SCIENCE EUROPE
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DFG Deutsche Forschungsgemeinschaft
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THE RATIONALES OF OPEN SCIENCE

DIGITALISATION AND DEMOCRATISATION IN RESEARCH

SCIENCE EUROPE

HIGH-LEVEL WORKSHOP

14 September 2017, Berlin

COLOPHON

September 2017

Deutsche Forschungsgemeinschaft (DFG)
German Research Foundation
International Affairs/European Science Policy
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Please note: The opinions contained herein do not necessarily represent the official position or policies of DFG, Science Europe and the Federal Ministry of Education and Research.

FOREWORD

Dear participants,

The 2017 Science Europe High Level Workshop is taking place during a period of turning points with regard to the future direction of the European Union. As the 60th anniversary of the Treaties of Rome is celebrated, controversial debates on the future of the European Union have played a major role during elections in the Netherlands, in France and in the UK, as well as in last year's Brexit referendum.

These debates have revealed a growing distrust among the people of Europe in terms of the democratic accountability of political institutions as well as the legitimacy of research systems to provide expertise. Furthermore, these political debates and our societies in general are increasingly affected by digitalisation, which is changing the way in which conflicting political messages are conveyed in our liberal societies.

In this regard, the topic of this year's Science Europe High Level Workshop appears to be timely: "The Rationales of Open Science – Digitalisation and democratisation in research".

Open Science, one of the most prominent strategic goals of the European Commission, is intrinsically tied to digitalisation, which itself holds the promise of both making use of the exponential amount of data it has helped to produce, and opening up new possibilities in the interconnection of science and society.

Also in relation to Open Science, cloud-based information infrastructures together with big data applications are gaining broad political and economic attention. At the same time, the application of Open Science principles and methods could potentially lead to wide-reaching implications for research as a profession and its intrinsic processes of advancing our scientific knowledge.

Open questions range from a scientific definition of research data to alternative methods of public rating of research. Furthermore, the different interpretations of Open Science in terms of citizen engagement – data collection, science communication or even co-design of research priorities or co-creation of research results – are still too vague.

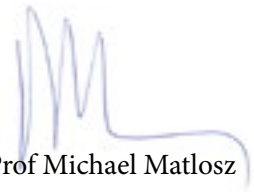
The idea of obtaining societal acceptance of research by immediate digital citizen participation requires a profound debate on the system of science as such, the reliability of research data and scientific outcomes, the function of blue sky research and the role of science as the authority for a rational and methodologically reliable search for knowledge.

The Science Europe High Level Workshop invites this debate on Open Science as a tool for the democratisation of science. It aims to achieve a clarification of the connection between science and democracy and of the distinct responsibilities and competences of both politics and the scientific communities.

This booklet has been designed to provide you with relevant background information on this complex topic. We hope that it will contribute to fruitful debates during the workshop. The outcome of the debate will be published in a set of Science Europe policy recommendations.

We look forward to welcoming you to a lively and instructive meeting in Berlin.

Yours sincerely,



Prof Michael Matlosz
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PROGRAMME

VENUE: Sofitel Kurfürstendamm Berlin, Augsburger Str. 41, 10789 Berlin

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Thursday 14 September 2017

09.00–09.30	Registration & Welcome Coffee	*Opéra Foyer, 2nd floor*
09.30–10.00	**Welcome Speeches** ▪ **Michael Matlosz**, *President, Science Europe* ▪ **Georg Schütte**, *State Secretary, Federal Ministry of Education and Research, Germany* ▪ **Peter Strohschneider**, *President, German Research Foundation (DFG)*	*Salon Opéra, 2nd floor*
10.00–12.00	**Digitalisation and Democracy in Research** Keynote Speech **Christoph Möllers**, *Professor of Public Law and Jurisprudence, Humboldt University of Berlin* Panel Discussion Moderator: **Sven Stafström**, *Director General, Swedish Research Council (VR)* ▪ **Sander Dekker**, *State Secretary, Ministry of Education, Culture and Science, the Netherlands* ▪ **Marin Dacos**, *Scientific Advisor, Ministry of Higher Education, Research and Innovation, France* ▪ **Søren Harnow Klausen**, *Member of the SE Scientific Advisory Committee* ▪ **Christoph Möllers**, *Professor of Public Law and Jurisprudence, Humboldt University of Berlin* ▪ **Klement Tockner**, *President, Austrian Science Fund (FWF)*	
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13.30–15.30 **Open Science – A Better Science?** *Salon Opéra, 2nd floor*

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Robert-Jan Smits, *Director-General, DG Research and Innovation, European Commission*

Panel Discussion

Moderator: **Marc Schiltz**, *Secretary General, Luxembourg National Research Fund (FNR)*

- **Bjørn Haugstad**, *State Secretary, Ministry of Education and Research, Norway*
- **Matthias Kleiner**, *President, Leibniz Association (LG), Germany, and Member of the Open Science Policy Platform (OSPP)*
- **Robert-Jan Smits**, *Director-General, DG Research and Innovation, European Commission*
- **Milena Žic Fuchs**, *Member of the EC High Level Group on Maximising the Impact of EU Research and Innovation Programmes*

15.30–16.00 Coffee Break *Opéra Foyer, 2nd floor*

16.00–17.00 **Conclusions for Next Steps in Open Science Policies** *Salon Opéra, 2nd floor*

Concluding Discussion

Moderator and Rapporteur for the previous panels: **Michael Matlosz**, *President, Science Europe*

- **Christoph Möllers**, *Professor of Public Law and Jurisprudence, Humboldt University of Berlin*
- **Georg Schütte**, *State Secretary, Federal Ministry of Education and Research, Germany*
- **Robert-Jan Smits**, *Director-General, DG Research and Innovation, European Commission*
- **Peter Strohschneider**, *President, German Research Foundation (DFG)*
- **Milena Žic Fuchs**, *Member of the EC High Level Group on Maximising the Impact of EU Research and Innovation Programmes*

17.00–19.00 Reception *Opéra Foyer, 2nd floor*

20.00 Dinner *Enoiteca "Il Calice"*
Walter-Benjamin-Platz 4, 10629 Berlin

1. DIGITALISATION, DEMOCRATISATION AND OPEN SCIENCE

DIGITALISATION AND SOCIETY

Digitalisation is playing an increasingly important role in shaping our society. The past two decades have seen an accelerated integration of network-based services and technologies into virtually every aspect of public and private life. When people use the term "digitalisation", they are often referring to three different levels of digitalisation that build upon each other:

1. The actual conversion of analogue data streams into digital bits (correctly: "digitisation")
2. The process of adopting digital technologies across all possible societal and human activities
3. The overall societal implications which result from this adoption of digital technologies – a change of business models, new socio-economic structures or legal and policy measures.

In the discussion that follows, we are concerned with the third stage of digitalisation, as the consideration of "how digital technologies organise, shape, and influence the various societal spheres of our contemporary world" (Brennen/Kreiss 2016). One of these societal spheres has been the science system.[1]

DIGITALISATION AND THE SCIENCE SYSTEM

Within the last two decades, digitalisation has massively affected the way in which research is conducted in all phases of the research life cycle, from discovery, planning, applying for funding, carrying out the project, analysis, writing, publication and outreach to the assessment of research. Technological innovation has resulted in new forms of publishing, the possibility of virtual access to huge datasets and the development of research software. These technological developments have prepared the ground for pursuing a greater openness of the science system. Digitalisation:

1. facilitates access to scientific information and to the prior research process,
2. makes scientific data more readily available and reusable,
3. facilitates scientific collaboration,
4. provides new opportunities for multidisciplinary research, and
5. provides new ways of engaging citizens who are not professional researchers.

Openness promises increased reach and visibility for science as well as transparency, which can strengthen its quality assurance systems and credibility.

"OPEN SCIENCE"

Many scientists and policy-makers have therefore embraced the cultural shift towards openness in research that digitalisation has made possible. This cultural shift has mostly been referred to as "Open Science". In its essence, Open Science refers to "the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process" (Nielsen 2011). In such a view, Open Science

1. In the text that follows, the term 'science' is used as the general term for the building of knowledge and understanding.

could be considered as a principle that already existed long before, but which has gained momentum following digitalisation. Many European states and the European Union have adopted various kinds of Open Science strategies in research.[2] Most of them include demands for open access (to research publications), access to and reuse of research data, and network-enabled open collaboration. Other aspects of an "open science system" include post-publication peer review, open research notebooks, open access to research materials, open source software, citizen science, and research crowdfunding. Bartling and Friesike (2014) have proposed five distinct discourses. Their preliminary classification of Open Science includes:

1. Infrastructure in terms of collaborative platforms and services for scholarly communication
2. Accessibility of research for the public, broadly varying from science communication to citizen science
3. Measurement, e.g. the development of alternative metrics
4. Open access to publications, data, software etc.
5. Collaborative modes of research, e.g. through open software

DIGITALISATION AND A NEW DELIBERATIVE IDEAL OF DEMOCRACY

As is clear from the above, one component of Open Science has been a more active engagement of citizens in the science system. This "participatory turn" is based on a deliberative ideal of democracy (Rawls 1993, Habermas 1996, Fishkin 2009). Deliberative democrats believe that there exists a "democratic deficit" in western democracies where policy-making has taken on a technocratic nature with a growing distance between the elites and the public (Lövbrand et al. 2011: 475–476; Joss 2005: 202). The lack of direct influence of citizens in formal processes of decision-making would question the accountability and legitimacy of collective decisions. Therefore, voting and representation would no longer be sufficient. Instead, collective decisions would need to be legitimised through an open and reasoned dialogue among free and equal citizens.

Owing to its supposed compatibility with the new information and communication technologies (Roberts and Crossley 2004), this deliberative model of democracy has been gaining ground in western democracies since the 1990s. It is based on the assumption that the public nowadays not only has the technical possibility to participate in political processes because of digitalisation, but is also motivated to actively and systematically do so. However, while a debate on increased societal participation seems evident in democracies, in which legitimacy is conveyed through representation, it has been less clear why this debate should also take place in the science system, in which legitimacy has traditionally rested on the quality of knowledge. In the discussion that follows, we will trace how the idea of "democratising research" through broader participation by citizens has emerged and entered the science system.

2. The Appendix contains an overview of selected initiatives of the European Commission concerning the technical implementation of Open Science.

2. TRACING THE IDEA OF "DEMOCRATISING RESEARCH"

THE "STANDARD VIEW OF SCIENCE"

Since the end of the Second World War, the consensus between scientists, policy-makers and the public in western democracies has been to lodge management of the scientific enterprise with the science community itself (Jasanoff 2003: 227–229). This idea found one of its clearest expressions in Vannevar Bush's report "Science – The Endless Frontier" (1945). Scientific autonomy was considered the best way to secure the quality of research. Peer review ensured that state-sponsored scientists met the aims and standards of research in consistency with a discipline's priorities, theories, and methods. Citizens participated in research mainly as data collectors in such fields as archaeology, astronomy, and natural history. However, the partnership entailed a clear division of the roles of citizens as "amateur data collectors" and scientists as "professional elucidators" who should generate knowledge from the data and advance science (Eitzel et al. 2017: 6). This "standard view of science" (Bijker et al. 2009) implied that scientists were knowledgeable experts, while the public had inadequate knowledge.

THE "PARTICIPATORY TURN" IN SCIENCE

Within the last 30 years, this view of science has come under increased scrutiny. There has been a growing demand for "Open Science", which includes broader societal participation in research. Many of the new citizen science initiatives foresee greater roles for the public in the management of the scientific enterprise. They are intended to go beyond traditional citizen science activities such as data gathering activities and to include (at least in the long term) the participation of the public in research design, the conducting of research and its evaluation. In their most radical version, they are thought to "democratise research" and thus to improve the democratic accountability of research.

SCIENCE AND THE DELIBERATIVE IDEAL OF DEMOCRACY

The "participatory turn" in science (Jasanoff 2003: 235–238) can be traced back to applying the deliberative ideal of democracy (see "1. Digitalisation, Open Science and Democratisation") to the science system. An increasing number of science and technology scholars no longer approach knowledge development as a process separate from the logic of democracy (Lövbrand et al. 2011: 478). They believe that scientists should no longer consider societal participation purely in order to allow research to reach larger scales (geographically or in terms of sample size) or to realise educational objectives such as improving the ecological literacy of citizens. Instead, they demand that scientists should justify their knowledge claims to much broader groups than their scientific peers. This argument for a democratisation of research arises mainly from:

1. new modes of knowledge production
2. an advancement of "post-normal science"
3. an erosion of scientific authority

Broader societal participation is believed to restore public trust in science, re-orient science toward coping with the complexity of environmental problems and transform research into an interactive system with possibilities of participation for different stakeholders (cf. Eitzel et al. 2017: 7–10, Frederking et al. 2016: 8).

1. NEW MODES OF KNOWLEDGE PRODUCTION

In general, the boundaries between scientists, citizens and policy-makers have become more blurred. Technological progress has facilitated the ability of citizens to access scientific information on the internet and to contribute to science through smartphones with computing and sensing abilities. Societal progress has increased the pool of citizens who are able and willing to contribute to science – owing to a growth in higher education, increased leisure time and increased life expectancy (Haklay 2015: 12–13).

At the same time, science feeds increasingly into policy-making and the everyday lives of individuals and societies (Ferretti & Pavone 2009: 289). Gibbons et al. (1994) claim that the public has already become a reference point for all scientific activity, as knowledge is increasingly produced in contexts of application and in a wider variety of locations, science is increasingly transdisciplinary and scientists have grown more aware of the social implications of their work (quoted in Jasanoff 2003: 234). According to this view, science is still the most crucial, but no longer the only relevant source of knowledge (Liberatore & Funtowicz 2003: 149).

This would cast doubt on the idea that scientists should remain accountable to their own peers only and not to society at large. Citizens should no longer be understood as pure "data objects" but rather be integrated actively in research processes (cf. Schäfer/Kieslinger 2016: 2). Gibbons et al. (1994) consider it a relic of an earlier era to keep insisting upon a separate space for science, with autonomous measures for quality control (quoted in Jasanoff 2003: 235). Nowotny et al. (2001: 117) plead in favour of a "mode 2" science in which the reliability of scientific knowledge is "complemented and strengthened by becoming also socially robust". By this, they mean that the expectations and reactions of citizens should find their way into the scientific process.

2. ADVANCEMENT OF "POST-NORMAL SCIENCE"

The demand for greater democratic accountability of scientists has also been closely connected to the advancement of science into fields where not only scientific knowledge is uncertain, but also the direction in which society should move (Weingart 2008: 143). This debate started in the 1960s, when damage to the environment resulting from technological progress first became an issue. Since then, concerns that the products of science could put society at risk have featured prominently in debates on nuclear energy, anthropogenic climate change, human cloning and embryonic stem cell research.

There is an increasing belief that the assessment of research in these specific areas of "post-normal science" (Funtowicz & Ravetz 1991) should not be left to the judgment of scientists alone (Bijker et al. 2010: 126–129). Societal involvement would be needed prior to research because, once knowledge was available, little could be done to stop its spread and implementation. A priori engagements between scientists and citizens would enable the latter to understand the societal risks involved in the development of science and thus ensure that science would not expose society to risks that it is not willing to tolerate.

Funtowicz & Ravetz (1991) believe that traditional experts should be flanked by an "extended peer community" of those affected by or with special knowledge of the issue. Jasanoff (2005: 190) argues that citizens should hold scientific experts accountable "by asking on whose behalf science and technology choices are made, with what rights of representation and according to whose definition of the common good".

3. EROSION OF SCIENTIFIC AUTHORITY

Arguments have also been put forward in support of greater democratic accountability of science because science has increasingly been disputed as an objective source of knowledge and expertise for decision-making. Since the 1980s, science has come to be understood as being socially constructed (Lotriet 2015: 36; Bijker et al. 2010: 122). Politics and other influences are, it is suggested, intrinsic to the scientific process and knowledge. Some scholars have implied that there would be even space for science to be influenced by social advocacy. This has weakened the authority of scientific knowledge and resulted in public uneasiness that science could be misdirected and become a servant of governments and other interests. Enthusiasm for scientific endeavours has thus been replaced by a sceptical wait-and-see approach. Instances of scientific fraud or misconduct have often been exaggerated to portray a flawed system in general (Jasanoff 2003: 229).

Although it might seem a paradox, the fact that science has become more relevant in policy-making than ever before has also contributed to the erosion of its authority. The difference between scientific experts and policy-makers has been blurred in the mediation between scientific knowledge and political needs. Ferretti & Pavone (2009: 289) argue that scientific judgment promised to bring neutrality in political decision-making. Instead, government-appointed experts have often shaped political decisions under the guise of giving scientific advice. Thus, science and technology are no longer considered to be solutions to socio-political problems; they have become part of these problems.

3. FORMS OF SOCIETAL PARTICIPATION IN RESEARCH

DIFFERENT DEGREES OF SOCIETAL PARTICIPATION: FROM CO-OPERATION TO CO-DESIGN

Societal participation in research should not be defined as a phenomenon that can be entirely correlated to the 21st century. However, within the last 30 years, the participatory turn in science has led to a proliferation of its forms and to the emergence of unprecedented forms of interaction between scientists and citizens. Since 1989, societal participation in research has most often been denominated as "citizen science" (cf. Frederking et al. 2016: 1), but the terms "public participation in scientific research", "participatory science", "civic science", "amateur science" or "crowdsourced science" (ibid.: 2) have also been used frequently. These forms of societal participation must be clearly distinguished from forms of science communication, in which scientists are the providers and the public merely passive recipients. They vary not only in terms of terminology, but also according to their activity, geography (i.e. local, regional, national or global level), research area, and the degree and quality of societal participation.

Schäfer & Kieslinger (2016) maintain that the most important distinction between different types of societal participation relates to the degree of societal participation or in other words "how close or how far they are from established forms of research". Societal participation in research should be differentiated according to the "locus of knowledge creation". This locus of knowledge creation moves along a continuum from projects where knowledge creation is mainly in the hands of researchers to those where citizens are equal or even the main knowledge producers. Frederking et al. (2016: 4) currently distinguish four degrees along this continuum. This is a valuable approach in order to trace whether and how increased demands for a greater public accountability of research have actually manifested themselves in the way society participates in research today.

Co-operation

The *co-operation model* implies a minimal and passive participation of citizens such as for example "passive sensing" (Haklay 2015: 14), where participants provide a resource that they own (e.g. their phone or space in their backyard) for automatic sensing used by scientists for analysis. Other forms of societal participation according to this model are for example "volunteer computing", where citizens allow scientists to run complex computer models on their personal computing devices when they are not in use, and "volunteer thinking", where scientists make use of the cognitive ability of people in passive leisure activities such as watching TV (ibid.).

Collaboration

The *collaboration model* implies a more active participation of citizens. It includes the traditional forms of societal participation in research such as monitoring environmental pollution, observing flora and fauna, identifying images and collecting different forms of data.

Co-production
The co-production model envisages a more equal role for citizens who participate not only in the collection, but also in the analysis of data.

Co-design
The *co-design model* involves citizens on a par with professional scientists, for example in the development of research policy and questions, in the co-design of research programmes, in setting the agenda for research projects, in the funding of research projects (through crowdsourcing) and possibly also in the evaluation of research projects.

Schäfer & Kieslinger (2016) make a strong case for also relating the locus of knowledge creation to the focus of project activities. Most citizen science activities can be placed on a matrix of societal participation with "traditional research" (i.e. researchers as knowledge producers with a focus on answering scientific questions) at the one end and new forms of research (i.e. citizens producing knowledge with a focus on interventions in socio-ecological systems) at the other end.

To illustrate the different degrees to which society participates in research, we have selected three prominent examples of the implementation of societal participation in research at an EU, member state and research performing level: the European Commission's Open Science strategy, the Dutch National Research Agenda and the *Museum für Naturkunde Berlin* – a Leibniz Institute.

THE EUROPEAN COMMISSION AND "CITIZEN SCIENCE"

Societal participation has featured prominently on the European Commission's agenda since the beginning of the 21st century. For Nowotny (2005: 38), this is hardly surprising since the EU has been at the centre of the debate on a "democratic deficit" with a perceived lack of democratic legitimacy of its governance structures. In 2001, the European Commission's White Paper on Governance drew on new guidelines for the collection and use of expert advice, which had been prepared by a working group on "democratising expertise", in order to "provide for increased accountability, plurality and integrity" (Jasanoff 2003: 226). In 2007, an expert group commissioned to assess "how to respond to the widely-recognised problem of European public unease with science" concluded that European institutions should attribute a more active and creative role to their publics and not fall back on the "narrative of a singular hierarchy of knowledge, with publics imagined as epistemically-incompetent [sic!], thus untrustworthy." (European Commission 2007: 78). The idea is that, by engaging in deliberations with scientific experts, citizens can shape a more democratically committed knowledge society.

"Citizen Science" has consequently evolved to become a central issue in the 3O Strategy (Open Science, Open Innovation, Open to the World; 2015) of Carlos Moedas, European Commissioner for Research, Science and Innovation. For the Commission, citizen science means that "participants provide experimental data and facilities for researchers, raise new questions and co-create a new scientific culture" (European Commission 2014: 10). This would allow for the "democratisation of science".[3] For the Commission (2013: 3–5), engaging citizens and society "in completely new ways" would be made possible by developments

3. For further information cf. https://ec.europa.eu/digital-single-market/en/citizen-science [20.07.2017].

in digital technology. Through access to scientific information and processes, citizens would be aware of the potential and limits of scientific knowledge creation, and could participate in studying and monitoring issues relevant to them. Thus, research agendas could be re-directed towards issues of concern to citizens and scientific practices would become more efficient and trustworthy (European Commission 2016: 54). The old restricted and "elite" approach of science would expand to a "more egalitarian view of research" (European Commission 2013: 5).

In order to foster such cultural change in the system of research, the Commission has included "Science with and for Society" as a specific programme section in Horizon 2020. A major part of this is the guideline "Responsible Research and Innovation" (RRI),[4] to which future research projects and processes as well as researchers themselves are to adapt themselves. RRI has been implemented as "cross-cutting issue" in Horizon 2020 and according to the Lamy Report is likely to play a role in the next framework programme as well (cf. European Commission 2017). It implies that various stakeholders work together in research and innovation on five central (political) issues with the intention of better aligning research processes and results with the values, needs and expectations of society.

In contrast to traditional interpretations of societal participation, the Commission's definition of possible citizen activity in the research context exceeds the traditional forms of co-operation or collaboration with experts. Thus, the given statements imply the possibility of citizen participation in the form of co-production or co-design, which would include a shift from researchers and branch-specific interests to societal expectations and claims as the baseline of research projects and agendas. However, concrete guidelines for the implementation of Citizen Science in research processes still need to be clarified.

The European Citizen Science Association (ECSA) was founded by organizations of 17 member states of the EU to unify the various approaches and create a shared awareness of the importance of Citizen Science. As a pan-European alliance it is also strongly involved in strengthening the Citizen Science position within the EU programmes and agendas, e.g. in the context of projects in Horizon 2020 (cf.: "Do it Together Science") and by promoting RRI.[5] The aim of ECSA is to further encourage the growth of the Citizen Science movement in Europe as well as internationally (cf. Frederking et al. 2016: 3).[6] In addition to this intention to set European standards with respect to Citizen Science, the EU has already funded (e.g. "Sea for Society"[7]) and promoted (e.g. via the platform "Socientize"[8] and at events like the "Euroscience Open Forum") various projects containing Citizen Science elements.

4. For further information cf. https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation [20.07.2017].
5. Cf. https://ecsa.citizen-science.net/about-us [20.07.2017].
6. In order to better align the given forms and endeavours of Citizen Science movements and projects, the ECSA recently published 10 guiding principles for Citizen Science (cf. Eitzel 2017: 7), such as "Both the professional scientist and citizen scientist benefit from taking part". For further details cf. https://ecsa.citizen-science.net/engage-us/10-principles-citizen-science [20.07.2017].
7. Cf. http://seaforsociety.eu/np4/home.html [20.07.2017].
8. Cf. http://www.socientize.eu/?q=de/content/socientize [20.07.2017].

SOCIETAL PARTICIPATION AS PART OF A NATIONAL SCIENCE POLICY: THE DUTCH NATIONAL RESEARCH AGENDA

The integration of societal participation in the development of the Dutch National Research Agenda can be defined as a mixture of a collaborative exchange between lay–expert knowledge and to a certain extent a sort of co-design. The origin of this reform was a new science policy in 2014, in which the Dutch Ministry of Education, Culture and Science called for the development of a unifying research agenda (cf. Molenaar 2017: 31). For the development of the new agenda (2015), different stakeholders could submit online questions that they wanted to see answered by science or at least further investigated. Thus the agenda-setting was primarily based on public consultation (cf. de Graaf et al. 2017: 11). The aim was to identify societal themes and research fields of greatest interest. A "Knowledge Coalition" that consisted of the most important Dutch institutions for scientific research was primarily responsible. A Steering Committee and Liaison Group including a wide range of different civil society organizations further supported the Coalition.

In the process that followed, nearly 12 000 questions were submitted to the responsible parties and clustered into larger questions by expert panels. Based on this process of aggregation, 140 "cluster questions" were divided into different routes that focused on complex societal, scientific, or economic issues. These routes were then implemented – also via alignment to already existing agendas – to represent the new National Science Agenda. It is planned that the agenda will be reviewed after about seven years. Nevertheless, it was the first time in history that such an interactive approach was used for developing a new national research agenda.[9]

CITIZEN SCIENCE POLICY IN GERMANY

The facilitation of active societal participation in research is a topic that is increasingly recognized and supported in Germany. As in the Netherlands, the role of the citizen in this context exceeds the status of "pure data collector". The most commonly known platform for promoting and fostering Citizen Science in Germany is the project "*Bürger schaffen Wissen*" (GEWISS), a joint venture between the Leibniz-Gemeinschaft, Helmholtz-Gesellschaft and several academic and non-academic institutions. The project is financed by the Federal Ministry of Research and Education as well as the *Stifterverband*.

The platform recently published a Green Paper on Citizen Science Strategy 2020 for Germany (2016). To foster the further recognition and development of Citizen Science in Germany, the Green Paper contains the following three recommendations with regard to the strategic alignment of Citizen Science (ibid: 9):

- Creation of a culture that values Citizen Science in society, science and policy
- Development of structures which ensure data quality and data management
- Clarification of the legal and ethical framework conditions

A virtual platform[10] has also been created where current citizen science projects are presented and interested stakeholders can gain information about the different aims as well opportunities to participate.

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9. For a detailed insight into the summarised conception and development of this process, the official platform of the "*Wetenschapsagenda*" provides all relevant information, cf. http://www.wetenschapsagenda.nl/ publicatie/ from-vision-for- science-to-dutch-national-research-agenda-in-365-days/?lang=en [20.07.2017].
10. For further details have a look at: http://www.buergerschaffenwissen.de/ [20.07.2017].

One of the most commonly known institutional examples fostering Citizen Science in Germany is the *Museum für Naturkunde* – Leibniz Institute for Evolution and Biodiversity Science in Berlin. The integrated research museum actively takes part in the GEWISS project as well as in research projects with a concrete Citizen Science framework, e.g. in the project "*Wissensdinge*" (2013–2015).[11] In this project, citizens were asked to share their personal relationship with exhibits in the Museum. Thus, citizens shared their experiences and perspectives on scientific objects, which were framed within current scientific discourses of cultural theory by scientists. The *Museum für Naturkunde* in Berlin is currently also the headquarters of the European Citizen Science Association (ECSA).

11. For further details have a look at: http://www.mfn-wissensdinge.de/projekt/ [20.07.2017].

4. KEY ISSUES AND KEY QUESTIONS

The Science Europe High-level Workshop offers a unique opportunity for a differentiated approach to the complexity of the concept of Open Science and for a wider common understanding of its scope within the research system.

While the previous chapters offer background information on the issues of digitalisation and democracy in general, the following reflections highlight the key issue of Open Science as the qualitative leap between digitalisation and societal participation in research, as well as a distinction between access to information and scientific knowledge.

The challenges here relate less to the availability and accessibility of digital infrastructures but fundamentally to the question of how scientific knowledge is achieved and what scientific standards are the prerequisites for maintaining the validity and integrity of scientific results.

Public participation in science has many interpretations (see "3. Forms of societal participation in research") and is based on a certain understanding of civil society (Expert Forum on Public Participation and Transparency of the High-Tech Forum 2017: 7). However, given the heterogeneity of societies, a diverse representation of the public would be expected in many aspects: motivation, interests, knowledge and much more. The general conclusions of most approaches to an extended involvement of civil society in research acknowledge the need for a 'final moderation' of the interaction with scientists by 'an expert'.

- ***How can such moderation be managed?***

Furthermore, inclusion of the public is more evident in certain research fields that are directly linked to the public's objective requirements, such as environmental problems or health issues. The inverse does not hold: not every scientific problem equates to a societal problem and vice versa. Thus, it is less evident that societal participation will be popular in highly abstract and theoretical research.

- ***Are there certain limitations of involvement?***

An important social phenomenon linked to the diversity of today's civil society is the use of social media as an individual means of both information gathering and expression of opinions. The openness of digital channels simultaneously allows for highly individualized choices of information and its processing, leading to uncertainties as to the true or false value or meaning of the piece of information. Unfortunately, the internet does not provide for queries (as opposed to human communication). The need for contextual explanation of data is particularly important in science and is indeed the very basis of any scientific reasoning.

- ***Does publicly open access to data and research processes require a certain key code?***

Open science is also connected with 'alternative science' or 'alternative metrics' in the sense that non-scientists can engage in 'non-mainstream' experimentation or in the rating and assessment of scientific projects, for instance via 'likes' in social media. This approach obviously leads to the question of the addressee and the consequences for both the integrity of the research system and the basis of political decision-making.

- ***How can responsible science be quality-assured in Open Science?***

Further consideration, which is far beyond the scope of this High-level Workshop, will have to take into account current research on the impact of big data on individuals, groups and societies, and on choices made based on context-free data analysis lacking argumentative structures within the human-digital interface.[12]

The shape of Open Science will depend on answers to such reflections, especially in the light of a successful mutual understanding of the digital research area by both the scientific communities and politics.

Guiding questions that also yield a clear definition of open scientific participation and a clear distinction between issues of science communication versus democratisation of science might include:

- What is the qualitative link between excellence and openness?
- How can Open Science be a criterion for better science?
- What are the drivers and constraints of Open Science with regard to the advancement of scientific knowledge?
- Are all stages of research processes suitable for openness, and for whom?
- Do resources for accountability come with a cost?

Consequently, and as a next step, the results of this first European debate on the implications of linking digitalisation to democracy for scientific processes will be elaborated into policy recommendations to decision-makers in science policy at EU level, in member states and Science Europe member organisations, with a possible global outreach.

12. Cf. the recent Dagstuhl report "Data, Responsibility" (Abiteboul et al. 2016:43): "The promise of Big Data is to improve people's lives, accelerate scientific discovery and innovation, and enable broader participation. Yet, if not used responsibly, Big Data can increase economic inequality and affirm systemic bias, polarize rather than democratize, and deny opportunities rather than improve access. Worse yet, all this can be done in a way that is non-transparent and defies public scrutiny."

APPENDIX

OPEN SCIENCE IMPLEMENTATIONS: SELECTED INITIATIVES OF THE EUROPEAN COMMISSION[13]

EUROPEAN OPEN SCIENCE CLOUD (EOSC)

As part of the European Cloud Initiative (which was announced in April 2016 by the European Commission), the EOSC is envisaged as a stakeholder-driven virtual research environment with services for the storage, management, analysis and re-use of research data, across borders and scientific disciplines. The EOSC is intended to be built upon:

- integration and consolidation of e-infrastructure platforms (such as GEANT, EGI, PRACE, etc.)
- federation of existing research infrastructures and scientific clouds (such as data-intensive ESFRI infrastructures)
- development of cloud-based software services for Open Science

In 2016, the European Commission estimated an amount of €6.7 billion (coming both from public and private sources) to implement the European Cloud Initiative. The Commission has indicated that it will invest approximately €2 billion, mainly through HORIZON 2020 and the next EU Framework Programme for Research and Innovation, with the remaining amount expected to come from national public and private investors.

OPEN SCIENCE POLICY PLATFORM (OSPP)

Established in 2016 by the European Commission, this platform with 25 members representing various stakeholder groups (universities, research funders, libraries, etc.), has the mandate to advise the Commission on how to further develop and practically implement its Open Science strategy along the following Open Science action lines:

- Rewards
- Altmetrics
- Open Science Cloud
- Changing business models for publishing
- Research Integrity
- Citizen Science
- Open Education and Skills
- FAIR Open Data

13. Cf. https://ec.europa.eu/research/openscience/index.cfm [04.08.2017].

EXPERT GROUPS ON OPEN SCIENCE

The European Commission has set up or is setting up various expert groups which cover distinct aspects of Open Science, for example:

- High Level Expert Group on the European Open Science Cloud – to advise the Commission on the measures needed to implement the European Open Science Cloud
- Expert Group on FAIR data – to turn the FAIR data principles into an operational reality, which means that research data is Findable, Accessible, Interoperable and Reusable
- Expert Group on the Future of Scholarly Publishing – to assess emerging and alternative open access business models with the aim of achieving an economically viable transition towards open access
- Expert Group on Altmetrics (published its final report in March 2017 on how to advance a next-generation metrics in the context of Open Science)

In addition, RISE (Innovation and Science Policy Experts), another expert group of the European Commission, also delivered a report with recommendations on Open Science in May 2017.

OPEN ACCESS PUBLISHING PLATFORM

The European Commission is currently in the process of planning the establishment of an Open Access publishing platform. This platform should allow open access publication of pre-prints and peer-reviewed articles related to projects funded by HORIZON 2020. Furthermore, the platform will contain mechanisms for open peer review and alternative metrics. Corresponding funding action has been included in the draft Work Programme 2018 of HORIZON 2020.

GO FAIR

This bottom-up initiative, prepared mainly by stakeholders from the Netherlands and Germany, aims for the practical implementation of the recommendations of the EOSC High Level Expert Group. GO FAIR will develop an ecosystem of infrastructures, build up competences for research data management, including the training of data stewards capable of providing FAIR data services, and promote a programme of cultural change with relevant stakeholders. In May 2017, on the occasion of the Competitiveness Council of the EU, Germany and the Netherlands issued a declaration of support for GO FAIR, primarily by establishing a support office for a pilot phase of 2 years.

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CVs OF THE SPEAKERS AND PANELLISTS

Michael Matlosz

President of Science Europe

Michael Matlosz holds a BS degree in chemical engineering from the New Jersey Institute of Technology, and a PhD from the department of chemical engineering of the University of California, Berkeley. He began his professional research career at the Swiss Federal Institute of Technology (EPFL) in Lausanne (Switzerland) from 1985 to 1993. He was appointed university professor of process engineering at the National School for Advanced Study of the Chemical Industries (ENSIC) in Nancy (France) in 1993. From 2005 to 2009 Professor Matlosz initiated and directed for CNRS (France) the major European research initiative entitled IMPULSE. A member of the European Technology Platform for sustainable chemistry 'SusChem' since 2005, Professor Matlosz was chair for the French National Research Agency (ANR) programme in sustainable chemistry from 2006 to 2009. He was Director of ENSIC-Nancy from 2006 to 2011 and head of the ANR's Department of Emerging and Exploratory Research from 2012 to 2014. From September 2014 to July 2017 he was President and Chief Executive Officer of ANR. Professor Matlosz is a member of the National Academy of Technologies of France. He was elected President of Science Europe in November 2015.

Georg Schütte

State Secretary at the Federal Ministry of Education and Research Germany (BMBF)

Georg Schütte has been State Secretary at the Federal Ministry of Education and Research (BMBF) since December 2009. Prior to this, he was Secretary General of the Alexander von Humboldt Foundation in Bonn since 2004. Before, he worked as Executive Director of the German–American Fulbright Commission in Berlin. During this period, he was also a member of the EU Commission's expert group on 'Benchmarking Human Resources'. He studied journalism at the University of Dortmund and 'Television and Radio' at the City University of New York. He worked on his doctoral thesis at the Siegen University and was a Visiting Fellow at Harvard University. Georg Schütte is Chairman of several scientific and political boards and councils.

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Peter Strohschneider

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Peter Strohschneider is the President of the *Deutsche Forschungsgemeinschaft* (DFG, German Research Foundation), the central self-governing organisation for sciences and the humanities. He studied German philology, as well as law, history, sociology and political science, and received his PhD from the Ludwig-Maximilians-University (LMU). He was Professor of German Medieval and Early Modern Studies at Dresden University of Technology. Since 2002 he has held the chair of German Medieval Studies at the LMU in Munich. His research foci lie in the fields of German medieval and pre-modern culture and literature, as well as academic research policy. He was a visiting professor at the *École Pratique des Hautes Études* in Paris, the Freiburg Institute for Advanced Studies and the Goethe University Frankfurt/Main. He chaired the German Sciences and Humanities Council (*Wissenschaftsrat*). He is a member of numerous international committees and academies.

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Christoph Möllers, Dr. jur. (München), LL. M. (Chicago) is a Professor of Public Law and Jurisprudence, Faculty of Law, Humboldt-University Berlin and a Permanent Fellow at the Institute for Advanced Study Berlin. His main research interests include German, European and comparative constitutional law, regulated industries, democratic theory in public law, and the theory of social norms. He was a Fellow at NYU School of Law and at the *Wissenschaftskolleg zu Berlin* and visiting Professor at CEU Budapest, Princeton University, Université Paris II and the LSE. He is a member of the Berlin-Brandenburg Academy of Sciences. In 2016 he was awarded the Gottfried-Wilhelm-Leibniz-Prize of the DFG. From 2011–2014 he served as a judge at the Superior Administrative Court in Berlin, he is a member of the newly established committee of independent eminent persons of the EU Authority for European Political Parties and European Political Foundations.

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Robert-Jan Smits is Director-General of DG Research and Innovation (RTD) at the European Commission. In this capacity he is responsible for defining and implementing the EU policy and programmes in the field of research and innovation (average annual budget 8 billion euro). He was one of the main architects and negotiators of Horizon 2020, the 80 billion EU programme for science and innovation (2014–2020). Mr Smits has also been instrumental in the development of several policy initiatives in the field of European science and innovation such as: the European Research Council (ERC), the European Roadmap for large scale facilities, Public-Private Partnerships in research, the Innovation Union and the European Research Area (ERA). Mr Smits is chairing several high-level committees such as European Research Area Committee (ERAC), the Steering Committee of the ERC Executive Agency (ERCEA), the Executive Committee of GEO (Global Initiative on Earth Observations) and joint S&T committees with Europe's key global partners. He has received several recognitions and awards for his contribution to European Science and innovation, including an honorary degree from Edinburgh University, a life-time achievements award from EuroScience and the 2016 Academy Medal from the Royal Netherlands Academy of Arts and Sciences. Mr Smits was born in the Netherlands. He has degrees from Utrecht University in the Netherlands, *Institut Universitaire d'Hautes Etudes Internationales* in Switzerland and Fletcher School of Law & Diplomacy in the United States of America.

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Director General of the Swedish Research Council (VR)

Sven Stafström received his PhD in theoretical physics from Linköping University (LiU) in Sweden in 1985. In 2000 he became professor in Computational Physics at LiU, a position he still holds. His main research interests are in studies of charge transport in carbon-based materials for electronic applications. He has published more than 220 papers in international science journals. Sven Stafström has served as Director of Studies at the Department of Physics, Chemistry, and Biology (LiU), acting Dean at Linköping Institute of Technology, Director of the National Supercomputer Centre (NSC) and Head of the Department of Science and Technology at LiU. In 2010, he became Secretary General of the Swedish Research Council for Natural and Engineering Sciences, a position he held until he became acting Director General in November 2013. Starting from June 2014, he is Director General of the Swedish Research Council, a position which lasts until 2020. Sven Stafström is also board member of Fulbright Sweden, *Vetenskap och Allmänhet* (Science and Society), member of the Advisory Council, Swedish Higher Education Authority and member of the Council of European Spallation Source (ESS).

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Marin Dacos is the Advisor of Open Science at the French Ministry of Higher Education, Research and Innovation. He is in charge of policies related to open access, open data, open source, open metrics, and citizen science. He is also the founding director of OpenEdition, a portal dedicated to digital publications in human and social sciences (HSS). OpenEdition is a national research infrastructure and a facility of excellence, with more than 500 000 articles, book chapters, and so on, and 50 million visits a year. He has published books and articles about digital publishing, open access and digital humanities. He has been laureate of the Aggregation of History (1996). He was awarded the CNRS Innovation medal in 2016.

Sander Dekker

State Secretary at the Ministry of Education, Culture and Science, the Netherlands

As part of his degree, Sander Dekker conducted research on the police and criminal justice system. He went on to work for the Crisis Research Centre (COT), which initiates and provides research studies, courses and training in disaster response and crisis management. He was also a member of the parliamentary committee evaluating investigative methods. After graduating, Mr Dekker conducted research and taught public administration at the University of Leiden. In 2001 he was a visiting researcher at Oxford University's Centre for European Politics, Economics and Society. From 2003 to 2006, he represented the People's Party for Freedom and Democracy (VVD) in The Hague municipal council, and from 2006 to 2010 served as portfolio holder for Youth, Education and Sport. He then became portfolio holder for Finance and City Management, a position held until he joined the government. On 5 November 2012, he was appointed State Secretary for Education, Culture and Science in the Rutte–Asscher government.

Søren Harnow Klausen

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Søren Harnow Klausen holds a PhD from the University of Tübingen. He is professor of philosophy at the Department for the Study of Culture, University of Southern Denmark and leader of the research programme 'Knowledge and Values'. His main research interests are the philosophy of science and the humanities, social epistemology, philosophy of mind, value theory, well being and creativity and innovation. He has previously served as vice-chair of the Danish Research Council for the Humanities.

Klement Tockner

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Professor Dr Klement Tockner is president of the Austrian Science Fund (FWF) and professor for Aquatic Ecology at the *Freie Universität Berlin*. He received a PhD in zoology and botany from the University of Vienna and a Titulary Professorship at ETH, Switzerland. Between 2007 and 2016 he was director of the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) in Berlin. He is a globally recognised scientist on freshwater biodiversity, ecosystem functioning, and river and wetland management. He has published more than 250 scientific papers including 130 ISI papers. In 2009, he edited a comprehensive book on European Rivers (*Rivers of Europe*, Elsevier). Klement Tockner has successfully managed large inter- and transdisciplinary projects (such as the EC-funded project BioFresh), and he is member of several scientific committees and international advisory boards including the National Institute of Environmental Studies, Japan (NIES). He is elected member of the Austrian Academy of Sciences and the German Academy of Sciences (Leopoldina).

Marc Schiltz

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Marc Schiltz holds a PhD in Physics (Crystallography) and an Executive MBA from INSEAD. He has been active in research and higher education for more than 20 years in several European countries and is a recognised scientist in his field of expertise. Drawing on his international experience, he has developed a thorough expertise in strategic research management and organisation. Since 2011, he is heading the National Research Fund, which is the central agency for promoting and funding research activities in Luxembourg. In this role, he has significantly contributed to enhance the quality of the Luxembourg research system and to build bridges with the private sector as well as with the international scientific community. He represents Luxembourg in international organisations such as the Global Research Council and has been an elected member of the Governing Board of Science Europe since 2015.

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State Secretary Bjørn Haugstad holds a doctorate from Oxford University, with a thesis on strategy realisation in knowledge intensive organisations. He also holds a Master of Science in Industrial Economics from NTNU, and an intermediate subject of Economics from the same place. Haugstad has been research director at the University of Oslo from 2009 until 2013, and comes from a position as Director General of the Ministry of Petroleum and Energy. Haugstad was State Secretary in the Ministry of Education and Research 2001–2005.

Matthias Kleiner

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Matthias Kleiner completed his habilitation in the field of forming technology in 1991. In 1994, he joined the faculty of the newly founded Brandenburg Technical University of Cottbus as Professor of Forming Technology in the Chair in Design and Manufacturing. Professor Kleiner was awarded the most prestigious prize in German research, the DFG's Gottfried Wilhelm Leibniz Prize in 1997. He responded to the call to the TU Dortmund University in 1998, where he held the Chair of Forming Technology. From 2004 to 2006, he served as managing director of the newly established Institute of Forming Technology and Lightweight Construction (IUL). He has played an instrumental role in a number of international and interdisciplinary research projects and research networks and acts as a member of numerous international professional committees and academies. In 2011, he co-chaired the German "Ethics Commission for a Safe Energy Supply". Matthias Kleiner was elected President of the German Research Foundation (DFG) in 2007. His six year-term of office as President of the DFG ended in December 2012. Matthias Kleiner assumed office as President of the Leibniz Association in July 2014.

Milena Žic Fuchs

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Milena Žic Fuchs was born in 1954 in Zagreb, Croatia. She graduated in English language and literature and Ethnology at the University of Zagreb and continued as a Fulbright doctoral scholar at the Linguistics Department of UCLA. She obtained her PhD in Cognitive Linguistics at the University of Zagreb, and is currently a Full Professor there. She was elected Fellow of the Croatian Academy of Arts and Sciences in 2010 and member of Academia Europaea in 2013. She served as the Croatian Minister of Science and Technology from 1999 to 2000. From 2009 to 2012, she was Chair of the Standing Committee for the Humanities of the European Science Foundation. From 2012 to 2013, she was member of the EC Expert Group for ESFRI Roadmap, and is at present member of numerous Science Advisory Boards at European level, in the domains of Research Infrastructures and SSH. As of 2008, she was a member of the ERC Advanced Grant Panel SH4 'The Human Mind and its Complexity' and Chaired it from 2014 to 2015. As of November 2016, she is a member of the EC High Level Group on maximising the impact of EU research and innovation programmes, chaired by Pascal Lamy.

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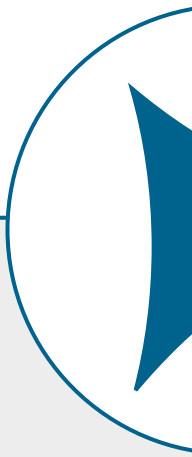

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