation of OS requires a lot of cooperation among scientists and institutions, and it is challenging to introduce OS in a hyper-competitive environment. (L. d'Andrea, Berliri, M, Marta, LF, 2018) The FIT4RRI report also points out that the existing science assessment system may even result in poor-quality research, which does not aim to serve science but just build a career for scientists. The quality of scientific research is also suffering from lack of funding for fundamental research with researchers increasingly spending time and energy in applying for funds. (L. d'Andrea, Berliri, M, Marta, LF, 2018) The RRI-Practice Netherland's case report outlines possible solutions for the responsible implementation of OS in the situation of hyper-competition in science

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as follows: "*Potential drivers for the further implementation of open science are: revising evaluation- and valuation criteria and systems, improving the monitoring of open science, and stimulating the re-use of research data, for instance by means of funding.*" (van der Molen, 2018)

Stakeholders and their responsibilities

The reports have identified different conceptualization and various understandings of what responsibility means in the context of OS, demonstrating differences between countries, institutions and fields of science. (van der Molen, 2018) In general, different project reports (RRI-Practice, GRECO, GRRIP, etc.) refer to RRI, including OS, as a specific framework for responsibility in EU science policy, where responsibility is becoming a part of regulatory framework, incorporated into institutional practice, and leading to the ethically sound and inclusive scientific practice in the future. Responsibility implies close collaboration of all social actors and institutions involved in OS.

Responsible research at all stages of the process involves individual responsibility of the researcher. The implementation of OS values (openness, transparency etc.) and OS practices (open publishing, open data, public engagement etc.) is largely considered as individual responsibility of researchers. Nevertheless, some reports point out that not all researchers have developed a clear understanding on their responsibilities in the context of OS. (Evans, 2018) One of the activities where researchers repeatedly report lack of knowledge and skills is public engagement. (Wullum Nielsen, 2018) Also the FIT4RRI project report notes that, in many cases, it is not clear for researchers how to ensure public engagement, and there is a lack of personal experience in public communication. (van Lente, 2018) This requires researchers to acquire new knowledge and skills (Barbosa, 2020) and should be taken into account in researcher evaluations.

Another group of responsible actors are policy-makers and funding organisations, e.g., in the FIT4RRI report the interviewed respondents see policy changes as the most efficient tool to implement OS and thus emphasize the role of policy-makers. (L. d'Andrea, Berliri, M, Marta, LF, 2018) Policymakers are expected to develop adequate political frameworks and guidelines for responsible implementation of OS at different levels: institutional, national, EU, international. Additional tasks are making OS a priority, ensuring necessary funding, developing OS infrastructure and introducing control mechanisms.

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Some of the reports (RRI-Practice, ONMERIT, FIT4RRI) include criticisms towards policymakers, e.g., bureaucratisation, lack of a strong link with practice, lack of understanding of the scientific process and lack of willingness to engage in the implementation of OS. On the other hand, the ONMERIT report notes that also researchers sometimes lack knowledge about policy-making process. This may lead to a two-sided lack of understanding between scientists and policy-makers which may further result in mutual disappointment. (Cole, 2021) To solve these problems, cooperation, as well as exchange of information between policymakers and research community are particularly important. (Cole, 2021)

Academic and research institutions are viewed as a specific group of important stakeholders with their responsibilities regarding implementation of OS. In project reports, there are discussions on institutional values, formal and informal practices, power structures, practices of responding to research misconduct, training of employees, etc. In national reports of the RRI-Practice project, it is identified that understanding of institutional responsibility and mechanisms for exercise of responsibility in different institutions differ and are closely linked to national policies; nevertheless, the authors state that "*[i]nterest and support on the part of organisational leadership is key.*" (Hennen, 2019) As practical responsibilities of research institutions in implementation of OS, a number of tasks are mentioned in reports:

- prioritisation of OS by translating national strategies into practical tools (Evans, 2018)
- developing and implementing OS guidelines for storage, management, dissemination and sharing of research data and metadata (Egeland, 2018)
- internal proactive policies (L. d'Andrea, Berliri, M, Marta, LF, 2018)
- devoting specific funding and time in employees schedule for OS practices
- new institutional practices, evaluation of old practices, promoting new institutional culture (Breit, 2016)
- organizing staff training on OS and its elements, communication with society, citizen science
- supporting researchers in addressing ethical dilemmas in context of OS practice (Evans, 2018)
- establishing and maintaining institutional OS infrastructure
- measuring and evaluating OS activities at institutional level (Evans, 2018)

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At the same time, reports identify several challenges that institutions can face in the process of introducing OS. The FIT4RRI and GRIP project reports analyse specific aspects of institutional management of OS and public engagement by bringing together data from reports developed by other projects. The authors list the following problems: resistance to new practices, turnover of employees, power relations, existing institutional traditions, conflicts between individual and institutional responsibilities, personal conflicts, lack of knowledge and motivation within the organisation. (L. d'Andrea, Berliri, M., Federico M., 2018) To help solve these problems, the GRRIP project among other solutions recommends to rethink incentives for researchers at research institutions, and to reconfigure evaluation criteria so as "*to encompass OS, develop closer collaboration between researchers, research departments and their respective research administration units (libraries, etc.)*" in helping to implement OS. (Breit, 2016)

Academic publishers are reported to be important stakeholders responsible for enforcing OS principles, as well as strengthening research ethics and integrity in the publishing process. Irresponsible publishing practices and prioritization of economic interests of publishers lead to breaches of research integrity, limited access to research results, weak peer review, flourishing of predatory journals, etc. (Egeland, 2018) Journals are also expected to publish replication studies, negative results and contribute to other OS activities promoting quality and transparency of science. (Kennedy, 2018)

Another important stakeholder in OS process is industry. The ON-MERRIT project provides analysis of drivers and barriers to uptake of OS resources in the industry, including discussion on responsibilities of industry. Some industry responsibilities fostering uptake OS mentioned by ON-MERRIT report are the following: raising employees' education level, providing incentives and support, organizing training in OS, fostering trans- and interdisciplinary cooperation and exploiting the "wisdom of the crowd". (Fessl A, 2021)

Intellectual property and OS

The analysed reports indicate that social issues and cultural attitudes include a tension between values of openness and transparency vs. IP and sensitivity of research data. (Hennen, 2019) The GRECO report refers to a tension between the fact that in most societies intellectual work is protected by IP rights, while OS involves activities which scientists may see as contrary to these rights. (Barbosa, 2020) The RRI-Practice national

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reports show that the understanding of the ownership of the data and IP varies across countries, and stakeholders are referring to concept of ownership as a barrier to the introduction of OS and sharing open data, as well as mentioning of institutional ownership as a specific aspect, which may also be a barrier for the introduction of OS. (Hennen, 2019)

At a time when all intangible assets have become a global resource – the *terra nullius* of the twenty-first century (Johnson, 2001), there are still very few scholars who address OS from a legal and more specifically – intellectual property rights perspective. Furthermore, the responsible aspect of OS practice is not being articulated yet, as questions of research ethics and integrity in the uptake of OS are under-researched (Beugelsdijk, van Witteloostuijn, & Meyer, 2020; Landi et al., 2020; Phillips & Knoppers, 2019; Wessels et al., 2014).

While the IP rights are still seen as a tool for fostering and management of innovation as recognised in the recent European Commission reports on knowledge valorisation (Commission, 2020; Commission, 2019), the OS movement is very often being opposed to the *status quo* of research practice, as the new system for research and knowledge generation, evaluation and communication. A similar narrative of opposition between the old and the new is very visible in the Budapest Declaration (BOAI, 2002). The text claims that "*An old tradition and a new technology have converged to make possible an unprecedented public good*" (BOAI, 2002), where the public good described is the Internet. Already in this statement, the underlying inequalities are very visible, as many communities worldwide are excluded from or hindered in the use of the electronic distribution of goods. It is therefore crucial to consider the implicit challenges and inequalities, that the OS is generating, throughout the whole process of knowledge and data production, generation, evaluation and communication.

Another critique of the IP rights in relation to the digitalization and new technologies is the 'proprietary' aspect. Several authors (Hess & Ostrom, 2007; Unger, 2022) have concluded that the concept of IP ownership is no longer relevant in the digital age. It is worth mentioning, that lawyers and scholars have advocated strongly over the last decades for a general shift from this proprietary aspect towards a more open and dynamic notion of (intangible) goods, to include free access for relevant communities and groups (Lixinski, 2019). This new concept of an inclusive property law, advocates for a notion of "*property with a built-in limitation to accommodate public interests*" (Lixinski,

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2019: p.59). Nevertheless, aspects of possession and access to digital information are not widely discussed and many implicit power relations are not being approached by scholars nor practitioners.

To better understand the challenges and possible coexistence of the IP system and the OS framework, the current normative context should be briefly discussed. Intellectual property comprises of two main groups of rights:

1) literary and artistic works, which are mainly covered by copyright, and
2) industrial property: patents (as well as utility models and supplementary protection certificates), trademarks, industrial designs, geographical indications and trade secrets.

Furthermore, IP rights are not systematically harmonized on the EU level. They are highly diversified, national-related legal regimes, rather than a monolithic system, where multiple and diverse concepts and mechanisms of protection are co-existing, despite the more and more digitalized market for intellectual assets and works. Without an effective harmonization at the EU level, the legislative processes at national level, in which many countries are already engaged to meet the challenges of technological progress, have led to differences in copyright protection and thus have created restrictions on the free movement of services and goods, and have contributed to the fragmentation of the internal market. The impact of these inequalities and inconsistencies in European copyright legislation is becoming more acute with the development of the information society, where the cross-border use of artistic, creative and scientific works has already increased significantly. In this normative context science has to generate, analyse, evaluate and communicate its results. Each model of protection has a different potential impact on OS, that will be shortly discussed below.

Copyright

In the context of copyright protection, there are two different sets of rights that apply to works: moral rights (depending on the legal system, most widely spread are the rights to attribution of authorships, and in the civil law countries: rights to first communication/dissemination to the public and the right of integrity of the work), and economic rights (renumeration rights as a closed list of exceptions and limitations). Rights exist from the creation of the work, and in some legal regimes moral rights last for an unlimited period of time (in French copyright system: the ‘conception

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personnaliste' (Desbois, 1978)). To be granted protection under the copyright regimes the work should fit the statutory criteria of ownership, originality and fixation.

Common law countries implemented a different concept of copyright. In the common law system copyright is a set of norms concerning primarily the property sphere. Only in 1989, moral rights were included into the legal order of the United Kingdom - the new Copyright, Design and Patents Act (CDPA) of 1988. Pursuant to the provision of Art. 9 the author of a literary, dramatic or artistic work is considered to be the person who created it. The above general principle of recognizing the right to authorship includes two premises: the work should record the skill, labor and judgment of the creator, and the author must have put in a certain effort during the act of creation. It should also be noted that on the basis of the British Copyright Act, there is a situation where copyright is granted, in a first place, to an entity other than the actual creator. The CDPA standards also introduced a highly debatable provision for granting protection to computer-generated works.

What has to be more systematically analysed and discussed in the context of the recent rapid technological progress is the balance between protection of works and inventions and benefits for society. Technological novelties are already challenging all established key concepts of parties protected (i.e. consideration on authorship attribution to non-humans, like the artificial intelligence), 'works' (this concept is already broadened to some examples of databases, as traditionally copyright cannot exist over ideas and facts), economic rights and moral rights.

Patents

Patents are offering a limited time protection, for usually a period of up to 20 years. To receive protection an invention has to fulfil requirements such as: novelty, being 'non-obvious' and applicable to the industry, and others. Patents are strictly territorial rights, and exclusive rights are only applicable in the country in which a patent has been granted. (WIPO, n.d.)

Nevertheless, patents are being critically discussed in the literature, e.g., Stiglitz considered the system to be hindering innovation, generating transaction costs and not fostering knowledge dissemination. (Stiglitz, 2007) In this context, the efforts of European Patent Office for knowledge sharing and opening, should set a positive

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example: the EPO's EspaceNet, as a database for patent documents, with most of them already in the public domain, after the expiration of patent protection.

Trademarks

A trademark is an informational reference to an object that affects the public perception of it. The trademark protection usually lasts no longer than 10 years. A consent of the rightsholder is needed to use the trademark, however this form of protection is not relevant to the transmission and reproducibility of information.

Trade secrets

Trade secrets are a very restrictive and exclusive form of IP rights management. They can cover all kinds of secrets, from personal to industrial and governmental. Trade secrets are not compatible with OS practice.

Institutionalisation/patrimonialisation of IP rights

Another important aspect related to the coexistence of IP rights and OS that is not clearly investigated in the literature so far, is the institutional/patrimonial aspect of protection. The historical justification for IP rights were to give authors and inventors rights to manage and decide on the (commercial) usage of their works. IP rights are perceived as tools to foster and give additional incentives and rewards to scientist, creators, and inventors. This rational is often being named in the most recent documents like the report on *Science, research and innovation performance of the EU*, 2020: A fair, green and digital Europe (Commission, 2020). The World Intellectual Property Organization Copyright Treaty also recognises in its preamble the need "*to maintain a balance between the rights of authors and the larger public interest, particularly in education, research and access to information*" (WIPO, 1996). Similar wording can be found the UNESCO Declaration on Science and the Use of Scientific Knowledge that recognizes the need "*to consider the scope, extent and application of intellectual property rights in relation to the equitable production, distribution and use of knowledge*". (UNESCO, 1999)

In their initial conceptualisation, IP rights were legally recognised and enforceable in the national state of the author or (for copyright) in the country where the work was first published. A more universal perspective was developed in the first generation of human

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rights (Universal Declaration of Human Rights (UDHR) of 1948, Art. 27; International Covenant on Economic, Social and Cultural Rights (ICESCR), Art. 15).

Both the UDHR and the ICESCR acknowledge the 'IP paradox' (Geiger, Frosio, & Bulayenko, 2018), meaning the coexistence and equality of contrasting rights:

1) right to science and free access to it and
2) rights to protection of the moral and material interests of the authors.

The freedom of researchers and the collaborative aspect of research processes, which are one of the main features of OS practices, are not novel from a legal perspective, as both were addressed already in the 50th and 60th of the 20th century in UDHR and ICESCR as fundamental principles of research work and cooperation. It can be therefore argued that the novelty of OS framework is mostly related to the use of new technologies (in terms of techniques, tools, channels of communication and dissemination), and not necessarily – the fundamental principles of research and knowledge production and generation. Moreover, entrusting national states with IP rights management gave the IP a national-based character, almost impossible to be preserved in the era of digitalised transfer and generation of knowledge.

Nevertheless, like other 'Cinderella rights' (similar to language rights (May, 2011) or to the right to non-discrimination in the European Court of Human Rights ECHR (O'Connor, Pollner, & Fugh-Berman, 2016)), the right to science remains underdeveloped, with no clear scope nor enforceability (Wyndham & Vitullo, 2018).

The processes of linking IP to national states may be called 'the phase of standardisation' – the introduction of national criteria due to the needs of law regulations and administration. State institutionalisation made of IP rights a nation-related issue, or even nationalised, which means that states could be seen as the primary holders of IP rights. Legal and administrative processes and methods are now confronted with scientific contextualization and practice, that challenge national protection strategies and IP rights management policies.

Power relations

From a legal perspective, property titling is offering the strongest protection, in a sense of control as well. The control aspect is of great importance, when analysing OS, as in

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many cases the control over IP rights is not being executed by individual authors, but rather by national states, commercial institutions, and organisation and/or collective rightsholders.

One of the core principles of legal theory and practice is to protect the weakest party. That was also the traditional justification of copyright, as authors were to decide on reproduction and commercialisation of their works. Nowadays, the companies that own scientific publications often exercise their control against the interests of universities and other research centres (Larivière, Haustein, & Mongeon, 2015). According to some authors, like Unger, IP rights are a matter of not only sharing knowledge but exercising power (Unger, 2022: pp.127-128).

An interesting dynamic, that is not being widely commented, appears when protecting different intangible assets. For traditionally protected by copyright works, many initiatives (including OS) are fostering 'freeing' and 'opening' the resources for general public and societal needs, while for many intangible expressions that are not protected and are considered a part of the public domain, scholars and practitioners are recommending additional protection (traditional expressions of art and culture, folklore, traditional knowledge and community-based resources). In both (contradictory) cases, interests of wider groups, and not individuals, are the rational for granting/removing protection: for traditional expressions of groups and communities with special attention given to indigenous communities some additional, IP-based protection or a sui generis system is discussed to overcome its inability to fulfil the statutory criteria of ownership, originality, duration, fixation and inventiveness (Janke, 2009). In case of already protected scientific and research works – the benefits for society are mentioned as the main reason for (re)opening research and knowledge generation and dissemination by, a 'per default', principle of entering the public domain (with the most recent policy of CC0 for results of EU funded projects under the Horizon Europe programme).

Commodification of IP rights

Within the current copyright system in Europe, the fundamental document is the Berne Convention from 1886. This legal document has established the framework for the protection of intellectual property, that continues to function to the present. Its main guiding principles are: reciprocity between contracting parties, no requirements for granting protection and the best protection status, meaning that a work is protected by

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the minimum set in the Convention, even if protection is not granted in the country of origin of the work.

The Berne Convention was heavily criticized for not having any mechanisms in place to impose upholding protection norms by third countries. To secure some worldwide standards, during the so-called third stage of regulation, the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement in 1994 was developed and signed by 164 parties, which included a settlement resolution system under the World Trade Organization (WTO) rules. With this Agreement IP rights were introduced to the trade domain, where 'authorship' was translated into 'ownership' and intellectual creation was considered a transactional good.

Despite the guiding principles of protecting authors and their works, the TRIPS Agreement has also established a hierarchical structure, in which interests of dominant nations might overrule weakest states and parties (Drahos & Braithwaite, 2002; EARTO, 2020; Patry, 2009; Sell, 2003). A side effect of the Agreement was the establishment of a system that protected first and foremost, the interests of those countries that are home to the industries that utilise the relevant intellectual property (Hilty, 2009: p.8).

Therefore, it can be argued, that within this system, IP rights were further institutionalised, and partly turned into a highly politicised commodity. Moreover, this state-mandated management of intellectual assets gave national authorities a privileged position in the processes of identification, evaluation, and protection of IP. The TRIPS-based protection model can be described as a 'stewardship model' developed by official and professional circles, particularly in Western Europe and North America (Lynott & Wylie, 1995). It not only refers to the state-sanctioned management and protection of intellectual assets, but it also privileges Western value systems at the expense of others. for example, by excluding traditional knowledge and community-generated knowledge.

Open access

Similar tension can be traced in the recently adopted and much fostered models of open access to scientific results. The inequalities arising from the open access system, that is recently very widely and globally promoted, were clearly defined in the European Federation of Academies of Sciences and Humanities (ALLEA) Statement on Equity in Open Access (ALLEA, 2021). Challenges, as lack of access to the open access models by

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not affiliated researchers or researchers from resource-deficit areas, were mentioned and discussed, and other, non-European models were listed. Inclusiveness and diversity should be taken into consideration, especially in terms of OS framework that is infrastructure heavy and functions at its best in the high-income countries with established and operational systems of public funded research. The statement ends with a plea for a more balanced, hybrid approach, in which some conventional publishing routes are maintained.

Towards new collective rights: OS activists

OS activists very often refer to the new collectivism of rights, were the community involved in the knowledge creation and generation processes is proactively managing the development and protection of the works thorough the whole process. These models are being further identified in opposition to the traditional 'static' IP rights system. In the book *Understanding Knowledge as a Commons* (Hess & Ostrom, 2007) knowledge studies scholars addressed aspects of IP rights relevant for researchers and OS practitioners. Most of the conclusions were in favour of an open and collective framework for knowledge creation, generation and dissemination, as the IP was generally perceived as a 'fence' hindering crucial scientific and research activities as public scrutiny, citation, an 'error correction' (Boyle, 2006: p.123).

Nevertheless, it has to be underlined, that commons (including 'free software') are successful only if integrated and based on the existing IP rights management models. Commons are simply a different way for creators to exercise copyright and manage their IP rights. Moreover, a well-designed open license/common is characterised by a number of exceptions and limitations, that secure not only the creation, but also legitimate ethical, privacy and security considerations, especially those of third parties involved.

Conclusions

The social context including cultural differences, economic disparities, trust issues, inequalities and distribution of responsibilities among stakeholders is an important factor influencing the implementation of OS framework. The analysis of social challenges and implications show that the 'one-size-suits-all' approach is not applicable for building a responsible and functioning OS system, it requires a tailored and well-planned communication, support and training, based on needs and social characteristics of a

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particular group. More social sciences research and analysis is necessary to gather data on these needs and attitudes, especially in disadvantaged and less represented groups, e.g., scientists in low- and middle-income countries. At the institutional level, when developing Diversity Action Plans for academic environment addressing inequalities based on gender, ethnicity, age, socio-economic status, disability, career stage etc., issues related to OS should be addressed and included in these plans.

Another important social factor influencing uptake of OS is cultural resistance towards the re-organization of the scientific process and changing the established ways of doing research. To overcome cultural resistance and to incorporate OS practices, targeted management to change academic culture at individual, institutional, national and European level is crucial. The resistance towards OS may be increased by lack of skills and knowledge necessary for practicing OS, for example, lack of information about existing OS infrastructures. So, positive management, aimed at internalization of OS principles and values, as well as supporting scientists in their efforts to open scientific practices, data and research results is crucial. The hyper-competitiveness of the academic environment and the existing science assessment systems still heavily based on quantitative indicators are additional barriers for responsible practicing of OS calling for novel and effective solutions.

The IP system and OS framework can coexist; however a more systematic, evidence-based analysis and operational synthesis is needed for better informed policies on national and international level. One important prerequisite for a better informed and effective practice of OS within the current IP rights system is the correct use of existing permissions in national and international IP regimes. As the number and diversity of IP rights' management tools might be easily overwhelming for scholars, researchers and especially – citizen scientists and non-expert practitioners, a less-specialised debate is needed, to inform and guide the general public. Moreover, IP rights are impacting the daily practice of research, like data management (taxonomies, ontologies, text and data mining, hyperlinks, etc.). That requires operationalised guidelines and recommendations for individuals and research institutions.

At the policy level, especially within the EU, an initiative to adjust the existing legal framework to the OS practice, by identifying and providing expectations tailored for the OS, is highly recommended. Moreover, the *sui generis* protection of databases should be critically revised, as it might not be compatible with the most recent OS practices.

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When analysing the balance between OS and IP rights, it can be concluded, that these two systems are compatible and can be adjusted to the societal needs and novel technological possibilities. What is urgently needed is a more inclusive debate on how to use the existing legal framework and comprehensible training materials, open courses and advice for researchers and practitioners. Some initiatives and channel are already in place, as for example the webinars offered by the European IP Helpdesk.

As a closing remark, it is worth acknowledging, that historically, IP rights were only conceptualized and developed because of the technological progress, namely – the invention of the printing press. These rights are therefore shaped in relation to the new markets, technological tools and means for renumeration, commercialization and dissemination of intangible goods. As the fundamental principles of research work and access to science and the protection of authors and creators also coexist for decades in the current legal system, the same way the OS practice can be integrated, to secure a more open and inclusive practice of science, better access and higher public scrutiny and a more global and inclusive approach to collaborative research and knowledge generation and communication.

References

Abele-Brehm, A. E., Gollwitzer, M., Steinberg, U., & Schönbrodt, F. D. (2019). Attitudes toward open science and public data sharing. *Social Psychology, 50*(4), 252-260.

ALLEA. (2021). Equity in Open Acess. Retrieved from https://allea.org/wp-content/uploads/2021/10/ALLEA-Statement-Equity-in-Open-Access-2021.pdf

ALLEA. (2022). Aligning Intellectual Property Rights with Open Science. Retrieved from https://allea.org/wp-content/uploads/2022/04/ALLEA-Statement-Aligning-IPR-with-Open-Science.pdf

Andanda, P., Wathuta, J, Leisinger, K , Schroeder, D. (2017). National and International Compliance Tools, a report for TRUST. Retrieved from https://trust-project.eu/wp-content/uploads/2017/02/TRUST-664771-National-and-International-Compliance-Tools-Final.pdf

Ardil, C. (2007). Open science philosophy and paradigm of scientific research. *International Journal of Humanities and Social Sciences, 1*(12), 850-860.

Barbosa, L. A., E.; del Cañizo, C.; Cristóbal, A.B.; Revuelta, G. . (2020). Practical guide on Open Science for researchers. Retrieved from https://zenodo.org/record/3968116#.Y_SubB9By5c

Bernstein, M., Brandstätterb, T, Griesslerb, E, Cohenc, J, Loeber, A, Seebacher, LM, Marschalek, I, Unterfrauner, E. (2017). D2.1: Diagnosis: RRI in Excellent Science. Retrieved from https://newhorrizon.eu/wp-content/uploads/2019/02/D-2.1-Diagnosis-in-Excellence-Science.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Beugelsdijk, S., van Witteloostuijn, A., & Meyer, K. E. (2020). A new approach to data access and research transparency (DART). *Journal of International Business Studies, 51*(6), 887-905.

BOAI. (2002). Budapest Open Access Initiative. Retrieved from https://www.budapestopenaccessinitiative.org/read/

Bodlos, A., Honegger, L., Kaczmirek, L., Beckmann, V., Breton, V., Romier, G., van, & Wezel, J., Streit, A., Stevanovic, U., Galeazzi, F., Tanlongo, F., van Nieuwerburgh, I. (2020). Summary report of the EOSC-Pillar National Initiatives Survey. Retrieved from https://zenodo.org/record/3937318#.Y_Uwjx9By5c

Boyle, J. (2006). Mertonianism Unbound?: imagining free, decentralized access to most cultural and scientific material. *Understanding Knowledge as a Commons From Theory to Practice, The MIT Press, Cambridge, Massachusetts*.

Borgerud, C., & Borglund, E. (2020). Open research data, an archival challenge? *Archival Science, 20*(3), 279-302.

Breit, E., Forsberg, EM. (2016). Scientific misconduct and integrity: An organizational perspective. . Retrieved from https://printeger.eu/wp-content/uploads/2016/10/D2.6.pdf

Cole, N., Reichmann, S, Ross-Hellauer, T, Wieser, B. (2021). ON-MERRIT D5.3 Networks of Engagement in Deliberative Policy-making: Expert Reflections on Barriers to Participation. Retrieved from https://doi.org/10.5281/zenodo.5550534

Commission, E. (2020). *Science, research and innovation performance of the EU, 2020 : a fair, green and digital Europe*: Publications Office.

Commission, E., Centre, J. R., Triaille, J., Barbarossa, E., & Grande, S. (2017). *IPR, technology transfer & open science : challenges and opportunities*: Publications Office.

d'Andrea, L., Berliri, M, Marta, LF. (2018). WP5 Summary Report. Deliverable 5.2. Retrieved from https://zenodo.org/record/4153540#.Y_TLdx9By5c

d'Andrea, L., Berliri, M., Federico M. (2018). Summary Report, Deliverable 1.3. . Retrieved from https://zenodo.org/record/1434355#.Y_UPeR9By5c

Delikoura, E., & Kouis, D. (2021). Open research data and open peer review: Perceptions of a medical and health sciences Community in Greece. *Publications, 9*(2), 14.

Drahos, P., & Braithwaite, J. (2002). *Information feudalism: Who owns the knowledge economy?* : Routledge.

EARTO. (2020). Towards a balanced approach between IPRs and open science policy Retrieved from https://www.earto.eu/wp-content/uploads/EARTO-Paper-Towards-a-Balanced-Approach-Between-IPRs-and-Open-Science-Policy-Final.pdf

Egeland, C., Maximova-Mentzoni, T, Braarud, A, Hanssen, AB, Forsberg, EM. (2018). Report from national case study: Norway. Retrieved from https://www.rri-practice.eu/wp-content/uploads/2018/09/RRI-Practice_National_Case_Study_Report_NORWAY.pdf

Evans, N., Veldkamp, C, Valentini, E, Marušic, A, Buljan, I, van Hoof, M, Dzinalija, N, de Vries, R, Widdershoven, G. (2018). Mapping Normative Frameworks of Ethics and Integrity of Research. D 2.3. Stakeholder Consultation. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5be1fb1a0&appId=PPGMS

Fessl A, M., K. (2021). D4.2 Drivers and barriers to uptake of Open Science resources in industry. Retrieved from https://zenodo.org/record/5549762#.Y_URNx9By5c

Geiger, C., Frosio, G., & Bulayenko, O. (2018). The exception for Text and Data Mining (TDM) in the Proposed Directive on Copyright in the Digital Single Market-legal aspects. Retrieved from

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

http://www.europarl.europa.eu/Reg-Data/etudes/IDAN/2018/604941/IPOL_IDA(2018)604941_EN.pdf

GENDERACTION. (2018). D 5.1 Report on Strategic advice for enhancing the gender dimension of Open Science and Innovation Policy. Retrieved from https://genderaction.eu/wp-content/uploads/2018/12/741466_GENDERACTION_D11_Report-on-Strategic-advice-for-enhancing-the-gender-dimension-of-OS-and-Innovation-Policy_submitted.pdf

Gianni, R., Lindner, R. (2017). Current status, perspectives and tools of RRI in H2020 and global perspective. D.1.3. . Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5b6dc7b76&appId=PPGMS

Gottschling, M. (2020). Starting the Process: Summary of Recommendations from Guidelines on Governance Settings for Responsible and Open Science. Retrieved from https://zenodo.org/record/3760665#.Y_UfkB9By5c

Griessler, E., Álvarez, Eneko, Bernstein, Michael; Antonia Bierwirth, Robert Braun, Malene Vinther Christensen, Stephanie Daimer; Kerstin Goos Helmut Hoenigmayer, Niels Mejlgaard, Maria Lehmann Nielsen, Mathias Wullum Nielsen, Johannes Starkbaum, Raúl Tabarés. (2017). D5.1. Diagnosis: RRI in Widening Participation, SWAFS, EIT, JRC, EURATOM and Instruments of H2020. Retrieved from https://newhorrizon.eu/wp-content/uploads/2019/03/D-5.1-RRI-in-Diversity-of-Approaches-Revised-Version_Final.pdf

Hahn, J., Ladikas, M, Forsberg, EM, Kulakov, P, Doezema, T, Maximora-Mentzoni, T, Pansera, M, Scherz, C, Owen, R. (2017). D16.1 Report on International Workshops. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5b623df0c&appId=PPGMS

Hennen, L., Damianova, Z, Egeland, C, Grinbaum, A, Hahn, J, Hajdinjak, M, Ladikas, M, Ludwig, D, Macnaghten, Ph, Magaudda, P, van der Molen, F, Neresini, F, Owen, R, Pansera, M, Politi, V, Pols, A, Shelley-Egan, C. (2019). RRI-Practice. Deliverable D15.1 Implementing RRI: Comparison across case studies. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5c4ef9a42&appId=PPGMS

Hess, C., & Ostrom, E. (2007). *Understanding knowledge as a commons: From theory to practice*: MIT press.

Hilty, R. (2009). Rationales for the legal protection of intangible goods and cultural heritage. *Max Planck Institute for Intellectual Property, Competition & Tax Law Research Paper.*

Hopp, C., & Hoover, G. A. (2019). What crisis? Management researchers' experiences with and views of scholarly misconduct. *Science and Engineering Ethics, 25*, 1549-1588.

Yandong, Z. (2018). Report from national case study: China. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bd55b2b4&appId=PPGMS

Jackson, A., & Guerra, N. S. (2011). Cultural Difference. In S. Goldstein & J. A. Naglieri (Eds.), *Encyclopedia of Child Behavior and Development* (pp. 447-448). Boston, MA: Springer US.

Janke, T. (2009). Indigenous intangible cultural heritage and ownership of copyright. *Intangible cultural heritage and intellectual property: Communities, cultural diversity and sustainable development*, 159-188.

Johnson, V. (2001). Getting over terra nullius, Paper presented at the Australian Registrars Committee Conference. Retrieved from http://www.eniar.org/news/art13.html

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Joo, S., Kim, S., & Kim, Y. (2017). An exploratory study of health scientists' data reuse behaviors: Examining attitudinal, social, and resource factors. *Aslib Journal of Information Management, 69*(4), 389-407.

Kennedy, M., Ampollini, I, Breit, E, Bucchi, M, Deans, Z, ter Meulen, R, Seppel, K, Vie, KJ. (2018). Investigating the workfloor: experiences of research integrity and misconduct through focus groups. Retrieved from D4_3-Investigating-the-work-floor_experience-through-Focus-groups-1.pdf

Kunst, S., & Degkwitz, A. (2019). Open Science-the new paradigm for research and education?

Lacey, J., Coates, R., & Herington, M. (2020). Open science for responsible innovation in Australia: understanding the expectations and priorities of scientists and researchers. *Journal of Responsible Innovation, 7*(3), 427-449.

Lakomý, M., Hlavová, R., Machackova, H., Bohlin, G., Lindholm, M., Bertero, M. G., & Dettenhofer, M. (2020). The motivation for citizens' involvement in life sciences research is predicted by age and gender. *Plos One, 15*(8), e0237140.

Landi, A., Thompson, M., Giannuzzi, V., Bonifazi, F., Labastida, I., da Silva Santos, L. O. B., & Roos, M. (2020). The "A" of FAIR–as open as possible, as closed as necessary. *Data Intelligence, 2*(1-2), 47-55.

Larivière, V., Haustein, S., & Mongeon, P. (2015). The oligopoly of academic publishers in the digital era. *Plos One, 10*(6), e0127502.

Lixinski, L. (2019). *International heritage law for communities: exclusion and re-imagination*: Oxford University Press.

Lynott, M. J., & Wylie, A. (1995). *Ethics in American archaeology: Challenges for the 1990s*.

McDougall, R. (2015). Reviewing Literature in Bioethics Research: Increasing Rigour in Non-Systematic Reviews. *Bioethics, 29*(7), 523-528. doi:10.1111/bioe.12149

O'Connor, B., Pollner, F., & Fugh-Berman, A. (2016). Salespeople in the Surgical Suite: Relationships between Surgeons and Medical Device Representatives. *Plos One, 11*(8). doi:10.1371/journal.pone.0158510

ORION. (2020). How to guide: Public dialog. . Retrieved from https://www.orion-openscience.eu/publications/reports-papers/202103/how-guide-public-dialogue

ORION. (2021a). D4.4 Final report on the training work package. Retrieved from https://www.orion-openscience.eu/public/2021-10/D4.4_Report%20on%20the%20training%20work%20package_v1.1.pdf

ORION. (2021b). ORION Deliverable 5.4. Final evaluation report on co-creation experiences.

Patry, W. (2009). *Moral panics and the copyright wars*: Oxford University Press.

Phillips, M., & Knoppers, B. M. (2019). Whose commons? Data protection as a legal limit of open science. *Journal of Law, Medicine & Ethics, 47*(1), 106-111.

Pols, A., Macnaghten, PA, Ludwig, D. (2018). General process recommendations for a reflective RRI audit in multi-partner, international projects. Deliverable 16.4. Retrieved from https://www.uc.pt/site/assets/files/478772/rri-practice-deliverable-16_4-general-process-recommendations.pdf

Pols, A., Macnaghten, PA, Ludwig, D. (2019). RRI-Practice internal RRI review. Deliverable 16.3. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5c70b3c34&appId=PPGMS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Segado-Boj, F., Martín-Quevedo, J., & Prieto-Gutiérrez, J. J. (2018). Attitudes toward open access, open peer review, and altmetrics among contributors to Spanish scholarly journals. *Journal of Scholarly Publishing, 50*(1), 48-70.

Sell, S. K. (2003). *Private power, public law: The globalization of intellectual property rights* (Vol. 88): Cambridge University Press.

Severin, A., Egger, M., Eve, M. P., & Hürlimann, D. (2018). Discipline-specific open access publishing practices and barriers to change: an evidence-based review. *F1000Research, 7*.

Smart, P., Holmes, S., Lettice, F., Pitts, F. H., Zwiegelaar, J. B., Schwartz, G., & Evans, S. (2019). Open Science and Open Innovation in a socio-political context: knowledge production for societal impact in an age of post-truth populism. *R&D Management, 49*(3), 279-297.

Stiglitz, J. E. (2007). Economic foundations of intellectual property rights. *Duke LJ, 57*, 1693.

Tenopir, C., Allard, S., Douglass, K., Aydinoglu, A. U., Wu, L., Read, E., . . . Frame, M. (2011). Data sharing by scientists: practices and perceptions. *Plos One, 6*(6), e21101.

UNESCO. (1999). Declaration on Science and the Use of Scientific Knowledge and the Science Agenda: Framework for Action. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000116994

Unger, R. M. (2022). *The knowledge economy*: Verso Books.

van Buggenhout, M., Christiaens, J. (2017). Deviance in science: a criminological analysis. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5aa38cca4&appId=PPGMS

van der Molen, F., Consoli, L, Ludwig, D, Pols, A, Macnaghten, Ph,. (2018). Report from national case study: Netherlands. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bd25bcf3&appId=PPGMS

van Lente, H., Koretsky, Z, Zeiss, R. (2018). WP 2 Summary Report. Retrieved from https://zenodo.org/record/1434358#.Y_SfiB9By5c

Wessels, B., Finn, R. L., Linde, P., Mazzetti, P., Nativi, S., Riley, S., . . . Wadhwa, K. (2014). Issues in the development of open access to research data. *Prometheus, 32*(1), 49-66.

WIPO. (1996). World Intellectual Property Organization (WIPO) Copyright Treaty. Retrieved from https://www.wipo.int/treaties/en/ip/wct/

WIPO. (n.d.). Patents. What is a patent? Retrieved from https://www.wipo.int/patents/en/

Wyndham, J. M., & Vitullo, M. W. (2018). Define the human right to science. In (Vol. 362, pp. 975-975): American Association for the Advancement of Science.

Wullum Nielsen, M., Mejlgaard, N, Alnor, E, Griessler, E, Meijer, I. (2018). Ensuring Societal Readiness. A Thinking Tool. Retrieved from https://newhorrizon.eu/wp-content/uploads/2019/10/Deliverable_6.1_THINKING_TOOL.pdf

Zenk-Möltgen, W., Akdeniz, E., Katsanidou, A., Naßhoven, V., & Balaban, E. (2018). Factors influencing the data sharing behavior of researchers in sociology and political science. *Journal of Documentation, 74*(5), 1053-1073.

Zhu, Y. (2020). Open-access policy and data-sharing practice in UK academia. *Journal of Information Science, 46*(1), 41-52.

Zuiderwijk, A., Shinde, R., & Janssen, M. (2019). Investigating the attainment of open government data objectives: is there a mismatch between objectives and results? *International Review of Administrative Sciences, 85*(4), 645-672. doi:10.1177/0020852317739115

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430