OPEN INNOVATION IN SCIENCE

OIS research conference

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May 8–10

Vienna, Austria

Welcome to the Open Innovation in Science (OIS) Research Conference 2023!

The events of recent years have made it clear that humanity must learn to deal with multiple and increasingly complex challenges. Scientific research plays a central role in meeting these challenges. A recent report by the World Health Organization, presented at the 33rd European Congress of Clinical Microbiology & Infectious Diseases in Copenhagen, for example, shows that coronavirus vaccinations have saved more than a million lives in Europe and former Soviet Union countries. At the same time, science skepticism is increasing in many countries, societal actors are questioning the value and legitimacy of science, and many citizens lack a personal connection to science or simply do not care. A recent study by the Austrian Academy of Sciences, for example, shows that roughly 30% of Austrians have little trust in science and even more (37%) prefer to rely on common sense rather than science. The lower the income of the respondents, the weaker the trust in science and scientific researchers: A full 60% of people from financially weak households even have little or no trust in science.

Are science and society more disconnected than ever? How can scientists ensure societal impact, measure it, and convey it to the broader public?

Questions such as these are central to this year's conference, which seeks to explore "Synergies and tensions around impact: How does OIS come into play?" We will critically reflect upon the influence of openness and collaboration on achieving scientific and societal impact – whether OIS practices promote societal impact at the expense of scientific productivity, whether they help us achieve both and, if so, under what conditions.

The Open Innovation in Science (OIS) research framework developed at the very first OIS Research Conference in Vienna provides a useful backdrop for our discussions. Among others, it highlights different mechanisms of openness and collaboration as a means to increasing both the scientific and the societal impact of scientific research. This includes widely accepted mechanisms such as science communication efforts and open sharing of data and results. More interestingly, there may be great promise of practices that are at the "frontier" of openness and collaboration, such as co-creation with citizens. However, the OIS framework we developed was meant as an agenda for future research rather than a statement of findings. As such, it remains unclear whether and how OIS practices can actually yield synergies between scientific and societal impact. And we still know little about potential tensions or trade-offs that need to be taken into account when deciding whether, and how, to implement open and collaborative practices to achieve societal impact.

Keeping the special conference theme in mind, we hope that the OIS Research Conference 2023 will build on the success of prior editions by:

- Inspiring discussions around an integrated and contingent view on the role and value of openness and collaboration in science,
- Connecting researchers across various disciplines and engaging them in collaboratively progressing the field, and
- Linking different streams of research on open and collaborative science and science-based innovation.

In addition to inspiring research paper sessions and projects applying OIS practices, this year's OIS Research Conference features a variety of interactive sessions dedicated to the special conference theme on "Synergies and Tensions around Impact", including a Keynote Speech to kick-off the conference, and an OIS Debate co-sponsored by the Academy of Management TIM Division. Finally yet importantly, we will continue the tradition of "walking the talk" in an OIS Experimentation Session.

Thank you for joining the conference. We look forward to working with you to develop a better understanding of the processes, effects, and boundary conditions of open and collaborative approaches in science. And to having fun and building our OIS community along the way.

Welcome to Vienna!
The Organizing Committee

The Organizing Committee

MARION POETZ

Scientific Director &
Associate Professor

LBG OIS Center &
Copenhagen Business School

SUSANNE BECK

Senior Post-doc &
Conference Coordinator

LBG OIS Center &
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European School of Management
and Technology Berlin

CHRISTOPH GRIMPE

Professor

Copenhagen Business School

Conference Organizational Support

BARBARA KONTUREK

BENJAMIN BUSSER

Contents

Keynote
by Matt Marx
May 8 | 12:30 – 14:00

Matt Marx

- Matt is the Bruce F. Failing, Sr. Chair in Entrepreneurship and Professor of Management & Organizations in the Dyson School of Applied Economics & Management at the SC Johnson College of Business at Cornell University.
- He is also a Research Associate at the National Bureau of Economic Research, an Associate Editor at Management Science, a Steering Committee member for the Innovation Information Initiative, curator of relianceonscience.org, and the Faculty Director of Entrepreneurship@Cornell.
- His research focuses on reducing barriers to the commercialization of science and technology, and as part of the Innovation Information Initiative steering committee he curates large-scale, open datasets for the scientific commons.
- His articles have appeared in a number of prominent journals, including Management Science, the Review of Financial Studies, Organization Science, the American Sociological Review, and Science, and has also been featured in the New York Times, BBC, The Economist, Washington Post, Boston Globe, The Atlantic, Wired, Fortune, Forbes, and Bloomberg. His work on employee non-compete agreements and job mobility has played a key role in policy reforms in Hawaii and Massachusetts.

OIS Experimentation Session:
Explore how OIS practices affect the synergies and tensions around scientific and societal impact

May 9 | 11:00 – 13:00

Each year, participants of the OIS Research Conference are given the opportunity to experiment with and reflect upon novel approaches to incorporating open and collaborative practices related to the special conference theme. This year, we focus on investigating how OIS practices affect the synergies and tensions around scientific and societal impact.

As OIS advocates the importance of taking a contingent view on openness and collaboration in science, and with novel disruptive digital technologies at hand, scholars are increasingly able to investigate when and under what condition OIS practices may contribute to increasing scientific productivity and (or) societal impact. By engaging in this OIS experiment, we hope to inspire fruitful discussions among participants and spark further research ideas related to the way we think about impact in science, the role of OIS and how we can better understand and measure the impact effects of openness and collaboration in science.

OIS Debate (co-sponsored with AOM TIM Division):
Synergies and tensions around impact: How does Open Innovation in Science come into play?

May 9 | 14:00 – 15:30

Moderator: Henry Sauermann

Panelists

Michaël Bikard

- Michaël is an Associate Professor in the Strategy department at INSEAD.
- He currently serves as a Senior Editor at Organization Science.
- His research and teaching focus on the emergence and spread of new ideas. In his research, he often takes advantage of "natural experiments." For example, he has developed a new method that uses simultaneous discoveries in science in order to conduct the first "twin studies" of new ideas.
- His work has been published in leading management journals including Administrative Science Quarterly, Management Science, Organization Science, and the Strategic Management Journal. His research has also received a number of awards, including first place in the MIT Sloan Doctoral Research Forum, the MIT Energy Fellowship, the Kauffman Dissertation Fellowship, the J. Robert Beyster Fellowship, and an NSF SBE Doctoral Dissertation Research Improvement Grant.

Aled Edwards

- Aled is the founder and Chief Executive of the Structural Genomics Consortium (SGC), Professor of Medical Genetics and Medical Biophysics at the University of Toronto, and an Adjunct Professor at McGill University.
- The SGC is interested in uncovering functions for all the "lesser-studied" human proteins, particularly those that might be targets for new drugs, and uses open science as the mechanism to partner with industry in this effort.
- The SGC outputs include a range of research tools that are made available to the research community without restrictions on use, over 2,000 peer-reviewed research papers, and over 4,500 structures into the Protein Data Bank. More than 80 clinical trials have been launched based on SGC-enabled discoveries.
- Aled has founded many companies, one of which developed a novel antibiotic (afabicin) currently in late-stage clinical trials, and another of which (M4K Pharma) is the first pharmaceutical company formed explicitly to use an open science model to invent new and affordably priced medicines for pediatric cancers.

Dilek Fraisl

- Dilek is a Research Scholar in the Novel Data Ecosystems for Sustainability (NODES) Research Group of the International Institute for Applied Systems Analysis (IIASA).
- She is also the Managing Director of the Citizen Science Global Partnership and a Consultant at the United Nations Development Program Oslo Governance Center.
- Dilek has a PhD in Sustainability Transitions, and her research interests are sustainable development, data and statistics, Earth Observation, and citizen science as theory, practice, and evidence-base for policy development. She has worked in the areas of data governance and data management, including research on citizen science data quality. She has led and contributed to citizen science projects related to marine litter, land use, and land cover, as well as other environmental issues funded by the European Commission, UN agencies, and other donors.
- She has several board memberships with scientific communities, the UN, and other global initiatives, including the UN Sustainable Development Solutions Network Thematic Research Network on Data and Statistics (SDSN TReNDS), the UN Framework Convention on Climate Change (UNFCCC) Resilience Frontiers, the Group on Earth Observations (GEO), and the UN Statistics Division (UNSD) Citizen Data Expert Group, among others. She is also involved in the organizing committees and scientific advisory boards of several European and global conferences including the UN World Data Forum.

Michelle Gittelman

- Michelle is an Associate Professor in the Management & Global Business Department at Rutgers Business School in New Brunswick-Newark, New Jersey.
- Her research focuses on institutions supporting innovation in the biopharmaceutical industry, and the use of bibliometric data to measure innovative and scientific activity.
- Recent work has examined the impact of the genomics paradigm on drug discovery strategies and patenting behavior.
- Her work has been published in Management Science, Organization Science, Research Policy, and Review of Economics and Statistics, among others.

Paper 1:
The impact of CIFAR databases on the development of deep learning: The making of a new technoscience

Daniel Souza, Aldo Geuna, Jeff Rodríguez

Artificial Intelligence (AI) technologies promise to revolutionize knowledge production. At the core of one of the most important approaches to AI is a series of Machine Learning techniques known as Deep Learning (DL). DL has been regarded as a new method of invention and potentially a general-purpose technology in which the next industrial revolution may be based. Although a growing literature has studied the impact of DL in the knowledge production process, little attention has been given to its inception and the institutional context in which DL has emerged as a field of study.

This paper analyses the emergence of deep learning as a technoscientific field, that is, a domain in the middle of scientific enquiry and technical problem-solving. More specifically, it examines the role played by open and freely available labelled datasets (CIFAR-10 and CIFAR-100) and the funding institute that supported the birth and growth of deep learning, the Canadian Institute for Advanced Research (CIFAR). Our analysis includes both qualitative and quantitative elements. We perform a literature review to better understand the nature and development of CIFAR as an important institution in the Canadian innovation system, and in particular the evolution of the work on AI through different stages. The literature review has been complemented with semi-structured interviews with relevant actors, including prominent academics working on the field of AI and DL, as well as CIFAR personnel linked directly or indirectly to the creation of CIFAR-10/CIFAR-100. Two kinds of interviews were conducted: general interviews with academics working on AI, not necessarily related to CIFAR datasets, with the aim of getting an understanding of the field and some general features that practitioners might look for in a training dataset; and more specific interviews with strategic individuals that were directly or indirectly related to the development of the CIFAR datasets. In total we conducted seven interviews, out of which two were with field experts not linked to CIFAR, and five with persons linked to CIFAR. Finally, to better understand the reasons behind the continuous use of CIFAR-10/CIFAR-100, a survey was developed using the Qualtrics platform and distributed to academics and practitioners who have used those datasets in their work. To find those who have used CIFAR datasets, a query was conducted using the Scopus database by Elsevier to find papers that contained CIFAR-10 or CIFAR-100 in their titles, abstracts or keywords. A total of 5,267 papers were identified in that search. Then, the authors of each paper were identified and individualized, to finally retrieve the email of the corresponding author. A total of 2,535 different emails were collected. The collected papers are then used in a bibliometric analysis focused on citations. We find that the open access CIFAR datasets were fundamental for the developments which lead to the DL revolution and still shape the trajectory of the field. We also show that CIFAR datasets are still relevant in the scientific production of developing countries, given its easy accessibility and low computational requirements.

Paper 2:
Adaptive design in the clinical research: Opportunities and challenges to improve the information's accessibility and transparency of the reporting

Andriy Krendyukov, Marc Lerchenmueller

Openness in pharmaceutical innovation has become a legal requirement in many constituencies. Drugs usually get tested in probands for clinical safety and efficacy in a highly regulated process, termed clinical trials, before marketing. Since 2007, there exists a US federal law that demands that drug developers report results from clinical trials on a publicly accessible database, clinicaltrials.gov, which has become the de facto information gold standard on clinical trials for all industry stakeholders.

Apart from ethical arguments underpinning mandated openness, researchers argue there should also be an economic incentive for open reporting. There is much evidence of a productivity crisis in drug development. Estimates suggest that the industry has cut its internal rate of return on R&D in half, dropping from about 15% to less than 8%, which would be lower than the long-term WACC. Although some of this decline simply reflects increasing costs, returns get depressed by exuberantly high failure rates. Only 1 out of 12 drug candidates entering clinical trials eventually reaches patients. Greater openness on clinical trial results would enable faster failure and reduce duplication of efforts to increase R&D efficiency to the benefits of corporations and patients.

Recent research, however, calls this narrative into question, indicating that firms may perceive the benefits from deterring competition exceed the benefits from sharing result information about clinical trials. Meanwhile, the regulatory agencies appear reluctant to strictly enforce openness, perhaps partly to not discourage needed innovation. Instead, leading agencies have issued research calls for innovative approaches to increasing transparency in pharmaceutical R&D, including the USFDA and the European Commission.

With this paper, we heed these calls and propose shifting the focus for openness from reporting results to reporting design choices for clinical trials. Specifically, randomized controlled trials (RCTs) have long been recognized as the gold standard for assessing the therapeutic effect of a new drug. Adaptive designs (AD) have been developed as an alternative to RCTs and have been endorsed by leading regulatory agencies with the promise to accelerate drug development. ADs are defined as a set of clinical trials that allow prospectively planned modifications to one or more aspects of the design based on accumulating data from subjects in the trial. During a clinical trial, information is amassed that was not available at the outset, reducing uncertainty, for example, about optimal dosing or duration of treatment. ADs take advantage of this information by allowing predefined adaptations to key parameters without undermining the integrity and validity of the results. Although endorsed, the uptake of ADs has been slow as organizations need to learn about ADs and the lack of openness on procedural choices constraints more widespread implementation.

To assess the potential benefits of ADs for bringing more treatments more efficiently, we focus on oncology drug R&D for three reasons. This market is the largest in terms of spending and cancer is the second leading cause of death. Finally, cancer treatments have provided a tractable way to measure R&D activity and will therefore allow benchmarking ADs against traditional designs.

Paper 3:
Navigating openness in AI breakthroughs: The case of AlphaFold

Angelo Kenneth Romasanta, Jonathan Wareham, Laia Pujol Priego

Artificial intelligence (AI) has become an increasingly important technology for accelerating research workflows and generating new knowledge. Due to the computational infrastructure and large datasets needed to train these models, many significant breakthroughs in AI have come from large tech corporations such as Google and Meta or organizations closely affiliated with them like OpenAI (funded by Microsoft). Consequently, uncertainty about the future openness of these technologies has been a concern to the scientific community. In response, our study aims to understand how researchers can use, refine, and build on these AI advances brought by large industrial players. Our study explores the processes they employ to go around barriers in openness, enabling them to truly realize AI's potential in science.

To study this evolving landscape of openness in AI, we explore AlphaFold, a breakthrough by Google DeepMind for predicting the structure of proteins. Determining how proteins fold in 3D space is critical in understanding biological functions and the mechanisms underlying diseases. Before AlphaFold, elucidating one structure would often take one Ph.D. student five years, with high chances of failure. To stimulate advances in the field, since 1994 structural biologists have been holding a biennial competition called Critical Assessment of Techniques for Protein Structure Prediction (CASP), where different research groups can put forward their best models in protein structure prediction. In its 14th edition in 2020, AlphaFold blew away its competition, leading many commentators to proclaim that the protein folding problem has essentially been solved. AlphaFold has been considered one of the biggest advances not only in AI and but also in science in general, serving as a springboard for new biological breakthroughs and therapeutics.

Exceeding further the expectations of the scientific community, DeepMind decided to release its code in public, enabling researchers to apply it to various protein targets. However, only the inference code to predict structures was made available. "In spite of its outstanding utility, the official AlphaFold2 implementation omits code for the model's complex training procedure as well as the computationally expensive training data required to run it" (Ahdritz et al., 2022). This opacity has made it difficult to understand the model's learning behavior and create novel variants for new applications.

To study how researchers get around these barriers, the authors attended the CASP competition in 2022 and analyzed the submissions by the research teams. We found that most research teams have incorporated AlphaFold in their models, extending it in different ways to advance their knowledge of proteins. We propose distinct configurations of scientists' processes to address inadequate transparency. Additionally, we also advance theoretical insights to make sense of the evolving landscape of openness in AI models.

This study has important managerial implications for both the research community and policymakers. For the scientific community, it offers insights into how scientists adapt to the advances in AI despite resource constraints and reflects on how researchers can quickly adapt to new breakthroughs to augment their research workflows. This study also informs policymakers on how scientific organizations can leverage AI technologies.

Paper 4:
Open science or entrenchment? The role of biological repositories on inter-institutional co-creation

Riold Furtuna, Carolin Haeussler, Fabian Hans, Samantha Zyontz

Access to research inputs has become more important as science, due to its growing complexity, requires a recombination of specialized skills, knowledge, or tools (e.g., Haeussler & Sauermann, 2020). As a result, growing collaborative and sharing networks spanning institutional boundaries emerge, but these networks can often become entrenched over time (e.g., Wuchty et al., 2008; Jones et al., 2008; McFarland & Dahlander, 2014; Catalini, 2018). Open science, however, has the potential to spur new channels, such as biological repositories, that facilitate sharing of skills, knowledge, or research tools. Generally, biological repositories perform an important certification and quality control process, prior to distributing research materials, including related information, to ordering research institutions worldwide (Furman & Stern, 2011).

Previous research has primarily focused on the impact of biological repositories on measures such as citations or overall publication rates (e.g., Furman & Stern, 2011). However, it has, to our knowledge, overlooked the potential effects of these sharing platforms on the dynamics of collaborative networks and the emergence of new inter-institutional co-creation patterns. To address this research gap, we build on a unique data set on the DNA-editing technology CRISPR by combining publication data from Microsoft Academic and sharing data from Addgene, a key biological repository for CRISPR-plasmid sharing (Kamens, 2014). We empirically investigate how the use of Addgene influences inter-institutional co-creation, defined as co-authored publications, by applying descriptive (diff-in-diff) regression and network analysis at an institutional level.

So far, our results indicate that Addgene plays a significant role in increasing overall scientific output, in terms of published papers, potentially by democratizing access to scientific tools. On the other hand, institutions that do not use Addgene seem to engage in more collaborative research and with a greater number of partners per paper, potentially attributable to the lower availability of tools and skills within these institutions (Zyontz, 2019) and, thus, their need to access them through collaboration with other institutions. Nonetheless, graphical network analysis has indicated that Addgene-using institutions dominate the initial network of pioneers. While the share of CRISPR-publishing institutions using Addgene decreases over time, they remain central to their network position.

When accounting for status, Addgene-using institutions, which have higher institutional status, co-create predominantly with institutions of more similar status, hinting to a potential entrenchment of high-ranking academic research institutions. We continue our analysis by stratifying Addgene users into depositors and orderers. First, we observe that depositors create more than orderers but co-create less than ordering institutions. Additionally, depositors have higher status and co-create with more closely ranked institutions, indicating a further entrenchment within high-ranking institutions. The centrality effect, previously mentioned, is particularly strong for depositors.

With this study, we contribute to the science in science (e.g., Wuchty et al., 2007; Jones et al., 2008) and Open Science literature (e.g., Mukherjee & Stern, 2009), and would like to continue doing so by advancing our network and difference-in-difference analyses. By doing so, we hope to gain a deeper understanding of how the use of Addgene, and institutional status, affect entrenchment and co-creation.

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Paper 5:
The influence of academic engagement on scientific knowledge production: Driving productivity or impact?

Carolin Nast, Pablo D'Este, Oscar Llopis, Dima Yankova

In recent years there has been an increasing call from science policy to encourage interaction between academics and non-academic actors in research activities in order to better align research priorities and societal challenges. Despite the rising consensus on the societal benefits of research involving greater academic and public engagement, it is still an open debate whether greater interaction drives or compromises fundamental scientific advances.

This paper explores to what extent academic engagement contributes to scientific performance in terms of productivity and impact. We hypothesize that academic engagement benefits research activities by enabling exposure to broader research questions and the mobilization of greater tangible and intangible resources from diverse stakeholders. We test our propositions by considering different interaction mechanisms of academic engagement: we differentiate between knowledge exchange mechanisms (e.g., joint research) and knowledge transfer mechanisms (e.g., consultancy and contract research).

We test our hypothesis using a large-scale survey of 11,992 scientists affiliated with Spanish public research organizations and universities from all fields of science in 2016. We measure scientific performance based on the number of scientific publications (productivity) and the number of top-cited papers (impact). Our results indicate that academic engagement is beneficial for scientific performance overall. However, we find that engaging through knowledge exchange is particularly associated with scientific impact, while engaging through knowledge transfer is associated with productivity. Our results have implications for universities and academics regarding third-mission activities.

Paper 6:
Taming the paper trail?
How AI helps assess science impact beyond citations

Andreas P. Distel, Christoph Grimpe, Sven J. Koerner,
Mathias Landhäußer, Marion Poetz

Do citations to academic research in practice documents reliably measure scientific impact? Based on a sample of scientific articles and clinical practice guidelines in diabetes, we run and validate an AI-supported text analysis that reveals biases in science impact assessments. Research may have been cited but not used, or it may have been used but not cited. Our findings suggest that guidelines build legitimacy by making reference to highly cited research without actually using it, while other research has a hidden impact as it has not been appropriately cited. These cases are frequent, questioning the reliability of citation links to assess impact.

Paper 7:
Organizing co-creation: Structures and practices that nurture open innovation in science

Ariadne Avkıran, Sarah R. Davies

Recent years have seen calls for research to be better embedded in society in various ways, from the need for public communication to the responsible research and innovation agenda or open science. Drawing these discussions together, open innovation in science (OIS) argues for "purposively enabling, initiating, and managing inbound, outbound, and coupled knowledge flows and (inter/transdisciplinary) collaboration across organizational and disciplinary boundaries and along all stages of the scientific research process" (Beck et al., 2022). In this paper we follow one project inspired by OIS principles to explore what it means to organize and implement OIS, and the kind of impacts it is able to have. Specifically, we ask how organizational design is able to support (or constrain) open and collaborative research approaches.

The case we examine uses co-creation to facilitate new interactions between university research, civil society, and the arts. The paper builds on an ethnographic study that explores this instance of co-creation, using interviews, document analysis, participant observation, and autoethnographic methods. Our central findings are threefold. First, we document how the project is able to empower citizens and experts by experience to develop research questions, apply their own expertise, and reflect on their envisioned impact. We therefore present the project as one successful instance of OIS. Second, we describe the organizational practices that were necessary to achieve these successes, describing how flat hierarchies, flexible administrative and project planning practices, reflexivity, and the ability of key actors to 'translate' across different domains were necessary to foster a mutual understanding of co-creation. Third, we also describe tensions around the nature of scientific productivity that emerged within the project. While knowledge is certainly being generated, and societal impacts are starting to emerge, this is not readily captured through metrics such as publications or citations. We therefore argue that OIS requires new definitions and ways of documenting scientific productivity, as well as specific forms of institutionalization.

Paper 8:
Scientific and social impact of scholarly research: Substitutes or complements?

Gernot Pruschak

Many governmental agencies and higher education institutions actively advocate for open and collaborative approaches to increase societal outreach and impact of scholarly research. Yet "editors of prestigious journals with high impact factors may have few, if any, incentives for changing their systems" (Banks et al., 2022: 265) towards becoming more open. We follow up on this conundrum by investigating whether scholars perceive scientific impact and social impact as substitutes or compliments in the publishing process.

In the context of open and collaborative research practices, we turn to open access publishing because it constitutes an already widespread practice in the academic community. More specifically, we assess scholars' perceptions of the scientific and social impact of their publications divided among different types of open access publishing (non-open access [closed], hybrid open access, and gold open access journals). Hereby, this study employs data gathered through an interdisciplinary survey among scientists identified through corresponding author contact details in articles published between 2017 and 2022 in 90 open access journals. In total, 446 researchers responded to the survey, of which 235 were eligible for inclusion in this study.

We find that scholars perceive that their articles published in closed and hybrid open access journals possess significantly higher scientific than social impact. In turn, we fail to identify a significant difference for articles published in gold open access journals. The study further shows that scholars perceive that their articles in hybrid and in gold open access journals generated more scientific and social impact than their articles in closed journals. We further analyze these results by investigating the antecedents of the perceived scientific and social impact of published articles. The results show that life scientists and social scientists assess the scientific impact of their publications in closed access journals significantly higher than their colleagues. European scholars assess the scientific impact of their articles significantly higher across all journal types. In addition, European scholars, as well as more experienced scholars, perceive significantly higher levels of social impact for their publications in hybrid as well as gold open access journals. We corroborate our results through employing scholars' perceptions of scientific and social impact of the respective journal types.

Our results provide direct implications for journal editors, publishers, and funders by showing that scientific and social impact do not automatically come together. Yet strengthening existing and implementing new initiatives aiming at increasing open access publishing could prove worthy in raising not only the scientific but also the social impact of scientific research. From a literature perspective, we add to the extensive debate about the effects of open access publishing on scientific and social impact. Hereby, our study demonstrates that these effects do not only occur out of bibliometric analyses but are also manifested in scholars' mindsets. Future research could therefore investigate whether these manifestations can shift scholarly publishing behavior towards aiming not only at scientific but also at social impact.

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Paper 9:
Creativity inside the box: How self-imposing and overloading constraints can enhance highly constrained innovation processes

Hila Lifshitz-Assaf, Steven Randazzo, Olivia Jung

There is a growing need to innovate under highly constrained conditions, whereby creativity inside the box is essential. In this study, we investigate Massachusetts General Hospital's "mission impossible," an initiative to design new, affordable, and open-sourced ventilators at a breakneck speed (75 days) to respond to the COVID-19-induced global ventilator shortage problem. We examine the innovation processes of seven projects aiming to accomplish that mission and find that how project participants dealt with the surfeit of constraints ("constraints work") was critical to rapidly developing new medical devices. Four of the seven projects modularized and sequenced given constraints to reduce the complexity, following a sequentially-focused design process, as the literature would predict. These projects were able to produce working prototypes under the tight time frame. The other three projects approached the highly constrained innovation process very differently. They first conducted "extreme mapping" of all potential constraints. Then, they self-imposed and overloaded additional constraints from the productyping stage, on top of the given prototyping ones. This resulted in a concurrent-foci design process, in which participants repeatedly cognitively switched focus between multiple constraints. While this process created a cognitive overload and increased complexity, it also directed their creative efforts towards resolving the tensions between constraints. These projects produced not only working but also rapidly deployable prototypes that surpassed experts' expectations, accomplishing the impossible mission. This study illustrates the importance of "constraints work" within the new product development process and deepens our understanding of highly constrained innovation processes.

Paper 10:
Open innovation at big science centers: A business model perspective

Saïd Yami, Ravi Madhavan, Markus Nordberg

The orienting question of the Open Innovation in Science (OIS) Research Conference 2023 is how OIS comes into play, highlighting the ecosystems and organizational designs that help or hinder OIS practices. Big Science Centers (BSC) are an especially interesting organizational context in which to explore such a question. Accordingly, we present an ongoing inductive study of an open innovation initiative at CERN (Geneva), IdeaSquare, a platform for early-stage cross-disciplinary collaboration between students, scientists, other CERN personnel, and relevant organizations in a way that aligns and supports CERN's scientific mission but also goes beyond pure discovery to the future of the world (https://ideasquare.cern/who-we-are). More broadly, it serves as an organizational laboratory for innovation experiments within CERN. In doing so, IdeaSquare moves away from the relatively tightly-coupled nature of the BSC model to the porous boundaries and adaptive action characteristic of open innovation. In addition, IdeaSquare has become a platform and a venue for engaging with a variety of stakeholders (external collaborators and university students). Viewed simultaneously as an experiment in how to conduct big science in the new open innovation environment and as an exploration of new ways to demonstrate the value of basic research to stakeholders, IdeaSquare illustrates one way in which OIS practices are influencing the BSC.

Seeking to understand the evolution of IdeaSquare within CERN, we conducted interviews with IdeaSquare staff and collaborators, as well as with scientists, engineers, and research managers from the more traditional core of CERN. In analyzing the qualitative data we adopt a business model lens, leveraging its ability to concretely describe the resources, competences, organization, and value proposition elements that constitute the way in which an entity creates and captures value. At the theoretical level, we draw upon the literature on the process theories of strategy and micro-foundations, as they contribute to Business Model Innovation (BMI). Further, we conceptualize the BSC as a nexus of business models, with different units pursuing loosely related goals in ways that share common approaches but also differ in important respects. Thus, the acceptance of OIS in BSCs can be viewed as a BMI process of incorporating new resources (e.g., industry networks), competencies (e.g., collaboration), or organization designs (e.g., science accelerators) into the nexus of existing business models. We present early insights from the analysis and advance testable propositions to guide further study. Suggesting that BSCs pose an exemplary context in which to study the organizational manifestation of OIS practices, we propose that our early evidence of the diffusion of OIS in the BSC's nexus of business models holds valuable lessons for the influence of OIS on the organization of science and vice versa.

Paper 11:
Bread upon the waters: Corporate science and the benefits from follow-on public research

Dror Shvadron

Firms' scientific publications influence scientific inquiry at academic institutions. I study the benefits of external follow-on research for the originating firms' subsequent innovation outcomes. To account for the unobserved quality of the underlying science, I develop a novel instrumental variable that exploits the quasi-random assignment of accepted manuscripts into scientific journal issues. I find that follow-on research drives firms' subsequent scientific investments and patenting. It is used as an input and guides internal resource allocation. The benefits depend on the firm's competitive position, possession of complementary assets, and characteristics of the research field. I contribute to the understanding of firms' determinants for participating in public research.

Paper 12:
Archetypes of open science partnerships: Towards tailored functional models?

Maria-Theresa Norn, Laia Pujol Priego, Irene Ramos-Vielba, Thomas K. Ryan, Marie Louise Conradsen

In recent years, a handful of Open Science Partnerships (OSPs) have emerged around the world. These are precompetitive public-private research partnerships that adhere to principles of open science, which includes putting all research outputs into the public domain and precluding participants from seeking Intellectual Property (IP) rights protection. OSPs are presented as an alternative, or a supplement, to conventional IP-based collaboration models. They are typically aimed at addressing long-standing challenges associated with the patenting of early-stage basic research, mitigating barriers to university-industry collaboration, and accelerating/strengthening the uptake of scientific research outputs in industry and society. Thus, OSPs seem to offer a promising new avenue for knowledge generation and dissemination in a context of institutional adaptation to varied strategic goals and changing environments.

These partnerships have, however, been subject of insufficient scholarly attention. We argue that further study is necessary to better understand the nature and possible implications of OSPs. To that aim, we present the results of a cross-country comparative study of five OSPs within the biomedical research field – Open Targets, the Structural Genomics Consortium, Enabling & Unlocking Biology in the OPEN (EUbOPEN), the Early Drug Discovery Unit (EDDU) at McGill University, and the Open Discovery Innovation Network (ODIN) – which identifies similarities and differences across partnerships. The comparative analysis examines a wide range of configurations related to the organization, governance, funding and outputs of OSPs.

The comparison is initially based on desk research and semi-structured interviews to identify common features and relevant singularities across OSPs. Such characteristics are then contrasted with representatives of each OSP and further discussed in a participative workshop. Selected dimensions are systematized around two key dimensions: organizational attributes and openness implementation. The former includes observations related to the level of independence of the OSP, its decision making processes, the type and role of funding, the influence of industry, and the scope of research activities. The latter focuses on the degree of openness and its application in terms of entry into the consortium, the development of collaborative activities, characteristics of the intermediation, or the accessibility of outputs of the research collaboration. Grounded in the analysis of all these dimensions, we suggest potential archetypes of OSPs.

Our findings underline that despite fundamental similarities, OSPs are not a homogeneous phenomenon. On the contrary, the studied cases show important organizational variety according to specific context conditions and aims. Likewise, these partnerships also display multifaceted openness patterns. The OSP emerging phenomenon, therefore, would require more fine-grained approaches to further explore potential implications in the practice of research in domains where collaborative arrangements are usually shaped by IP and in the valorization of this change in knowledge exchange and technology transfer processes.

Our proposed archetypes are intended to serve as a managerial inspiration for the design of future OSPs, particularly for practitioners and funders, by fostering informed decisions about critical OSP goals and organizational arrangements. The article also offers suggestions for future research paths by taking a closer look at the different models for OSPs and their functionality.

Paper Session 4: Scientists' perspectives
May 9 | 09:00 – 10:30

Chair: Christoph Grimpe
Discussants: Carsten Bergenholtz & H.C. Kongsted

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Paper 13:
When does project feasibility drive technological innovation? Evaluator expertise range, architectural knowledge, and preferences for existing technologies

Jacqueline Ng Lane, Zoe Szajnfarber, Jason Crusan, Michael Menietti, Karim R. Lakhani

The creation of technological innovations draws on knowledge of both the components that comprise the system and architectural knowledge of how the components are interconnected into a holistic system. As technological innovations tend to draw on multiple domains of knowledge, an evaluator's degree of domain overlap with the problem area is likely to shape their perceptions of the design toward either a componential or systems view. Yet we know relatively little about how expertise range – or the degree of knowledge overlap between an evaluator's domain(s) of expertise and the knowledge domains embodied in the problem area – shapes an evaluator's perceptions of the design and the effects of their perceptions on preferences for more novel versus more feasible solutions. To examine these relationships, we partnered with NASA and Freelancer.com to design an evaluation challenge, where we recruited 374 evaluators from inside and outside the domains of aerospace and robotics design, to rate 101 unique solutions for a total of 3,850 evaluator-solution pairs. Our results show that univalent evaluators – with expertise in a single domain of the problem area – are more likely to prefer solutions that are higher in feasibility but lower in novelty, demonstrating a feasibility preference. This feasibility preference is attenuated when evaluators have multivalent expertise spanning both domains of the problem area. Topic modeling of the evaluators' open-text comments suggests that expertise range shapes how a design is perceived: whereas univalent expertise is associated with detailed assessments of a design's components, allowing for greater uncovering of a design's limitations, we find that multivalent expertise is associated with more holistic assessments of the design's overall functionality, resulting from evaluators' architectural knowledge of the holistic system. Our findings suggest that selecting evaluators with varying expertise range in the problem area can lead to decisions to allocate resources to more novel, risky ideas that favor less familiar, untested technologies.

Paper 14:
Shaping professional and social identity of scientists: An exploratory study on the value of capability building in open and collaborative science practices

Marion Poetz, Agnieszka Radziwon, Alexander Ruser

While increasingly discussed as a remedy for declining scientific productivity and as a means to addressing the grand challenges of our times, applying open and collaborative practices to science goes way beyond the standard skill set and training of the academic researcher. Most scientists have defined roles and were trained in the traditional ways on how to develop research questions, apply popular methods, and reach their peers through knowledge dissemination in conferences and journals; changing these routines and exploring completely new pathways can be quite challenging. Although engaging in open and collaborative science potentially increases quality, depth, and impact of scientific research, the deviation from the traditional practices within scientific communities may trigger a lack of peer-, journal-, and institutional- acceptance, along with professional identity confusion. Early-stage discussions and training may help researchers in developing new and non-traditional capabilities, and along with professional interactions such as 1) initiating dialog with potential partners outside the established contexts of scientific cooperation, 2) engaging stakeholders from different also non-academic backgrounds, and 3) communicating and co-creating scientific results, may reshape both the professional and the social of researchers.

To develop a better understanding of how such training interventions influence the professional and social identities of scientists against the backdrop of increasing demands for engaging in open and collaborative research, we conducted an exploratory individual-level impact study. The study builds on data from two independent training programs in Open Innovation in Science (OIS) in Germany and Austria with a total of 27 participating scientists. As part of these training programs, participants learned about open and collaborative practices to science and were encouraged to experiment with these practices in their own research. Data collected followed a mixed-method approach combining semi-structured interviews, ego network mapping, structured training observations, and surveys to cover the biographical and professional backgrounds of the participating scientists, as well as document analysis of motivation letters.

The findings indicate that the impact of such a training depends on distinct starting conditions and should be viewed in relation to the career stage of the respective scientists. Moreover, we found evidence suggesting that training can have a lasting impact on scientists' self-image and can provide a remedy for dissatisfactions of experienced scientists with the existing academic system. However, our exploration also shows that OIS training competes with more traditional expectations of scientists.

Overall, we find that OIS training has a positive impact on participants' professional networks as well as their understanding of what it means to be a scientist. Our findings can thus inform future theoretical debates about the organization of open and collaborative science and practical expectations of scientists regarding their professional roles and their relations with society.

Paper 15:
Academia and societal challenges: Analyzing scientists' perceptions and engagement channels

Martin Kalthaus

There is an increasing call for universities and researchers to help to address grand societal challenges. While researchers provide a substantial body of scientific work that helps to understand societal problems, solutions to these problems are provided only to a limited extent by academia. A detailed assessment of how researchers can and want to address these problems is missing. To provide some insights into this open question, I analyze how researchers perceive their research relevant to address grand societal challenges, in particular climate change, increasing inequality, and political polarization, and how they transfer their findings to society. Based on a survey of 643 scientists from the German state of Thuringia, I relate the scientists' perception of how their research can address these problems to the channels they use to transfer their results. In doing so, I use factor analysis and aggregate three conventional transfer channels for technology transfer and 12 ways to engage with society in general, e.g., via talks, media engagement, consulting, and other forms of engagement, to four groups of researchers. While the research is ongoing, the results can indicate how different types of researchers perceive the relevance of their research for addressing societal challenges and how this perception relates to the way they engage with society.

Paper 16:
Designing incentives for impactful university-industry linkages: Evidence from UK funding

Stefano H. Baruffaldi, Cornelia Lawson, Felicia Seitz

Open and collaborative practices have been emphasized as an important mechanism for scientific research to fulfill the dual goal of producing new knowledge and solving 'grand challenges' (Beck et al., 2022). Most studies in open innovation have examined how organizations develop and frame a problem statement and then search for problem solvers externally. In the context of academic research, this would correspond to problems being identified by scientists and solved with or without external collaborators. However, organizations and scientists can themselves become problem solvers for externally defined problems, such as those defined by funders, as is the case for targeted or 'managed' calls, which allow funders to direct the efforts of science teams and shape their research. These are usually offered in addition to standard open response calls which are aimed at investigator-initiated projects.

To improve our understanding of how targeted and standard research grants foster impactful research, this study seeks to examine to what extent these grants stimulate research. Building on insights from open innovation, we consider to what extent internal and external problem formulation, and open and closed problem solutions, contribute in the context of public research.

Using unique data on more than 2000 research grant applications submitted in 2007 to the Engineering and Physical Science Research Council (EPSRC), the largest public funding body in the UK, we estimate a regression discontinuity design (RDD) model that compares near-misses with near-wins. We differentiate between targeted and standard calls, with the former looking to guide the problem formulation and solving of applicants. We moreover compare project applications that involve industry partners to those without, against which they compete, to understand the added or lost benefit when a collaborative project team is funded over an academic-only team.

Our findings show that standard grants without industry collaboration produce the most highly cited research, while on the other side targeted grants with industry partners successfully shift research agendas and stimulate future collaborative research. This suggests complementarity between problem formulation and solution types, such that externally defined problems benefit from having external industry partners, while internally defined problems have the highest impact when solved by academic-only teams.

Paper 17:
Do funded research projects deviate from grant proposals, and does it matter?

Andres Madariaga Espinoza, Stijn Kelchtermans,
Cindy Lopes-Bento, Arvids A. Ziedonis

While most funding agencies require ex-post reporting on the results of funded projects, they typically do not require – nor do they verify – that the executed research closely follows the awarded proposal (Azoulay et al., 2020; Price, 2018). Under such conditions, there is potential for funded research to "deviate from the plan", either deliberately or due to unforeseen circumstances inherent to research (Franzoni et al., 2022; Nelson, 1959). Despite these concerns, there is little evidence on whether funded projects systematically deviate from proposals as well as a lack of theoretical framework of reasons why this may be the case.

We leverage language processing tools and econometric methods to investigate whether publication outcomes deviate from their proposals, disentangling different research- and team-related reasons for such deviations. Based on insights from the economics of science and recent literature on knowledge production in teams, we identify internal and external factors that make awardees deviate from proposals. On the one hand, internal reasons might reflect contingencies related to the team. We expect changes in team composition to be associated with the probability of deviating, since the entry or exit of a team member coincides with the addition or removal of knowledge that the team can draw on (Xu et al., 2022; Wu et al., 2019). On the other hand, external factors might reflect the inherent uncertainty of research. We expect that failure to produce valuable findings (Nelson, 1959) or being scooped away by other scientists in the discovery contest (Dasgupta & David, 1994; Stephan, 2015), induces awardees to deviate from their proposal.

Our measure of deviation is the inverse of the cosine similarity of a proposal and the publication outcome. Publications are linked to grants using the Dimensions database of Digital Science, which is primarily based on reports provided by funding agencies. Our sample consists of approx. 13000 publication-grant pairs linked to 1200 faculty from a major Belgian research university (2008-2017), for which we have access to detailed administrative data (such as age, rank, and department).

Initially, we will identify whether and to what extent internal and external factors correlate with deviations from proposals. Subsequently, we will assess the differences in citation impact for publications as a function of the deviation from the proposals. In this analysis, we also account for the antecedents of deviations – internal vs external – and the characteristics of team members, in order to understand which factors are associated with a higher likelihood of above-average impact or a higher variance in citations.

Identifying the reasons for deviations from grant proposals holds direct implications for both researchers and funding bodies. In particular, we show whether deviations are of concern, as deviations driven by serendipitous discoveries (Yaqub, 2018) might be associated with higher research impact. Furthermore, by illuminating the reasons for deviations and their ultimate scientific payoff, we provide input to the debate on the net benefit of the detailed evaluation of research proposals (Herbert et al., 2013).

Paper 18:
Science-based products and early-stage development speed: A configurational approach

Clio Dosi, Angelo Kenneth Romasanta, Jonathan Wareham

The successful transfer of scientific breakthroughs to industry is crucial to fueling economic growth and addressing societal challenges. To understand how to accelerate the development of science-based products (Muller, 2010; Markman et al., 2005), we employ a contingency approach comparing the speeds of these development projects. Our data is based on a longitudinal study of ATTRACT, an initiative aiming to harness technologies from Europe's scientific infrastructures. We collected a unique dataset targeting 170 low TRL science-based projects, coupled with interviews. We use QCA to explore the interactions of different constructs in the success of science-based product development.

Previous studies on the development of science-based products have mostly focused on later stages. For instance, success has been defined by commercialization outcomes (Battaglia, Paolucci, and Ughetto, 2021) like licensing and spin-offs. With longer timeframes, measures including follow-on inventions or patent citations have been used (i.e., Anckaert and Peeters, 2022; Vakili and Kaplan, 2021). By focusing on later stages, we miss crucial insights on these stages where the probabilities of failure are higher and researchers, aware of the long-term path in front of them, need to quickly validate the potential of their technology (Anckaert & Peeters, 2022).

Researchers face several challenges in science-based product development partnerships. First, they need to coordinate across actors coming from different organizations, disciplines and expertise (Criscuolo et al., 2018). Second, the effectiveness of their collaborations depends on the nature and origins of the knowledge, as well as the types of technologies being developed (e.g., modularity, complexity, market focus) (Vakili and Kaplan, 2021). Third, researchers may vary in their project management practices (e.g., loosely or strictly) and are affected by implementation constraints (Isaeva, Ooms, and Johansen, 2022).

While these factors have been correlated with various success outcomes, the speed by which these outcomes are met has not been much studied. Speed is difficult to conceptualize in science-based products and extant studies predominantly focus on entrepreneurial action, exploring companies during their gestation speed (Mauer, Nieschke, and Sarasvathy, 2021) or after their founding year (Miozzo and DiVito, 2016). Filling this gap, we explore the elements that drive science-based product development speed.

The setting for this study is ATTRACT, an initiative funded by the European Commission to stimulate the transfer of technologies from scientific infrastructures. The initiative funded 170 projects with 100,000 EUR each to create a proof-of-concept. We collected data in 2 periods (at the beginning and end of the POC development) through documental analysis, and we administered surveys to understand the nature of their partnership, technology, and project management.

Our study identifies unique configurations of factors that enable the rapid development of science-based products. We conducted interviews with a subset of the project teams to validate and deepen our findings.

Our study provides insights into how research teams can accelerate their TRL development, leveraging elements under their control (e.g., partnerships or management choices) and ultimately realizing the impact of fragile early-stage science-based products.

Paper 19:
Co-publishing between science and industry and its relevance for inventions

Indira Yarullina, Frédérique Bone

The relationship between science and technology has been widely discussed for many decades. Basic research provides a foundation for potential technological applications, following the 'linear model' of the innovation process. The innovation process in its simple form consists of an invention, innovation and diffusion phase (Bush, 1945). Initially, new knowledge is generated in the invention phase and then, in the innovation phase, an economic application is derived which results in new products or processes that diffuse into an application. Many examples show that even very basic knowledge developed in academia later finds its application in industry (Ahmadpoor and Jones, 2017). At the same time, many observers argue that basic research rarely pays off in practical application or that practical advances typically proceed without any inspiration from basic research (e.g., Von Hippel, 2007).

Therefore, scholars try to approach the mechanisms of knowledge diffusion. Citations are widely discussed by scholars as a measure of knowledge flow. Jaffe et al. (1993) first empirically tested the concept by using patent-patent citations as a proxy for knowledge diffusion. Ahmadpoor and Jones (2017) found that most cited research articles (80%) link forward to a future patent and that most patents (61%) link backwards to a prior research article. The value of patents that refer to scientific publications is higher than or equal to that of patents without scientific references (Poege et al., 2019).

While the non-patent literature cited in patents is a well-recognized indicator of the link between science and technology, there is still room to understand the underlying relationships. Thus, in this paper we want to investigate what characteristics of public research make it more transferable to economic application. In particular, we want to test if firm involvement in a publication makes that particular publication more attractive for further economic application – namely, more relevant for patents.

To approach the research objectives, we use both publication data and patent data. Publication data capture the produced knowledge, while patent data capture the technology and potential economic value of technology. The non-patent literature citation captures the link between the produced knowledge (publication) and the application of this knowledge (patents). In order to connect publications with patents we use research results by Marx and Fuegi (2020, 2021). Their findings contain information on the link between both front-page and in-text citations from patents to scientific articles through 2020. After, we apply a microeconometric approach to understand the effect of having a co-author from a firm included on a publication has on the likelihood of this publication being cited further by a patent.

Patent citations are often used as a measure of knowledge flow, although scholars have consistently discussed that citations do not fully capture knowledge diffusion for firm innovation (Roach and Cohen, 2012). With this study, we want to contribute to knowledge transfer studies by exploring the relationships underlying the knowledge diffusion process. Moreover, this paper can provide a greater understanding of the knowledge transfer process for researchers, companies, policymakers and funding agencies involved and provide inputs regarding the characteristics of more transferable public science.

Paper 20:
Bounded exploration in local innovation system: The effects of local industry on academic scientists' research trajectories

Eunhee Sohn

Prior research has revealed that the research productivity and trajectory of academic scientists are influenced by their local social and economic context, but we understand little about the relationship between individual academics and their local industry environment. In this paper, I argue that the effect of local industry environment on individual research output is shaped by the strength of geographical constraints and tenure norms that academic researchers are subject to. Thus, I predict that the local industry environment stimulates more commercial and applied research by academic scientists, and this effect is more salient for researchers that are subject to less geographical constraints or less pressure for tenure. The analysis of a matched sample of plant biologists engaged in agricultural biotechnology research provides support for this argument. Being located within 50 miles of a major industry R&D headquarters increases the commercial and applied research output of academic scientists as compared to their non-industry colocated controls. This increase is primarily driven by less productive, female, and late-career academic researchers, whose research activity is more geographically bounded and who are less likely to switch institutions. Consistent with the proposition that a local industry environment provides a low-cost opportunity for exploration, I find suggestive evidence that local industry collaborations induce researchers to explore new research areas.

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Paper 21:
Co-designing interdisciplinary research projects: The sensemaking process in problem-team designs

Olga Kokshagina

Researchers become interested in inter-organizational strategizing and collaborative processes of strategy formulation and implementation. Organizations engage in inter-organizational collaborations when faced with problems that exceed their individual sensemaking capacities. Sensemaking refers to the process through which people attempt to understand issues or events that are somehow surprising or confusing. This process is typically a collective endeavor involving several people. While the sensemaking activity driven by a single firm is well documented, here we explore sensemaking in the case of inter-organizational research agenda setting. In particular, this research explores the sensemaking process in the case of temporary structures created to support the early stages of inter-disciplinary collaborations to deal with meta-problems. Drawing on data collected from two longitudinal case studies, we examined how two temporary structures were created to set up the collaborative strategies among different organizations. The first case covers a 2-year period, during which an inter-organizational group explored collaboratively the formulation of joint projects related to chronic risks. The participants consisted of researchers, companies, and policy makers that were confronted by and had to work within the limits of dealing with chronic risks from the mono-discipline point of view. The second case covers a 2-year period, during which the challenges related to misinformation and veracity were considered in order to develop joint projects to work on together. Because of the complexity of these issues, these organizations were unable to explore them individually and engaged in the process of collective sensemaking. In both cases we examine closely the process through which representatives from different institutions were included to the process of collective sensemaking and how it affected the dynamics of the process. Overall, this research sheds light on how participants created a collective repertoire of frames to make sense of a meta-problem and identify areas of common interests that drove both the identification of strategic areas and the team creation to tackle those challenges going forward.

Paper 22:
Exploring the creativity universe: How OIS practices come into play for early-career stage students at IdeaSquare

Catarina Batista, Ole Werner, Dina Zimmermann, Markus Nordberg

Literature on open innovation, in both science and industry, has become increasingly prevalent over the past years. However, the question as to what innovation really is, or how it comes about, is still not fully answered. In particular, it is still unclear how creativity, which has been shown to promote innovative, open, and collaborative behaviors, is fostered at early career stages. Therefore, it is of high value to investigate the contingencies of creativity to increase the prevalence of open innovation practices in working groups.

At IdeaSquare, the innovation space at CERN, multidisciplinary groups of students undertake innovation programs every year. As part of their academic program, these cohorts of students get to experience innovation workshops, guided tours through CERN facilities, and interactions with CERN physicists. These elements constitute the building blocks of their IdeaSquare and CERN immersion and are designed to demonstrate the implementation and added benefits of open innovation.

This study aims to explore the relationship between the IdeaSquare experience (building blocks), the development of creativity, and attitudes towards open innovation practices, with diversity of the cohort as a moderating variable. It is hypothesized that when interacting with a large collaborative organization (such as CERN), students' creativity will be boosted and their attitudes towards open innovation practices will change positively, inspiring them to subsequently apply open innovation practices in both industry and academia.

For that, an experimental mixed-design setup will be used to analyze 12 student cohorts that will visit IdeaSquare in 2023. These cohorts include undergraduate and graduate students coming from different academic and cultural backgrounds. To ensure comparability between groups, the chosen cohorts for this experiment consist of groups that came for one-week visits. To assess diversity, the authors will map five different dimensions: academic background, age, gender, nationality, and ethnicity. In turn, creativity will be measured by using divergent thinking tests. Lastly, measurements of implicit and explicit attitudes towards open innovation practices will be recorded. All measures will be applied in the beginning and at the end of each cohort visit. By manipulating the exposure to different building blocks (only Tours/only Interactions/only Workshops/all combined) between cohorts, the authors expect to understand which elements contribute the most to the fostering of creativity and the increase of positive attitudes towards open collaboration. Results will be statistically analyzed using repeated measures multivariate analysis of variance (MANOVA) in SPSS.

With the present experiment, the authors aim to generate clearer insight on how to adapt, finetune, and foster open innovation practices to maximize their potential and leverage creativity development at early-career stages.

Paper 23:
The social side of open science: Exploring the sentiment, semantics, and structure on social networking platforms for entrepreneurship and innovation scholarship

Anne Radunski, Robert Rose, Valeska Maul, Katharina Hölzle

Over the past decade, social networking platforms have gained popularity in the scientific community as a means for disseminating knowledge and developing new research ideas. Generally, scientific discussions are transitioning from periodical publications to the realm of social networking platforms as a result of the open and convenient user accessibility, as well as the progressive and diversifying methods and forms of scientific discourse (Herman et al., 2020). Social-media based interactions are of great importance due to the novel information that they provide in real-time (Roberts et al., 2016). This especially holds true for scholars of fields such as innovation and entrepreneurship, which are focused on bridging practice and science.

Social network platforms enable open and collaborative approaches for scholars to exchange ideas with other experts and gain new research perspectives. Hence, data derived from social network platforms can serve as an indicator for potential new topics, enabling the identification of emerging research areas. To this end, innovation and entrepreneurship scholars contribute to a new contextual form of knowledge production, i.e., open science, which is accessible to the public to promote openness and collaboration (Beck et al., 2022). The trend towards social-media based interaction poses questions, though, about how these platforms differ from each other and further, how these patterns compare to traditional co-authorship publication networks. In our study, we examine how conversations differ across three different social networking platforms: Twitter, LinkedIn, and Mastodon. While on Twitter, the messages are written in a concise manner and thus promote exchange with non-experts. LinkedIn offers the possibility for a more detailed exchange. More recently, Mastodon has emerged as an alternative to Twitter, featuring a decentralized architecture. This study further examines where scholars talk about which topics as well as the structural evolution of both communities. Furthermore, we compare the interaction structure and prominence of authors engaged in social networking by platform and with their respective co-authorship publication networks.

To gain meaningful insights from unstructured textual data, we use computer science methodologies for knowledge representation to capture conversations in terms of their sentiment, semantics, and structure. Specifically, we use sentiment analysis to distinguish between positive or negative discourse, and topic modeling to identify and predict upcoming topics. We compare different time periods to gain a deeper understanding of contents discussed over time. Our findings bear relevance for the structure, quality, frequency, and immediacy of novel ways of engaging in scholarly discourse. Our research can help answer topical questions related to what scholars should consider when engaging on social networking platforms and, eventually, promote open innovation and science.

Paper 24:
Grassroots science: A mixed-method study of crowdfunding for scientific research

Chris Hesselbein, Chiara Franzoni

Crowdfunding for scientific research has been hailed for improving funding for science, communicating science to the public, and facilitating citizen participation in scientific research.

Yet crowdfunding may also affect the direction and type of research that is funded, because of its openness and collaborative ecosystem, which can increase the diversity of inputs and approaches and provide a more tolerant environment for experimentation and failure (Poetz and Schreier, 2012; Sauermann, Franzoni, and Shafi, 2019). Moreover, because non-scientists are asked to evaluate research proposals, and sometimes can propose research projects themselves, crowdfunding can potentially direct science towards more socially-engaged or pro-social and even 'undone' forms of research (Sauermann, Marco, and Franzoni, 2022).

However, because crowdfunding campaigns can be proposed, evaluated, and funded by non-scientists or non-experts, concerns have emerged that crowdfunded research could promote novelty at the expense of scientific rigor. For example, citizens may be swayed by charismatic or promotional communication (Byrnes et al., 2014), and prone to supporting controversial or populist topics (Golumbic et al., 2017) or pseudoscientific and disingenuous research (Mede and Schäfer, 2020).

This paper focuses on the potential of crowdfunding platforms to elicit and foster research proposals that can be characterized as novel and more socially engaged in terms of their topic, research outcomes, objectives, and methods, but also as potentially more problematic in terms of their controversial, pseudoscientific, or politicized orientation.

We conceptualize crowdfunding platforms as places where citizens can propose research projects that are relatively free from the constraints imposed by conventional funding agencies or the behavioral norms of scientific institutions. As such, crowdfunding platforms can represent repositories of 'grassroots' research, i.e., projects that reflect public concerns rather than scientific ones, and which therefore represent orientations that are significantly different from regular scientific projects.

This 'grassroots' characteristic is especially visible when looking at all the campaigns submitted to a crowdfunding platform rather than only those that are actually run. Indeed, many submitted projects are never run as a campaign, either because they are rejected during the platform's vetting procedure or because they are simply discontinued. Thus, submitted projects can be thought of as an unfiltered sample of grassroot science projects.

Paper 25:
Understanding knowledge sharing and collaboration dynamics in crowdsourced citizen science

Yao Sun

Recent research has witnessed a burgeoning interest in crowdsourced open innovation. In science, open innovation promotes knowledge co-creation by involving citizen scientists in the collaborative processes of scientific data collection and analysis, and the development and dissemination of scientific findings. Such deep interactions can motivate scientists to engage in innovation activities, close the gap between academia and the public, promote the democratization of science, as well as catalyze creativity and potentially give rise to more valuable social and scientific outcomes. Empowered by information technologies, online crowdsourced citizen science has become a recognized approach to advancing knowledge development in many areas such as climate change and sustainability, wildlife protection, disease tracking and prevention, biomedical research, etc. However, despite widely recognized knowledge contributions made by citizen scientists, the mechanisms underlying 1) citizen scientists' knowledge-sharing interactions and 2) knowledge collaborations between researchers and citizen scientists remain unclear.

To fill the research gap, this explorative study uses Zooniverse (zooniverse.org) as the testbed to examine the knowledge sharing dynamics among citizen scientists in contributing to crowdsourcing scientific research projects, as well as the knowledge collaboration dynamics between researchers and citizen scientists in co-creating scientific values. The study particularly focuses on a total of 1,183,022 comments displayed by the Talk section of 105 completed projects across 11 different disciplines (such as biology, climate, nature, physics, space, social science, etc.) to examine how crowd participants make their knowledge explicit and help one another in understanding the context or making sense of the findings. The Talk section serves as a place for Zooniverse volunteers and researchers to discuss their projects, collect and share data, and work together to make new discoveries. Integrating computational techniques (such as unsupervised natural language processing) with human coding and validation, this study attempts to explore and categorize the major types of crowd contributed knowledge in citizen science (e.g., questions, facts, conflicting situations, clarifications, ideas, etc.), as well as further employ regression analyses for unpacking the cross-type knowledge interaction mechanisms that facilitate the completion of crowd-powered research projects. Theoretical and practical implications for crowdsourcing science and citizen science are discussed.

Paper 26:
Unlocking useful input in crowdsourcing: The need for deep information exchange when the crowd (re)formulates the problem

Ademir Vrolijk, Zoe Szajnfarber

Crowdsourcing, and specifically broadcast search, has become an established tool for leveraging the expertise of outsiders. It excels at gathering distant knowledge from diverse problem-solvers – a feature solution-seekers across various industries have used to overcome internal cognitive entrenchment and solve specific problems. However, its success is not guaranteed: some broadcast searches have delivered game-changing approaches to stubborn problems, while others have resulted in zero useful solutions, seemingly producing little value for the seeker or solvers. To address this uncertainty, scholars have recommended a probabilistic approach: inviting more, and more diverse, solvers to submit increases the chances of finding a great solution. This approach has worked for narrowly defined problems. However, it is counterproductive when problems are more complex and open-ended: solutions based on distant knowledge are crowded out, negating the benefits of crowdsourcing.

In this paper, we introduce a different approach to address the uncertainty of broadcast search. It focuses on improving the crowd's submissions rather than increasing their numbers, allowing the seeker to better leverage their out-of-domain capabilities. We base this contribution on an in-depth case study of a crowdsourcing event with an open-ended problem. In a Citizen's Forum, the National Aeronautics and Space Administration (NASA) engaged a large group of individuals outside the aerospace industry on a spacecraft design problem. Over two years, we observed how NASA formulated the problem presented during the event, how Citizen's Forum participants solved it, and the impacts of their solutions within NASA.

Relying on quantitative and qualitative methods, we found a relationship between how the crowd interpreted NASA's problem, how they communicated their solutions, and how useful those solutions were to the seeker – forming the basis of our approach. In our setting, the crowd reformulated the problem often. Notably, their distant formulations drove useful solutions when they provided rich depth to their solution. Thus, seekers do not have to rely on probability to improve the outcomes of broadcast searches. By prioritizing a rich information transfer from the crowd, they can leverage out-of-domain thinking while (more) accurately gauging the quality of the submissions. We end by discussing the implications for theory and practice.

Paper 27:
Listening to the crowd? Experts' responsiveness to scientific project evaluations by members of the general public

Susanne Beck, Egor Burda, Marion Poetz, Henry Sauermann

Evaluations of project proposals are an integral part of the scientific enterprise. Such evaluations determine the allocation of limited resources to projects with the greatest potential and shape the trajectory of research fields (Hug & Aeschbach, 2020; Smits & Denis, 2014). Although proposal evaluations have traditionally been made by peers and other experts in the respective scientific fields, an increasing number of funding organizations (e.g., NIH, NIHR, SGF) now involve members of a broader public (crowds) in decisions regarding which projects to fund. Underlying rationale include, among others, the hope to steer research towards greater social impact and to address the challenge of rising incrementalism in research (Magnusson et al., 2016; Park et al., 2023).

Recent evidence suggests that crowds can be useful in evaluating ideas. However, crowds are not typically making final decisions in the context of science - they only provide inputs to professional decision makers (den Oudendammer et al., 2019; Herbert et al., 2021). As such, we need to understand whether and when professional decision makers in science "listen to the crowd" by integrating crowd inputs into their judgments and final decisions. To examine this question, we conduct an experimental study in the context of the medical sciences, where crowd members (e.g., patients and their relatives) are increasingly involved in research but are at the same time distant from experts with respect to their experiential knowledge and scientific expertise, raising the question of how experts will react to their advice.

Building on the literature on decision making as well as crowd evaluations, we theorize that experts' responsiveness to crowd advice will depend on the interplay between the form of crowd advice and the way the crowd was selected to participate in an evaluation. We argue that crowd evaluations reflect not only knowledge (e.g., about potential side effects and existing treatments) but also preferences (e.g., the subjective importance of different research questions, or how trade-offs between different aspects of proposals should be resolved). Thus, we argue that experts are more likely to consider crowd members' knowledge if crowd members are self-selected, while they will be more likely to consider crowd members' preferences if those preferences are expressed by a representative sample of the broader population of cancer patients and their relatives.

Our study makes several contributions to the literature. First, crowd evaluations have been studied primarily in the context of innovation or the arts, and we contribute by studying this important mechanism in the context of the sciences. Second, we add to research on crowd evaluations (Magnusson et al., 2016; Mollick & Nanda, 2016) by revealing how experts respond to crowd advice under different conditions rather than comparing crowd evaluation to expert evaluation. Finally, prior research has focused on the knowledge of the crowd. We distinguish knowledge vs. preference components of crowd inputs and show that this distinction matters. Our results suggest several avenues for future research as well as implications for scientists, crowd members, and funding agencies.

In this session, researchers from different disciplines will showcase novel approaches and tools to practicing openness and collaboration in diverse fields of research. Conference participants can learn about the cases by engaging with the case owners as part of an interactive exhibition setting (online and offline).

Project 1:
What Tiny Forests have taught us:
A case study in delivering multicommunity, place-based citizen science to achieve environmental and social impact

May Chemais, Divya Kumar, Daniel Hayhow, Sophie Cowling, Georgina Sturgeon, Claire Narraway

Project 2:
Co-creation with vulnerable groups – how to include the elderly or people requiring care in research processes to develop eHealth solutions supporting ageing in place

Andrea Kastl, Leonhard Dobusch

Project 3:
Open innovation in science:
Development and implementation in Ukraine

Olga Miroshnychenko, Andrii Vasylenko

Project 4:
The integrated system "Atque" to design cooperative and generative processes in science communication

Luca Toschi, Viola Davini, Marta Guarducci, Eugenio Pandolfini, Ilaria Papini, Marco Sbardella

Project 5:
Care for ME/CFS:
From machine learning to guidelines for primary care facilities

Eva Untersmayr, Johanna Rohrhofer, ÖGMECFS on behalf of all other project members

Project 6:
Picture Pile Platform:
Harnessing the power of crowd-driven artificial intelligence

Steffen Fritz, Tobias Sturn

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