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How National Science Funders Can Strengthen Global Collaboration and Avoid Isolationism

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In the wake of the pandemic, leaders should create multinational frameworks to coordinate research programs.

The outbreak of the COVID-19 pandemic underscores the fact that national isolation is not a viable option for any country, especially in the areas of science and innovation. Bringing the global scientific community together and harnessing its collective wisdom is essential not only for battling a pandemic but also for addressing challenges such as climate change, demography, and resource allocation.

International cooperation in science has greatly intensified since the beginning of the pandemic, although a lack of coordination among science funders still exists. The COVID-19 pandemic experience has raised awareness about the importance of open,

international scientific cooperation with clearly defined and mutually agreed conditions to ensure fair, open, and reciprocal collaboration. Although political tensions and competition loom large in political discussions—and often play counterproductive roles when attempting to confront shared problems—funders have the potential to mandate specific conditions that create safe, egalitarian spaces for fruitful collaborations based on mutual trust.

National science funding organizations provide the infrastructure that supports an international exchange of scientists and fosters cooperation among international research teams. Policymakers have the opportunity to improve conditions for international scientific collaborations, so that scientists can work together to address global challenges such as infectious disease outbreaks. Here we suggest refinements to these conditions and explore how funders can strengthen their collaborative activities. Funders, as a result of these changes, will be better able to build trusted global science networks for the advancement of science and the benefit of society.

SYSTEMIC CHANGES IN COOPERATION

Without fair, open, and reciprocal international cooperation, scientific progress is stymied. Science flourishes through the open exchange of people, ideas, culture, and technology, as long as commonly accepted international rules are observed. Meanwhile, global challenges call for global efforts in research, and as a consequence, there is a general trend for increased internationalization of scientific collaboration. The global science system has entered what public policy expert Caroline S. Wagner calls "the collaborative era in science," and has evolved into a highly networked international system.

Funders, as a result of these changes, will be better able to build trusted global science networks for the advancement of science and the benefit of society.

Studies show that scientific papers published by authors from different countries are more likely to be highly cited than single-nation papers, and international collaboration has been associated with greater scientific quality. International collaboration has grown more than 10-fold since 1991 for the most advanced countries and 20-fold for the so-called BRICS nations (Brazil, Russia, India, China, and South Africa). Many more nations participate in these publication activities than was the case two decades ago.

Moreover, shifts are taking place in collaboration across disciplines with a focus on global challenges and societal impact, where interdisciplinarity and transdisciplinarity are essential in the context of international cooperation. Most importantly, for example, achieving the United Nations' Sustainable Development Goals (SDGs), described as "a call for action by all countries—poor, rich and middle-income—to promote prosperity while protecting the planet," requires new approaches for conducting collaborative science. These approaches include cocreation, interdisciplinarity, and transdisciplinarity, as well as a framework sometimes called a "quintuple helix arrangement" that involves interactions among science, industry, government, the environment, and society.

More than 80 science funders representing international development aid agencies, private foundations, and national research councils have called for greater collaboration among science funders and the research community to address the most pressing challenges, as exemplified by the SDGs. Various international cooperation programs or initiatives among global funders or international organizations already exist targeting the SDGs. Among these initiatives is the SDG Research Funding Program launched by the National Natural Science Foundation of Chinain 2019, which invites the participation and joint efforts of global partners. Another initiative is the European Union Framework Programmes for Research and Technological Development; these EU programs have been the "main financial tools through which the EU supports research and development activities" with international cooperation as common priority throughout the programs.

A similar need for international collaboration can been seen in addressing climate change. The EU climate action and the European Green Deal, China's policies toward climate change and efforts to build what the country's leaders call an "ecological civilization," Japan's strategy in the follow-up to the 2015 Paris Agreement on climate, and the Green New Deal in the United States are all examples of new policy frameworks that offer opportunities for international scientific cooperation for the global public good. There are existing examples of governments and funders working together in similar contexts, such as the European Joint Programming Initiative "Connecting Climate Knowledge for Europe," which, according to the website, aims to "jointly coordinate climate research and fund new transnational research initiatives that provide useful climate knowledge and services."

CONSEQUENCES FOR FUNDERS

In order to adapt to this new paradigm, funders are broadening their portfolio of funding measures beyond basic research to mission-oriented and use-inspired research. They are paying more and more attention to the funding of transdisciplinary and interdisciplinary

research, for example, by applying specific measures or establishing dedicated structures for promoting and supporting interdisciplinary research. This type of interdisciplinary funding has been practiced by the Swiss National Science Foundation, the US National Science Foundation, the National Natural Science Foundation of China, and UK Research and Innovation.

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Meanwhile, funders' open exchange and close collaboration in different formats and forums are important for monitoring developments in the global science system. This monitoring includes identifying new trends and newly emerging areas of scientific investigation; reviewing how research funding is organized; and examining which changes of strategies, structures, and procedures of funding research may be necessary and appropriate. Together they help to promote the trends in global science that are already underway.

Increasingly, funders are working together across national borders to address common challenges. During the COVID-19 pandemic, for instance, the Global Research Collaboration for Infectious Disease Preparedness (Glopid-R) has been coordinating joint activities by national funders from 5 continents and 18 countries, and may be open to welcome additional funders even when political tensions between the newcomer's home country and a member's country exist. Indeed, funders as well as cooperating scientists have major roles to play in science diplomacy when other means of international communication and joint engagement are difficult. Adapting the general principles, framework conditions, and regulatory arrangements under which funders cooperate is of significant value for safeguarding international scientific cooperation when antiglobalization and nationalist tendencies are emerging. Research funders have the potential to develop safe spaces for fruitful collaboration under commonly agreed, well-defined conditions.

HELPING FUNDERS TO COOPERATE

Funders need to work together to create internationally credible conditions and mechanisms that allow them to cooperate freely, efficiently, and effectively across

different cultures and jurisdictions. Additionally, funders should jointly define commonly agreed principles, framework conditions, and regulatory arrangements for maintaining and further developing open international cooperation in accordance with real-world demands of the science system and the scientific community.

To accomplish these goals, funders must discuss and as far as possible agree on a set of general values and principles, which might include:

- A strong research culture and commitment to international scientific standards of excellence;
- Mutual respect, trust, and understanding of different scientific systems;
- Research integrity and ethical conduct;
- Reciprocity and equal access to funding and resources;
- Independence, openness, transparency, and accountability;
- Gender equality (e.g., hiring practices and pay);
- Free movement of people and ideas.

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In recent years, the Global Research Council (GRC) has issued publications with recommendations and guidance for capacity building and increasing connectivity among granting agencies worldwide, among other important topics. The GRC's coordinating efforts have prepared the ground for addressing topical challenges and systemic changes, and the organization is working to smooth a path for increased cooperation among research funders.

In terms of specific programs that can encourage, support, and promote researchers from different countries working together, funders must discuss and agree on a set of framework conditions, which might include:

- Jointly identified objectives and roadmaps of priority themes (including possible

limitations connected with aspects of national security) for strategic cooperation considering complementarity and mutual benefit;

- Appropriate funding schemes and long-term commitments for establishing and maintaining sustainable cooperation;
- Reciprocity of access to research infrastructures and resulting data;
- Transparent and mutually agreed rules for data sharing, transnational transfer of materials, intellectual property management and protection, and dissemination of results;
- Procedures for monitoring, regular review, and impact assessment of joint activities, follow-up, and mutual learning; and
- Procedures for responding to allegations of misconduct.

Once funders have reached consensus on values, principles, and framework conditions, they may embark on efforts for aligning the rules for cooperation. As experience shows, the differences among funders' target groups (for example, categories of eligible researchers, research consortia, research institutions, companies, or other organizations), grant types, instruments and procedures, and the related eligibility criteria for receiving funding create technical issues; funders need to resolve these technical issues for funding applications to enable collaboration and coordination. From a practical point of view, the following aspects deserve special attention:

- Well-defined target persons, groups, or institutions and respective eligibility criteria;
- Types of grants and instruments for international cooperation (e.g., mobility grants; grants for single principal investigators, early career and senior career fellowships; a spectrum of instruments for collaborative activities such as collaborative research, coordination and support actions, joint distributed research groups, joint doctoral schools, joint events, summer schools; joint studies; joint institutes or labs; access to large-scale research facilities, establishment of mega-science facilities);
- Commonly agreed, well-defined procedures for implementing joint activities, launching calls for proposals, evaluating and selecting proposals, and reviewing joint activities at regular intervals.

Mutual understanding and trust of each other's research and funding

environment provide the foundation for funders' cooperation.

The above three sets of conditions for cooperation build on one another. Only those funding institutions that agreed on the general values, principles, and framework conditions will arrive at the final stage of resolving technical issues. Mutual understanding and trust of each other's research and funding environment provide the foundation for funders' cooperation. Friction or misunderstandings in this regard can be solved through open dialog and communication, as well as flexibility and adaptability.

THE PATH FORWARD

The last 20 years have seen dramatic growth in collaborative international scientific activities and improved quality of research results in many countries, especially in Asia. As a consequence, many funding agencies are managing large numbers of bilateral or multilateral programs, and developed models for co-funding bilateral and multilateral research cooperation in response. Funding organizations need to allocate sufficient resources to properly implement international cooperation and they require professional staff to manage these programs and initiatives.

Commonly agreed values and principles, framework conditions, and regulatory arrangements are the basis for effective and sustainable cooperation structures and procedures. This requirement leads to the challenge of how to arrive at an appropriate level of alignment among different funders' approaches while at the same time enabling the funders to meet national priorities and follow national laws and internal procedures. The perceived and real issues such as fairness, openness, and reciprocity in collaborative arrangements, as well as unwanted external influences such as political tensions among countries involved, anti-globalization sentiments, and conflicts of interest among applicants are also possible obstacles faced by funders who engage in global collaboration.

Funding institutions need to strengthen, adapt, and further develop a global trusted network that supports scientific collaboration and an innovation ecosystem that is conducive to multinational collaboration. A robust network is especially essential in the face of systemic changes in science and collaboration as well as pressing real-world challenges such as COVID-19 and climate change.The following suggestions can form the basis for discussing these issues among funders and finding viable solutions that meet the requirements of different challenges.

1. Cocreation of internationally applicable mechanisms: Funders must work together to

ensure the sustainability of their collaboration by regularly updating the values and principles, framework conditions, and regulatory arrangements that allow them to cooperate. These agreements mean sharing best practices around science funding and putting in place funding schemes that meet international standards. Therefore, funders need to make further efforts to define these mechanisms for maintaining open international cooperation. Platforms such as the GRC at the global level, Science Europe at the European level, Asian Heads of Research Councils and similar structures in the Americas or in Africa will play increasingly important roles in shaping and moderating a global system of research funding. The constructive atmosphere during past international funders' dialogues provides reasons for optimism for the success of such exercises.

2. Open exchange and close coordination: The regular open exchange and close coordination in different formats of the participating funding agencies from around the world facilitates the exploration of common strategies to both adapt to and promote emerging trends in science. Open exchange also provides insights into and mutual learning from the broad spectrum of different modes and instruments of cooperation, from supporting researcher mobility to jointly establishing vast science infrastructures. Furthermore, friction and misunderstanding can be resolved only through trust-based dialog and communication in the framework of a global community of research funding professionals.

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3) **A special focus on young people:** International cooperation in networks of distributed teams is characteristic of twenty-first century networked science. It has become an integrated part of researchers' careers at home. Conducting research abroad for periods of exposure to foreign research environments, however, is also important for a young researcher's professional development. Therefore, funding agencies need to make additional efforts to encourage young people to go abroad for study and training. This broader exposure will aid their research efforts as well as build their personal scientific relationships and networks while deepening their experience, understanding, and respect of other science communities and systems.

4) **A long-term perspective:** Establishing open international cooperation and developing

trusted relationships requires time and effort, and these activities should be nurtured and maintained with a long-term focus. Continuous monitoring and follow-up as well as regular joint reviews are necessary measures for ensuring successful long-term relationships among research funders, both at the institutional and personal level. Moreover, funders' support for networking and maintaining sustainable teams of funded experts is a precondition for the sustainability of the global scientific community and facilitating the sharing of information, experiences, and scientific results. Keeping collaborations alive at all levels under difficult circumstances demands commitment, perseverance, and patience.

The twenty-first century is the era of collaborative science and international science networks. Open international cooperation among research funders is essential for jointly finding solutions to common problems. Cooperation among funding agencies provides and safeguards the basis for globally connected and integrated science and creates safe spaces for international scientific collaboration—potentially stimulating the emergence of new ideas.

This global cooperation is needed now more than ever if the scientific enterprise is going to address the challenges of our time. This joint approach includes not only achieving the SDGs, combating climate change, and addressing the still-ongoing problems caused by the COVID-19 pandemic but also creating a better world and shared future.

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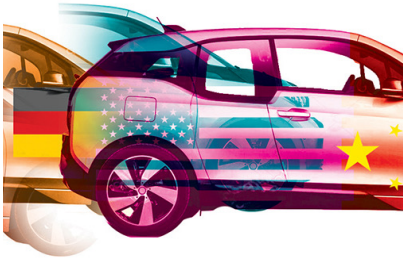

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