Institution: University of Exeter		
Unit of Assessment: UoA 21 Sociology		
Title of case study: The Openness Agenda: Re-Shaping the Governance of Science, Digital Technologies and Research Infrastructure in Europe		
Period when the underpinning research was undertaken: 2008-2018		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Professor Sabina Leonelli	**Role(s) (e.g. job title):** Professor of Philosophy and History of Science	**Period(s) employed by submitting HEI:** 2008-present
Period when the claimed impact occurred: 2015-2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

The European Commission (EC) mandated Open Access and Open Data from 2020, requiring governments, institutions and industry to make scientific information widely available and usable. Professor Sabina Leonelli's research directly impacted the implementation of these processes on an international level. Leonelli worked with the EC's science academies and national governments to implement an Open Science policy and assess its transformative impact on digital technologies, infrastructures and research management. This culminated in the launch of the Roadmap for Open Science Implementation at the National level and the Open Science Policy Platform Recommendations in 2018; paving the way for new approaches such as Plan S and Open Science Indicators used globally to assist the implementation of Open Access and Open Data. The research has ***informed*** **policy debates and public discourse,** ***shaped*** **EU policy** and has ***driven*** **adoption of policy at national levels.**

2. Underpinning research

Open Access, Open Data and the re-use of digital information plays an increasingly significant role in European and international policy. Drawing on her postdoctoral research in 2006, since joining the University of Exeter Leonelli has positioned herself at the forefront of researching the implementation and impact of such processes; while articulating the need to integrate philosophical, sociological and historical scholarship to study the impact of big data on research **[3.1-3.3].** Leading an ERC project **'DATA-SCIENCE'** (2014-2019) Leonelli explored the conceptual assumptions underlying the choice and use of theories, models and methods in data-centric biology and biomedicine; and the collective modes of inquiry in these fields, including the crucial role played by data infrastructures and their commercial or academic developers. This was flanked by an ESRC (2013-2015) and Leverhulme Trust project (2014-2016) focused on the role of "openness" in research and the impact of Open Data policies on scientific practice.

The outcomes of these projects underpinned the award-winning monograph **Data-Centric Science: A Philosophical Study [3.4]** and substantive research papers on Open Data, data science ethics and its importance within data science training, good practice standards, and security measures **[3.5, 3.6]**. Through this work, Leonelli:

- Identified the conditions required to effectively store, circulate and re-use research data to support artificial intelligence **[3.6]**.
- Described how bad data management can undermine the production of knowledge, and identified and examined examples of good practice which point the way towards practical solutions **[3.4, 3.6]**.

- Documented how researchers perceive and manage Open Science (OS) in their everyday practice, and how this may affect innovation in both the public and the private sector **[3.5]**.

Bringing these strands of research together, Leonelli presented the following arguments globally garnering stakeholders from academia, industry and government:

- OS is not a ready-made solution to the troubles of contemporary research, but rather constitutes an opportunity for all stakeholders in research to rethink how science is conducted, to which aims and with which effects, and most importantly how results are disseminated.
- OS behaviours have profound systemic effects on research as a whole and require a cultural change within all institutions and stakeholders in academia.
- Whether or not OS helps research governance and fosters excellence depends on how its principles are implemented.
- Rewards are key to cultural change within academia, and without a transformation of evaluation procedures and rewards for researchers, OS will not be successful.
- OS implementation is expensive and requires labour-intensive infrastructure, particularly to cater for the diverse requirements of disciplines and research systems around the world ("one size does not fit all").

Open Data requires both technical and human skills and labour, which in turn involve all three of the following components: (1) interoperable infrastructures such as the European Open Science Cloud; (2) new skills in data curation; and (3) governance changes in rewards and incentives.

3. References to the research

3.1 Bastow, R. and Leonelli, S. (2010) Sustainable digital infrastructure. EMBO Reports, 11(10): 730-735. DOI: 10.1038/embor.2010.145
3.2 Leonelli, S. (2010) The Commodification of Knowledge Exchange: Governing the Circulation of Biological Data. In: Radder, H. (ed) *The Commodification of Academic Research: Science and the Modern University*. Pittsburgh University Press, pp. 132-157. https://doi.org/10.1080/02698595.2011.623373
3.3. Leonelli, S. (2014) What Difference Does Quantity Make? On the Epistemology of Big Data in Biology. *Big Data and Society* 1: 1-11. http://bds.sagepub.com/content/spbds/1/1/2053951714534395.full.pdf
3.4 Leonelli, S. (2016) *Data-Centric Biology: A Philosophical Study*. Chicago, IL: University of Chicago Press. Winner of Lakatos Award 2018. https://doi.org/10.1007/s10739-018-9544-9
3.5 Levin, N. and Leonelli, S. (2016) How Does One "Open" Science? Questions of Value in Biological Research. *Science, Technology and Human Values.* https://doi.org/10.1177/0162243916672071
3.6 Leonelli, S. (2016) Locating Ethics in Data Science: Responsibility and Accountability in Global and Distributed Knowledge Production. *Philosophical Transactions of the Royal Society: Part A*. 374: 20160122. https://doi.org/10.1098/rsta.2016.0122

4. Details of the impact

This research has led to a substantive change in how Open Science (OS) policy has been understood and implemented not only in Europe but globally. As a leader in her field, Leonelli played a pivotal role in shaping policy and public discourse around OS. Most notably, the problem-solving nature of her work, and focus on incentives and reward to stimulate OS uptake has directly impacted the formation of EU policy and informed states on how to adopt OS requirements.

1) Informed Policy debates and Public Discourse

Leonelli identified steps needed for data infrastructures (e.g. European Open Science Cloud), publishing ventures and research training in OS to be trustworthy and effective in facilitating research. She presented this information through a diversity of forums including keynote addresses at the European Research Council (2014), AAAS (2017 and 2019), World Science Forum (2017), European Commission (2018), Sweden and France national Open Science policy

events (2018), League of European Libraries (LIBER) meetings and conferences organised by the European University Association (EUA), and addressing representatives of universities and funding agencies across Europe (2017, 2018, 2019). The EUA 2019 briefing on how university hiring and promotion should be organised in the future was directly informed by Leonelli's presentations to the council, including a keynote to their May 2019 workshop on Research Assessment [**5.1**].

In 2018, the Plan S initiative for Open Access Science was launched by Science Europe. Leonelli co-authored the Global Young Academies' (GYA) response to Plan S and presented it to Open Science Policy Platform (OSPP), in which they proposed moving away from an "author-pays" OA model [**5.2a**], thus affecting subsequent implementations and versioning of Plan S to include emphasis on Diamond Open Access (where authors are not charged for publishing), diverse disciplinary cultures and researchers' dependence infrastructures and institutions. In a report by cOAlition S, which details the rationale for the revisions made to the Plan S Principles, the response from GYA is directly cited as one of four groups of young scholars informing the new approach [**5.2b**]. The revisions themselves mirror very closely the points raised by GYA. Following this exchange, in 2019 Leonelli was appointed "Plan S Ambassador" by the cOALition S (one of twelve prominent figures in OS research and advocacy worldwide), contributing to ongoing efforts towards an Open Access model under which authors do not pay to publish.

2) <u>Shaped EU policy</u>

As lead of the Global Young Academy (GYA) Working Group on OS (2015-2017) Leonelli was instrumental in shaping the EU's 2016 position on OS by authoring of the GYA's Position Statement on Open Data [**5.3a**], and the Amsterdam Call for Action on Open Science [**5.3b**]. As testified by the GYA co-chairs: 'Both the Open Data Position Statement and the Amsterdam Call for Action went on to shape the EU policy on Open Science launched in May 2016, within which much emphasis was placed on the importance of consulting stakeholders – and particularly researchers – on implementation of Open Science policies and guidelines' [**5.3a**]. The co-organiser of the EU Presidency Conference on Open Science in April 2016 testifies to the '*significant impact that [Leonelli] had on shaping the Amsterdam Call for Action on Open Science which [was] presented to the EU Commission in May 2016 to underpin decisions on the adoption and implementation of Open Science policies*' [**5.3b**]. Her GYA role and extensive research portfolio led to her direct involvement with the EC. As a member of EC OSPP (2016-2020) advising the Commissioner for Research Science and Innovation, Leonelli provided insight on how to create a system where all new publications are freely available. The aim was to improve the quality of scientific research and allow findings to have greater visibility and impact. She was appointed chair of the Open Science Publishing Working Group (part of OSPP), advising the EC on the implementation of OS policy in practice [**5.4**]. The resulting report, a Position Statement on The Future of Scientific Publishing, highlighted the importance of re-thinking the current system of research evaluation and incentives in ways that will reward research quality and stimulate the uptake of OS publishing [**5.4**]. Based on this document, the European Competitiveness Council decided in 2017 to institute a new European Publishing Platform. Launched in 2020 as the 'Open Research Platform', the platform will enable all Horizon 2020 and Horizon Europe publications to be available via Open Access to some 1.7 million European researchers and 70 million professionals [**5.5**]**.**

Working closely with the OSPP Leonelli co-authored the EC recommendations on OS (OSPP-REC) [**5.6**], which were approved by the Competitiveness Council of the European Union in May 2018. The Commission and Chairs of OSPP acknowledged how Leonelli influenced science policy developments from 2017 onwards, detailing the significance OSPP-REC had on global innovation. The chair of OSPP from 2018-2020 details how "*the research of Professor Leonelli has had a significant impact on the outputs of OSPP and in turn on the policy decisions and guidelines on Open Science issued by the European Commission as well as many of the OSPP stakeholders"* [**5.7**]. For example, in November 2019 the EU released a high-level report on Indicators for OS which relied heavily on Leonelli's research on the variability of OS requirements [**5.8**] and went on to inform new methods of research assessment worldwide (such

as qualitative evaluations of researchers' Open Science contributions and a shift towards institution-level assessments).

3) <u>Driven adoption of policy at a national level</u>

Appointed by the EC as a Key Expert (one of two) for Mutual Learning Exercise (MLE) on "Open Science: Altmetrics and Rewards" (2017-2018) [**5.9**], Leonelli worked with Armenia, Austria, Belgium, Bulgaria, Croatia, France, Latvia, Lithuania, Moldova, Portugal, Slovenia, Sweden and Switzerland to advise them in adopting and implementing OS policy at a national level. In this role, Leonelli developed the **National Roadmap for Open Science**, details of which were presented in two EC reports and later consolidated in the final MLE report [**5.9**]. The representatives from the Department for the Information Society in Portugal described the value of the exercise as being: *"a praiseworthy example of how having an open approach, stimulating frank discussions, synergies and cross-fertilisation between interested parties can significantly advance knowledge on any issue. We need to fully embrace the cultural shift represented by Open Science and nurture it in all possible contexts."* [**5.9**]

Leonelli's research and insights underpin many national policy approaches to OS. Austria's national contact for Horizon 2020 explained that since being involved with the MLE *"there has been more of a focus on Open Science* specifically" [**5.9 p.3**]. A final recommendation document entitled 'Recommendations for a National Open Science Strategy in Austria', which was later published in October 2020 to provide impetus for implementation of Open Science in Austria, refers specifically to the National Open Science Roadmap developed by Leonelli [**5.9 p.3**].

In addition, feedback from the Flemish Government confirmed that *'The Flemish Open Science Board was created as a consequence of participation in the MLE.'* [**5.9 p.4**]. Simultaneously, in 2017 the Swiss Government commissioned Leonelli to author a report on the impact of Big Data on biomedicine. The recommendations were fully adopted by Switzerland as part of its national science strategy. The preface to the report attests to the uptake of Leonelli's recommendation by the Swiss government stating *"Prof. Sabina Leonelli looks at the extent to which the emergence of big data is altering biomedical research practice and findings (…) It will pursue this perspective over the coming two years."* [**5.10a**]. The impact of Leonelli's advice was further highlighted in a report issued in 2019 by the Swiss government on their vision for big data, where Leonelli is cited as informing the national policy on research data sharing [**5.10b**].

Momentum in Open Science policy continues to grow. In 2020, UNESCO were tasked by Member States to develop an international standard-setting instrument on Open Science in the form of an UNESCO Recommendation on Open Science to be adopted by all 193 Member States in 2021. Leonelli, as one of 9 key experts, co-authored a high-level response to this consultation with the head of CODATA, the World's leading research data organisation, which has been highlighted by UNESCO as one of their key responses and will go to shape their final recommendations [**5.11**]. 'cOALition S', a group of national research funding organisations supported by the European Commission and European Research Council, also responded to this UNESCO consultation. Leonelli and the Mutual Learning Exercise report is the only academic reference to be included within their response [**5.11**].

5. Sources to corroborate the impact

5.1 Saenen, B and Borrell-Damian, L (2019) UAE Briefing "Reflections on University Research Assessment: Key Concepts, Issues and Actors". *The EUA 2019 briefing on how university hiring and promotion should be organised in the future was directly informed by Leonelli's presentations to the council.*
https://web.archive.org/web/20201208195706/https://eua.eu/downloads/publications/reflections%20on%20university%20research%20assessment%20key%20concepts%20issues%20and%20actors.pdf

5.2 a) Vermeir, K, Riede, M, Leonelli, S (2018) Opportunities and Challenges for Implementing Plan S: The View of the Young Academies. *The Global Young Academies response to Plan S,*

co-authored by Leonelli; b) Rationale for the Revisions Made to the Plan S Principles and Implementation Guidance, cOAlition S. *Citing the Global Young Academy's response.*

5.3 a) Letter of Testimony from the Co-chair of the Global Young Academy and the Open Data Position Statement of the Global Young Academy and the European Young Science Academies (April 2016). *Confirms Leonelli's contributions and testifies that their Position Statement and the 'Amsterdam Call for Action' [5.3b] went on to shape the EU Open Science agenda, released May 2016*; b) Letter of Testimony from the coordinator of feedback to the Dutch Ministry and co-organiser of Amsterdam EU Presidency Open Science Conference in April 2016, detailing Leonelli's contributions to the widely influential *Amsterdam Call for Action* produced at that meeting. *This went on to shape the EU Open Science agenda, released May 2016*

5.4 Letter from The Director General of The European Commission, confirming Leonelli's appointment as a member of the Open Science Policy Platform and the Position Statement on The Future of Scientific Publishing (May 2017)

5.5 Articles confirming the launch of the Open Access Publishing Platform

5.6 Open Science Policy Platform (2018) OSPP-REC: Recommendations of the Open Science Policy Platform. Presented to Competitiveness Council of the European Commission in May 2018.https://web.archive.org/web/20200409135659/https://ec.europa.eu/research/openscience/pdf/integrated_advice_ospp_recommendations.pdf

5.7 Letter from the OSPP Chair, Professor in the Library and Information Science department, Universidad Carlos III de Madrid. *Testimony of Leonelli's influence on science policy developments from 2017 onwards, detailing the significance OSPP-REC had on global innovation.*

5.8 Indicator Frameworks for Fostering Open Knowledge Practices in Science and Scholarship, European Commission, 2019. *Leonelli's research is cited heavily, as the EU laid out its Indicators for OS*

5.9 Mutual Learning Exercise, Open Science: Altmetrics and Rewards (2018) European Commission https://web.archive.org/web/20201208194649/https://rio.jrc.ec.europa.eu/policy-support-facility/mle-open-science-altmetrics-and-rewards and Summary Report detailing participants progress

5.10 a) Leonelli, S. (2017) Biomedical Knowledge Production in the Age of Big Data. Report for the Swiss Science and Innovation Council; b) Policy analysis and recommendations by the Swiss Science Council (2019) on their vision for big data, where Leonelli is cited as informing the national policy on research data sharing

5.11 Input to the current Open Science Consultation by UNESCO, response co-authored with CODATA and response from cOAlition S which references Leonelli and the MLE report