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OIS research conference

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'SYNERGIES AND TENSIONS AROUND IMPACT: HOW DOES OPEN INNOVATION IN SCIENCE (OIS) COME INTO PLAY?'

Report

on special theme sessions
of the OIS Research Conference
2023

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INTRODUCTION

Recent years have revealed the pressing need for humanity to confront multiple, increasingly intricate challenges. Scientific research assumes a central role in addressing these issues. However, science skepticism is on the rise in several countries, with societal actors questioning the value and legitimacy of scientific endeavors. Additionally, a significant portion of the population lacks a personal connection to science or simply displays no interest in it. A study from the Austrian Academy of Sciences found that around 30% of Austrians have limited trust in science, and 37% prefer common sense over scientific knowledge. Trust in science is particularly weak among financially vulnerable households, with up to 60% showing little trust in it. Are science and society more disconnected than ever? How can scientists ensure, measure, and effectively communicate societal impact to the general public? These questions formed the starting point for the Open Innovation in Science (OIS) Research Conference 2023 with a focus on 'Synergies and tensions around impact: how does OIS come into play?'

In specific sessions dedicated to this focus theme, the conference critically examined the influence of openness and collaboration in achieving scientific and societal impact. Does the adoption of Open Innovation in Science (OIS) practices such as crowd and citizen science, academia-industry co-creation, or data (material) sharing and reuse promote societal impact at the expense of scientific productivity? Can these practices enable the achievement of both goals, and if so, under what conditions?

The OIS research framework (Beck et al., 2022), initially developed during the first OIS Research Conference in 2019, provides a valuable foundation for this discussion. It emphasizes various mechanisms of openness and collaboration as catalysts for enhancing the scientific and societal impact of research. These mechanisms encompass widely accepted practices such as science engagement and the open sharing of data and results. Additionally, there is considerable promise in practices at the 'frontier' of openness and collaboration, such as the co-production of science with citizens and other stakeholders. However, the OIS framework serves as an agenda for future research rather than a conclusive statement of findings. Consequently, it remains uncertain whether and how OIS practices can effectively generate synergies between scientific and societal impact. Moreover, we still possess limited knowledge about potential tensions or trade-offs that may arise when deciding whether and how to implement open and collaborative practices in order to achieve societal impact.

This report provides a summary of two focus-theme sessions at the heart of this year's conference program: the OIS Experiment and the OIS Debate. Both sessions aimed at engaging the conference participants in different ways to push forward our understanding of the interrelationships of scientific and societal impact and the role of OIS.

OIS EXPERIMENT

The OIS Experiment is a key element of the annual OIS Research Conference: participants 'walk the talk' by experimenting with different OIS approaches and discussing the resulting insights. This year, participants discussed the scientific and societal impact of selected pairs of similar research articles of which one each applied OIS practices and the other one did not. Blind to the use of OIS practices in the two articles, participants first discussed what criteria could be used to assess both scholarly and societal impact. They then tried to actually assess the impact of the two articles along the defined criteria. For doing so, conference participants were randomly divided into six groups, each joined by a facilitator and provided with copies of the bibliographic information and the abstract of the two articles (one page each). Articles came from within the medical and health sciences, with each article pair published on a similar topic and in a similarly ranked journal during a similar period of time

The groups discussed a broad range of different criteria and measures to assess societal and scientific impact for these articles (see Table 1). Acknowledging variation across different disciplines and research fields, most groups covered the following factors when thinking about the assessment of scientific impact:

• Citation count: one of the most widely used metrics is the number of times an article has been cited by other researchers. A higher citation count suggests that the article has had a significant influence on subsequent research and is considered impactful within the scientific community.

• Journal impact factor: the impact factor is a measure of the average number of citations received by articles published in a particular journal. Publishing in high-impact journals is generally considered prestigious and can contribute to the perceived impact of the article. At the same time, participants also highlighted problems with using the impact factor, e.g., that it relates to the journal rather than the article level.

• Expert evaluation: expert assessment plays a crucial role in evaluating the scientific impact of an article. Peer review, where other researchers in the field evaluate the novelty, quality and significance of the research, is a fundamental step in determining impact.

Assessing the societal impact of an academic article involves considering a range of criteria beyond the traditional measures of scientific impact. While societal impact can be more challenging to quantify, the group discussions also identified several common criteria:

• Policy and practice impact: the extent to which the research has influenced policy decisions, shaped regulations, or contributed to practical applications in various fields. This can be measured by tracking citations or references in policy documents, government reports, or guidelines.

• Public engagement and outreach: the level of public engagement and dissemination of the research findings to broader audiences. This includes efforts to communicate research through public lectures, media coverage, press releases, and engagement with non-academic stakeholders. Assessments may consider metrics such as media mentions, social media interactions, or public event participation.

• Industrial and economic impact: the extent to which the research has led to innovations, technological advancements, or contributed to economic development. This can be evaluated through indicators such as patents, industry collaborations, commercialization of research outcomes, or economic indicators like job creation or revenue generation.

• Societal benefits and well-being: the impact on the quality of life, well-being, or social progress resulting from the research. This could include improvements in public health, environmental conservation, social equity, cultural understanding, or addressing societal challenges. Assessments may consider indicators like improvements in health outcomes, reductions in social inequalities, or cultural and social transformations.

• Stakeholder engagement and collaboration: the level of collaboration with stakeholders outside academia, such as community organizations, advocacy groups, NGOs, or industry partners. This criterion evaluates the meaningful involvement of these stakeholders in research design, knowledge co-production, and the extent to which their perspectives and needs are addressed.

Table 1: Summary of the criteria discussed for assessing the impact of the medical and health science articles across all six groups

CRITERIA FOR ASSESSING THE SCIENTIFIC IMPACT

- *Citations*
- *Backwards citations*
- *Number of downloads & number of reads*
- *Journal impact factor*
- *Standard metrics*
- *Author h-index (but: individual level)*
- *Type of journal*
- *Novelty*
- *Subsequent funding triggered by the paper*
- *Involvement of people in research*
- *Long term scientific impact (as opposed to short term)*
- *Level of interdisciplinarity*
- *Level of transdisciplinarity (collaborations with industry)*
- *Combination of novel work fields*
- *Efficiency of the methods (cost/time)*
- *Methodological rigor – Quality of methods – Design of experiment (sample design, instruments, controls, etc.)*
- *Accessibility of paper/method – Open Data – Data re-use*
- *Use of the method/diffusion*
- *Quality improvement*
- *Contribution to the field*
- *Uptake*

CRITERIA FOR ASSESSING THE SOCIETAL IMPACT

- *Media Coverage / Outreach / Media presence of authors*
- *Public attention*
- *Awareness*
- *Patent citations to publication*
- *Citations in policy reports / guidelines*
- *GitHub Statistic /use of code*
- *References from non-scientific documents / Uptake in practice/policy*
- *Can you move from these results to policy impact?*
- *Relevance of the research for stakeholders*
- *Use in applied research / Use in innovation / Use in medical treatments/products*
- *Uptake*
- *Breadth of use (could also apply to scientific impact)*
- *Translation into practice / Adoption in clinical practices*
- *Actual improvement (short vs. long term)*
- *Technology ready to be applied*
- *AI appearance*
- *Appearance on syllabus of courses*
- *Burden of disease: disability adjusted life years – Relevance for affected people*
- *Behavioral change in society and how many*
- *Managerial implications made explicit in the abstract*
- *Savings in health care*
- *Transferability to other fields*
- *Public education/discussion/awareness*

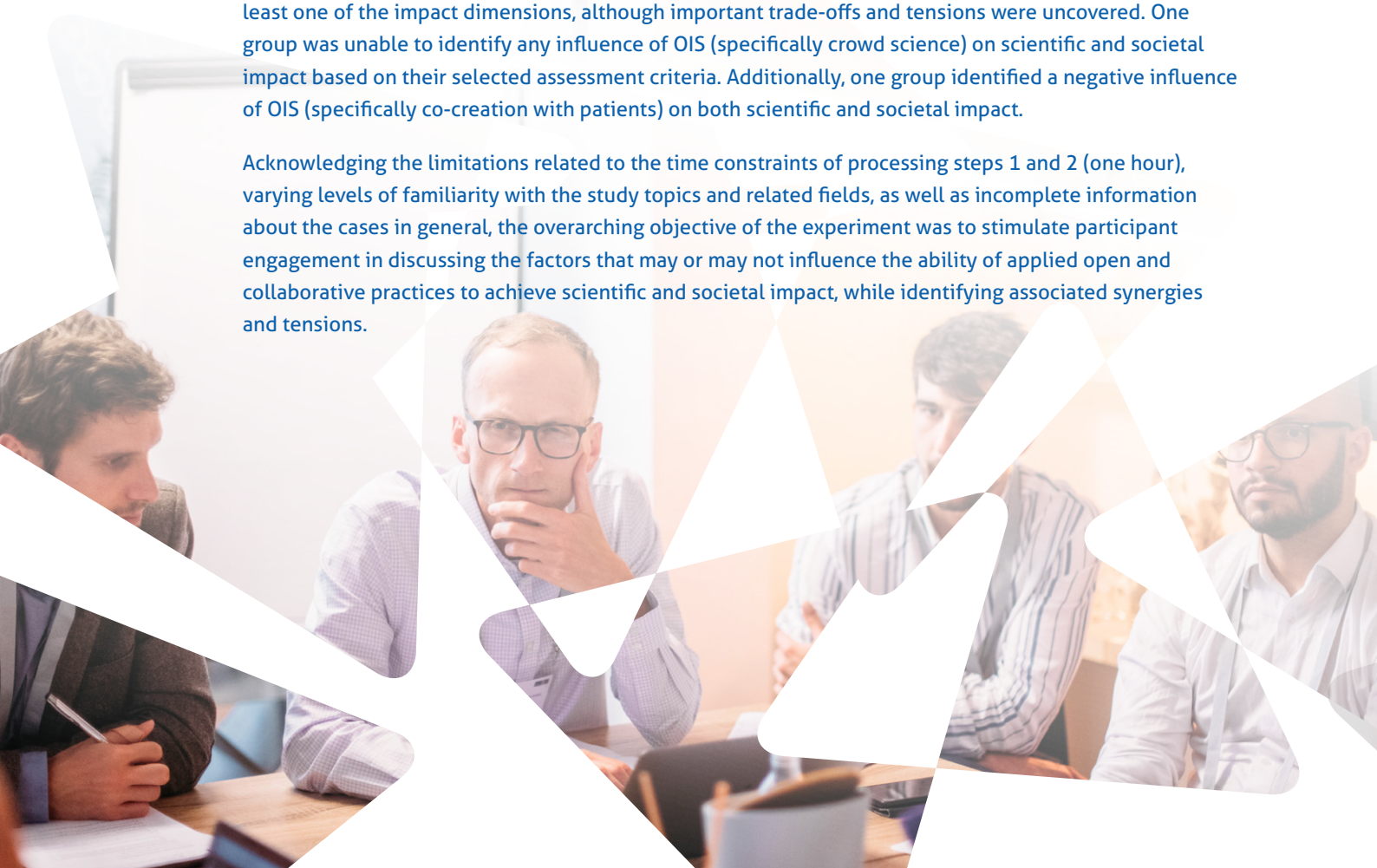
The discussions in the initial stage of the OIS Experiment demonstrated significant variations in the criteria deemed suitable for evaluating impact, influenced by the diverse backgrounds of the conference participants. One noteworthy distinction pertained to the importance attributed to journal impact factors as a measure of scientific impact. This criterion held greater significance in the social sciences, particularly in fields like management and economics, compared to other disciplines such as biomedical research.

Table 1 also shows that certain groups considered research interdisciplinarity or research uptake as crucial factors for assessing scientific impact, while others viewed these criteria solely in terms of societal impact. Moreover, field-specific disparities emerged when determining criteria for evaluating societal impact. For instance, discussions highlighted the significance of measuring the translation of scientific research into innovation, along with the role of patents in this process.

During the second step of the experiment, the group facilitator unveiled information from a sealed envelope, revealing which of the two selected medical and health research articles applied an Open Innovation in Science (OIS) practice and the specific practice employed. The three pairs of articles were associated with one of the following OIS practices each: (a) crowd science, (b) inter- and trans-disciplinary research collaborations with industry partners, SMEs, and patient organizations, as well as (c) co-production of research with patients. After discovering the use of OIS in one of the articles, each group discussed the role of OIS practices and how they might have influenced the article's scientific and societal impact.

Overall, four out of six groups agreed that the utilization of OIS practices had a positive influence on at least one of the impact dimensions, although important trade-offs and tensions were uncovered. One group was unable to identify any influence of OIS (specifically crowd science) on scientific and societal impact based on their selected assessment criteria. Additionally, one group identified a negative influence of OIS (specifically co-creation with patients) on both scientific and societal impact.

Acknowledging the limitations related to the time constraints of processing steps 1 and 2 (one hour), varying levels of familiarity with the study topics and related fields, as well as incomplete information about the cases in general, the overarching objective of the experiment was to stimulate participant engagement in discussing the factors that may or may not influence the ability of applied open and collaborative practices to achieve scientific and societal impact, while identifying associated synergies and tensions.



The discussions emphasized both the tensions and synergies between scientific and societal impact. Some common tensions discussed within the groups, as well as during the subsequent plenary debrief, included:

• Time and timeliness and rigor: scientific impact is often measured by the rigor of research, which necessitates significant time for experimentation, data analysis, and peer review. However, societal impact often requires timely responses to urgent issues. The conflict arises from the disparity between the timeframes required for rigorous scientific research and the need for prompt action.

• Scientific standards in different communities: co-creating clinical studies with patients was discussed as potentially improving relevance and societal impact. However, it also carries the risk of subjective assessments, potentially leading to unsound conclusions and compromises in study design that may weaken its rigor and translational potential in medical practice.

• Research focus: scientific impact typically prioritizes advancing and validating knowledge within specific fields or disciplines, focusing on theoretical or technical advancements. In contrast, societal impact often necessitates interdisciplinary and transdisciplinary approaches, addressing real-world problems with actionable solutions. The tension arises when the pursuit of scientific impact through specialized research does not align with the goals of those OIS practices that emphasize broader societal considerations such as public engagement or innovation.

• Risk and uncertainty: scientific research involves exploring uncharted territories and dealing with uncertainty. Embracing risks and acknowledging uncertainty is crucial for scientific progress. However, societal impact often requires practical solutions and decision-making in the face of uncertainties.

• Funding priorities: scientific impact is traditionally evaluated based on academic metrics such as citations and journal rankings, which influence resource allocation by funding agencies and institutions. In contrast, societal impact may not be adequately captured by these metrics. This misalignment in funding priorities creates tensions, as researchers may feel pressured to prioritize activities that maximize scientific impact at the expense of addressing societal needs.

• Communication and accessibility: scientific impact relies on effective communication within the scientific community through peer-reviewed journals and specialized conferences. However, societal impact requires effective communication with a broader audience or specific non-academic stakeholder groups, including policymakers, companies, stakeholders, patients, and the general public. Bridging the gap between technical scientific language and accessible communication can be challenging.

While tensions can arise, there are also synergies between scientific and societal impact, and these are often facilitated by the use of OIS practices:

• Addressing grand challenges: many pressing societal challenges, such as climate change, public health crises, poverty, and inequality, require scientific expertise to understand and resolve. By conducting research on these challenges, scientists can contribute to finding sustainable solutions and influencing policy and practice, leading to positive societal impact. Additionally, this work often involves inter- and transdisciplinary research approaches, pushing the boundaries of knowledge in fundamental questions (scientific impact).

• Engaging stakeholders: achieving societal impact often necessitates collaboration with stakeholders beyond academia, including policymakers, industry representatives, community organizations, and the general public. By actively involving these stakeholders, scientific research becomes more relevant and applicable to real-world problems. OIS practices such as inter- and transdisciplinary research collaborations with industry partners, SMEs, and patient organizations, or co-production of research with patients enhance both the depth and relevance of research (scientific impact) and increase the likelihood of diffusion, adoption, and translation into innovation (societal impact).

• Science communication and public engagement or co-creation: effective science communication and public engagement or co-creation initiatives bridge the gap between scientific research and the wider public. By sharing research findings in accessible ways or directly involving the public in the research process, scientists can enhance public understanding of scientific concepts and build trust in science. This engagement fosters public support for scientific endeavors, amplifies the societal impact of research, and promotes informed decision-making among individuals and communities.

• Enabling or improving data collection, processing, or analysis: while the scientific impact of an article that applied a crowd science approach to generate RNA structures may still be under evaluation, the approach generated significant amounts of big data that could potentially lead to novel and relevant research in the field. Simultaneously, this approach allowed the general public to actively participate, shape, and learn about the underlying research, expanding outreach and societal impact. Interestingly, the article examined in this OIS experiment was co-authored by scientists and members of the crowd who went beyond data contribution, showcasing the potential of collaborative research efforts.

By leveraging OIS practices, scientists can tap into these synergies to amplify both scientific and societal impact, creating a mutually beneficial relationship between the two.

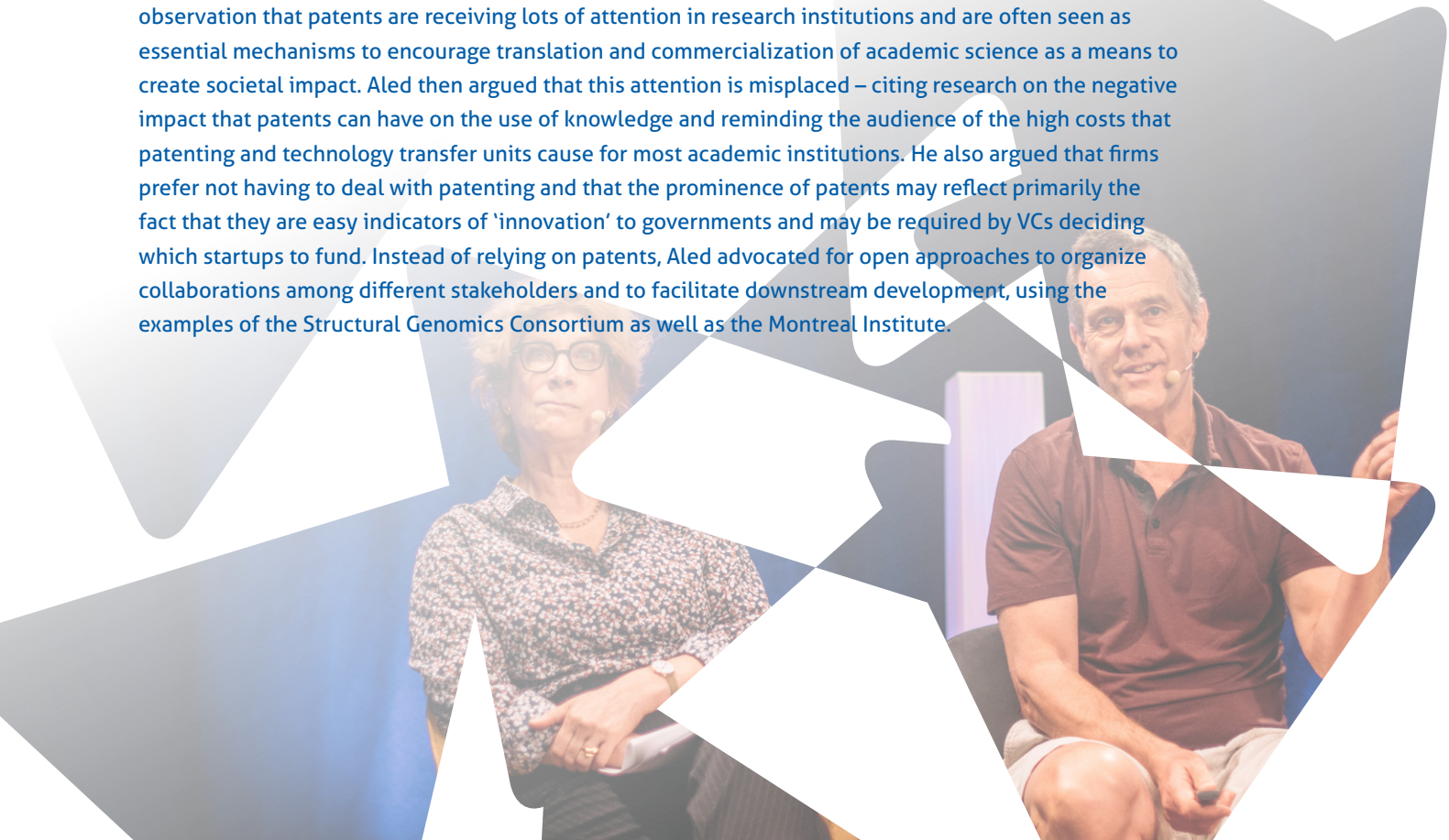
Taken together, the OIS experiment fostered insightful discussions regarding the role of OIS practices in achieving impact, both within the scientific community and in society as a whole. It shed light on the tensions and synergies that exist between scientific and societal impact and provided a better understanding of the contextual factors that influence the effectiveness of OIS practices. Factors such as the nature of the research (e.g., applied vs. basic), the specific scientific field, the timeliness of the research topic (e.g., Covid-19), the researcher's experience, and the availability of funding schemes were generally acknowledged as relevant boundary conditions. Furthermore, some groups delved into the motivations behind applying OIS practices and the importance of selecting and designing appropriate approaches to maximize the potential for achieving scientific and societal impact through inter- and transdisciplinary research methods. The experiment stimulated critical thinking on how these boundary conditions and considerations influence the outcomes of OIS practices in terms of impact.

OIS DEBATE

The OIS Panel Debate is another core element of the annual OIS Research Conference and is designed to stimulate discussion based on the research and practical experience of panelists. This year, the debate was co-sponsored by the Academy of Management TIM (Technology & Innovation Management) division. We invited four distinguished speakers who do research on OIS practices and/or use OIS practices in their work. Panelists were not forced to take particular positions but were encouraged to address in their opening remarks both potential synergies and tensions between scientific and societal impact, and the role of OIS in shaping these relationships. The debate started with 10-minute introductory remarks by each of the speakers, followed by a discussion among speakers as well as Q&A with the online and offline audience.

The first panelist was **Michelle Gittelman** (Professor at Rutgers University). She highlighted the benefits of open data sharing, archives, as well as data hubs for the progress of biomedical research. In addition to the direct benefits of sharing, she argued that mandates and incentives for sharing will shape norms towards greater openness and level the playing field for scientists. At the same time, Michelle recognized potential tensions arising from the time required to develop original data, high levels of competition, but also the precariousness of research positions and uncertainty of funding. Among others, these forces may push scientists to focus on the re-use rather than production of data, as well as the selection of methods that generate data faster and more cheaply. This, in turn, may create a bias against other important research approaches such as human subjects research (vs. computational studies) or longitudinal studies (vs. cross-sectional research). Michelle also suggested potential solutions such as less reliance on soft money positions and collective efforts to lower costs of sharing high-value data sets.

Aled Edwards is the founder and Chief Executive of the Structural Genomics Consortium and Professor of Medical Genetics and Medical Biophysics at the University of Toronto. His remarks started from the observation that patents are receiving lots of attention in research institutions and are often seen as essential mechanisms to encourage translation and commercialization of academic science as a means to create societal impact. Aled then argued that this attention is misplaced – citing research on the negative impact that patents can have on the use of knowledge and reminding the audience of the high costs that patenting and technology transfer units cause for most academic institutions. He also argued that firms prefer not having to deal with patenting and that the prominence of patents may reflect primarily the fact that they are easy indicators of 'innovation' to governments and may be required by VCs deciding which startups to fund. Instead of relying on patents, Aled advocated for open approaches to organize collaborations among different stakeholders and to facilitate downstream development, using the examples of the Structural Genomics Consortium as well as the Montreal Institute.



Dilek Fraisl is the Managing Director of the Citizen Science Global Partnership and Research Scholar International Institute for Applied Systems Analysis (IIASA). Her remarks shifted attention from openness of data and knowledge to openness in participation. More specifically, she discussed how collaborating with citizen scientists can be instrumental in collecting data to monitor sustainable development goals (SDGs), using data collection on environmental pollution in Ghana as an example case. But Dilek also recognized potential concerns about such initiatives and emphasized the need to build trust on all sides (including scientists, policy makers, as well as citizens) and to ensure transparency about the processes that are used. Moreover, she warned that citizens should not just be seen as 'free labor' but as valued contributors and stakeholders who should receive a share of the benefits created from their efforts.

Michaël Bikard (Professor at INSEAD) argued that openness and sharing have for a long time been core features of modern science without which it could not operate. However, he noted that there may well be a bias in favor of openness general – no less among the conference and panel participants. As such, he took the position of a 'devil's advocate' by focusing on two important challenges that should not be ignored, especially in discussions around even more radical forms of openness and collaboration. The first challenge relates to incentives and rewards: openness can be expensive, and participants need to be rewarded for the effort they invest in sharing data and other resources. Yet, current reward systems such as publications and patents are blunt instruments, and it is not always clear that the rewards go to the right people (e.g., as co-authors on scientific articles). Moreover, the rewards in some fields may not be commensurate to the costs of producing data, leading to a lack of incentives to produce certain types of data – reinforcing a point made earlier by Michelle Gittelman. The second challenge relates to quality. Michaël noted that most peer-reviewed science already does not get cited – and warned that things may get even worse if a large volume of research is disseminated openly, including on pre-print servers and other mechanisms that do not involve quality checks via mechanisms such as peer review. The quality of such open research is very uncertain, creating a risk that users build on low quality work or need to invest great resources to discern quality. Thus, while openness may increase both scientific productivity and societal impact by making knowledge more accessible, it may be detrimental for both goals if it leads to a decrease in the quality of the knowledge that is disseminated and used.

The introductory remarks by the four panelists triggered intensive discussion among panelists and also in the form of Q&A with the audience. These discussions led to several cross-cutting insights but also opportunities for future discussions and research:

• One insight was that openness and collaboration are two different aspects of the OIS research framework, but they are intimately intertwined. While some of these connections are synergistic (e.g., open data facilitates collaborations between professional scientists and citizens), they may also be in conflict. In particular, patents may be seen as 'closed' in that they restrict the use of knowledge and act as a barrier to collaboration, but they may also create incentives that encourage some stakeholders to collaborate in the first place and to invest in downstream development. This issue created heated discussion among panelists and also the audience – suggesting that some assumptions about the role of patents, and the nature of incentives in industry-academia collaborations need further research, ideally integrating the perspectives of academics studying patenting and practitioners who design collaborations and incentive mechanisms.

• A second insight is that many arguments for or against certain practices seem to confound mechanisms that are theoretically distinct and may be managed differently. For example, openness of data and results may occur via mechanisms that are not peer-reviewed (e.g., preprint servers), but one might also think about open diffusion that still applies mechanisms of quality control. Similarly, many industry-academic collaborations involve patenting as an important aspect – but they do not have to. Some citizen science projects may include participants with little scientific background and may struggle with data quality – but other projects may find ways to train participants and achieve data quality exceeding that generated using traditional approaches.

• A third pervasive theme of the general discussion was the need to consider field differences. The benefits and tensions around OIS practices will differ across fields, and there will not be one-size fits-all solutions to address existing challenges. Among others, participants noted that fields differ dramatically with respect to what data are being used and produced, what kinds of stakeholders do and can contribute to research, and what the incentives – and costs – of open and collaborative practices are. Moreover, fields develop over time and are shaped by a range of internal and external institutions such that static studies need to be complemented by dynamic and historical perspectives.

• An interesting observation regarding the discussion itself was that many arguments were made based on specific cases or personal experiences – be it costs and rewards of data generation, the risk of being scooped, or the incentives for certain types of collaborations. These cases and experiences provided powerful illustrations, but participants also challenged the generality and empirical prevalence of such cases. Thus, the debate highlighted the need to use a variety of research approaches to understand the role of OIS practices, including cases that serve as existence statements and allow deep qualitative insights but also larger scale empirical evidence as well as methods that allow for greater causal identification. The diversity of methods represented on the panel, among the audience, and in the papers presented at this year's OIS Research Conference is promising in that respect.

• Finally, the discussion pointed out that science is not just 'there' to be studied, but that human-made institutions are shaping science, while also being shaped by what happens on the ground. As such, the benefits and tensions of OIS practices should be understood in light of context-specific institutional features such as reward systems, funding mechanisms, as well as the expectations of policy makers and various stakeholders. Moreover, science is not unique in that respect, and many of the issues we discussed also arise in other contexts, such as open source software development. Social scientists seem well equipped to study these social and institutional aspects and can build on insights gained in other contexts to better understand tensions and devise potential solutions. The debate, as well as many engaged discussions during the paper sessions and coffee breaks of the entire OIS Research Conference 2023 illustrated the potential for such research. At the same time, they highlighted the benefits of bridging different disciplinary perspectives, and to bring together scholars and practitioners of science, illustrating just another way in which this conference 'walks the talk' of open and collaborative science.

The video of the entire OIS Debate is available here:
https://www.youtube.com/watch?v=wR7pngY-QYo

CONCLUSION AND OUTLOOK

The OIS Research Conference 2023 focussed on 'Synergies and tensions around impact: how does OIS come into play?', emphazising the importance of further exploring the transformative possibilities of open and collaborative research practices, while also highlighting the complexities and tensions inherent in this realm.

The conference shed light on the dual nature of OIS practices. On one hand, they have the potential to enhance scientific and societal impact by promoting greater productivity, inclusivity, responsiveness, and effectiveness in scientific endeavors. On the other hand, embracing openness and collaboration exposes the intricate interplay of societal expectations, institutional norms, and individual motivations that shape scientific practices.

The OIS Experiment and Debate sessions provided valuable platforms for examining the boundary conditions that influence the transformative potential of OIS. These discussions underscored the capacity of OIS to bridge the gap between scientific and societal impact. Simultaneously, they highlighted the challenges associated with aligning scientific processes with societal needs, integrating broader societal considerations into research, and effectively communicating scientific findings to diverse audiences. It became evident that a nuanced understanding of field-specific dynamics, institutional mechanisms, and stakeholder expectations is crucial for maximizing the effectiveness of OIS practices. This recognition calls for a holistic approach to comprehending and studying the multifaceted contingencies of OIS.

In conclusion, the OIS Research Conference 2023 provided a stimulating exploration of the influence of openness and collaboration on the synergies and tensions surrounding scientific and societal impact. The OIS Experiment offered diverse perspectives through in-depth assessments of the scientific and societal impact of published articles in the medical and health sciences, varying in their utilization of OIS practices. The OIS Debate highlighted the complexities inherent in openness and collaboration, emphasized the significance of considering field-specific differences, and emphasized the need for diverse research approaches to comprehend the role of OIS practices. Moving forward, the insights garnered from this conference will serve as valuable inspiration, guiding us as we navigate the intricate landscape of OIS and strive to harness its full potential for the advancement of science and society.

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