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# Strengthening international scientific collaboration

## *Five opportunities that emerged from the Covid-19 pandemic*

The Covid-19 pandemic illustrated how quickly international science can adapt and deliver desperately needed data and information to reduce the uncertainties around a huge societal challenge. The pandemic stress test for the international science system revealed several paths for its development and enhancement. By harnessing the following five opportunities, the international science system can be strengthened for tackling current and future complex societal challenges. The opportunities include: clarifying the roles of science and scientists in policymaking to preserve credibility and effectiveness of the science system, establishing interdisciplinary networks of scientists to improve readiness and response capacity of scientific policy advice in times of crisis, strengthening Open Science principles to increase reproducibility and democratisation of research, promoting knowledge co-creation to strengthen the integration of academic research into practical solutions and incentivising transdisciplinary research to improve collaboration between disciplines and extra-scientific actors. Governments and science funders play key roles in implementing corresponding measures.

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### **Clarifying the roles of science in policymaking**

The Covid-19 pandemic brought to light in a very explicit manner the various aspects of the relationship between science, policy and society in general [1]. At the heart of the corresponding debates were the roles of science and researchers in the process of public policymaking ([2] and [3]).

This is an opportunity for international science to explicitly delimit the ways in which it can contribute to public policymaking and avoid false expectations [4]. Thereby, science as a system can avoid its own politicisation and manipulation, which is a crucial condition for long-term credibility and effectiveness of the science system and science-based policymaking [5].

### **Scientific policy advice**

The goal of scientific policy advice is to reduce uncertainty. Thereby, policy goals shall be achieved more efficiently and effectively.

#### **Box 1: The limits of scientific expertise**

Scientists engaged in policy advice provide scientific expertise. They are not experts on social and normative questions that lie at the centre of political decision making. Hence, it is crucial that they acknowledge the limitations of their disciplinary scientific perspective [6]. Thereby, trust in science is increased and polarisation regarding scientific findings reduced [6].

Scientific policy advice is distinct from government decisions – it does not imply any kind of political measures [7]. This is due to the differing nature of science and politics. Whereas science tries to create common knowledge via systematic, descriptive and iterative approaches, politics is about finding a common will. The latter involves dealing with values, resources and power dynamics.

Scientific knowledge relevant to public policy is never value-free [8]. Scientists need to make their value judgements transparent. Thus, those can be integrated into public deliberation and democratic control [9]. It is the scientists' responsibility to distinguish between political and scientific claims and to not overstep their mandates [7].

## Recommendations

The debates around the role of science in policy-making and society in general are a great opportunity for science to sharpen its profile as a broker who involves decision makers in a conversation about alternatives [10]. At the same time, this role allows science to protect itself from instrumentalisation without giving up its own standards. Three main areas need to be tackled with fine-grained, small-scale measures.

First, public awareness campaigns should be started by the scientific community focusing on the role and limits of science. This involves media presence, public events, blog posts and further science outreach activities.

Second, the scientific network actors should prioritise trust- and network-building activities with decision makers to strengthen the mutual understanding and respect.

Finally, education of scientists about their role in the public and political discourse is needed [11]. Potential activities involve workshops at universities about the political system, science communication and the mechanisms of media coverage. The scientific community and institutions like universities should take responsibility here.

## Establishing interdisciplinary networks of scientists

As an emergency, at least in the beginning, the Covid-19 pandemic highlighted the importance of the readiness of scientific policy advice channels. A significant opportunity emerges therefrom for science and research in different institutional contexts:

establishing networks of scientific experts which are diverse regarding disciplines, characteristics, orientations and political views. Those networks can be activated in case of emergency and are accompanied by regular trust-building activities.

## Scientific policy advice during the pandemic

The performance of science advisory mechanisms during the pandemic did not meet the expectations in various countries [12] like Sweden [13], Italy [14], Switzerland [15] or Japan [16]. The problems were partly due to structural and procedural components. Firstly, there was a lack in diversity of scientific policy advice. Biomedical evidence was dominant [17]. Examples include the UK, where economic perspectives were neglected [18], or Switzerland, where social sciences were almost completely ignored [19].

Often, the science advice structures were not ready to perform. The US, for example, lacked formal mechanisms of high-level government science advice [12]. Switzerland had its science taskforce established only in the middle of the first wave of the pandemic [20].

In Japan, on the contrary, national science advice channels were already on a more advanced level due to the relatively recent experience of the Fukushima nuclear crisis [16]. Integration of scientific policy advice does not work from scratch – it requires experience and pre-built networks fostering trust and capacity ([21] and [17]).

## Recommendations

There is a need to build relationships, structures and processes in advance to connect scientists and political decision makers [22]. This can be achieved via diverse, interdisciplinary, transparent networks of scientists from which expertise can be drawn in times of crisis [23]. Such a network is administered by governmental staff in collaboration with national science network actors. Scientists can enter on a voluntary basis.

Thus, scientists get the opportunity to link their expertise to practice and build contacts in the policy sphere. To protect independence, which is crucial to ensure rigour and completeness of the evidence [24], financial compensation of the scientists is not intended.

Regular exchange activities of network members with government administration build trust

and mutual understanding, which are fundamental for effective collaboration in times of crisis [17]. These include roundtables, scientific anticipatory briefs, networking events or training for media communication. The Geneva Science and Diplomacy Anticipator (GESDA) can serve as a role model.

Besides, since clear roles are critical in times of crisis [25], explicit expectations should be set about what advisors are expected to do via unambiguous terms of reference [12]. Over time, guidelines and quality standards for scientific policy advice can be elaborated and shared internationally. Apparently, such networks need to be tailored to the institutional and political context of specific countries.

## Strengthening Open Science principles

As the pandemic unfolded, it became apparent that access to scientific data and information for all countries will be crucial to mitigate the pandemic. Emphasis on openness and transparency of research and data increased [17]. This shift presents a remarkable opportunity for the advancement of Open Science principles and corresponding initiatives throughout the international research community.

### Box 2: The pillars of Open Science

The aim of Open Science is to improve the quality of scientific research and its communication by creating transparency about the scientific process and its results for the research community and broader society [26]. The four pillars of Open science include Open Access, Open Source, Open Data and Open Peer-Review [27]. The reliability, reproducibility and rigour of research outcomes is improved by Open Science practices ([28] and [29]).

## Open Science during the Covid-19 pandemic

Open Science was practiced at the very beginning of the pandemic. The original SARS-Cov-2 genetic sequence was openly shared by their discoverers [30]. Scientists across the globe benefited therefrom in their research about tests, vaccines and therapeutics [17]. Meanwhile, Open Science principles regarding Covid-19 research were pushed by

various national and international organisations, creating a relevant impact on accessibility [17].

The pandemic caused an increase in openly accessible pre-prints [31], a term referring to articles which are not yet published in scientific journals [26]. Pre-prints speed up communication and reviewing within the scientific community [32].

Covid-19 related research papers were made freely accessible for all by established publishers such as Springer Nature [33] and Elsevier [34]. The share of open access publications regarding Covid-19 is significantly higher than for other medical topics like dementia or diabetes [17].

The pandemic catalysed the adoption of Open Science principles [26]. Still, quality of research was not always guaranteed, frauds were detected and the media had difficulty in distinguishing pre-prints from academic articles [17].

## Recommendations

Building on the momentum provided by the pandemic, efforts to advance principles of Open Science should be intensified. All actors of the research ecosystem can take responsibility. The focus here is put on research funders.

They should consider making funded output freely accessible, like for example the National Institute of Health does [35]. Besides, they should require funded projects to attach open data in a reusable format to the project output, like the European Research Council suggested [35]. Also, funders could make Open practices the de facto standard for submissions [35]. Similar considerations apply to pre-prints [17].

Criteria of fund allocation represent another lever. Research evaluations should be diversified [26] by putting less weight on quantity and more on quality of research [35]. This could be achieved by strengthening theoretical contributions and open practices, like the Dutch Research Council does [35]. To leverage Open Science practices in times of crises, it is critical that they have been established before [17]. Constraining the free flow of scientific information can hardly be justified [3].

## Promoting knowledge co-creation

During the Covid-19 response, new types of partnerships and networks emerged, integrating actors from academia, industry and civil society ([17] and [11]). They jointly produced innovation via knowledge co-creation [36]. Such arrangements

offer relevant opportunities for the science community when it comes to integrating academic research into practical solutions to societal problems, products and services. The following considerations about knowledge co-creation draw from Kreiling and Paunov [36].

### Box 3: Knowledge co-creation

Knowledge co-creation initiatives take various forms of collaboration like projects, exchange formats, shared infrastructure or institutional arrangements. They bring together complementary skills and expertise. Private public partnerships are an example. Participatory co-creation initiatives involving civil society democratise innovation efforts.

## Examples of co-creation during the pandemic

The foremost example of co-creation between academia and industry during the pandemic is vaccine development [17]. Other co-creation projects focused on open data repositories or ventilator production, such as the UCL Ventura CPAP breathing aid [37].

The Flanders Totally Digital project was carried by professional federations, governments and civil society organisations. It presented 400 solutions and led to 35 collaborations during the first wave. The online platform CrowdVsCovid [38] was created by citizens and scientists from European countries to provide information on Covid-19 challenges to policymakers. Hackathons represent another popular co-creation mechanism.

Given the considerable initial coordination cost and the potential effective solutions developed via collaboration, there is a clear rationale for STI policy support for co-creation projects.

## Recommendations

Co-creation activities should be integrated in funding programmes by including funding criteria to promote co-creation and explicit targets. Metrics could relate to network-building or mobilisation of actors.

Co-creation practices are favoured by supportive legislation. According to strategic areas of public interest, Special Acts or regulations might be considered to build capacity, facilitate R&D

and promote communication between stakeholders. Korea's Special Act on Fine Dust Reduction and Management is an example [39].

Coordination between regulatory bodies on national, transnational or product levels could be favoured by establishing pan-ministerial groups. For international collaboration, this is particularly important to clarify procedures and restrictions and for capacity-building.

Several co-creation initiatives during Covid benefitted from pre-established structures. Thus, they were able to perform much more quickly. To start co-creation initiatives from scratch, impartial intermediary institutions like innovation agencies can be helpful to facilitate the process. Co-creation can be incentivised by providing collaborative spaces ranging from physical infrastructure like laboratories to virtual platforms.

Co-creation initiatives often require temporary staff mobility. Policies allowing for flexible labour contracts enable staff from universities or companies to engage with other institutions in a regulated way. Finally, trust establishment between different actors is critical [17].

## Incentivising transdisciplinary research

Tackling the Covid-19 pandemic required a combination of research efforts from multiple disciplines and sources of knowledge. To address such complex societal challenges, disciplinary approaches are insufficient [11]. The wicked problems of the Anthropocene, including pandemics, call for a broad range of knowledge and understandings [40] to address the complexity and uncertainty involved.

### Box 4: Transdisciplinary research

TDR is a reflexive research process addressing societal problems via collaboration between disciplines (also called interdisciplinarity [41]) and collaboration between researchers and extra-scientific actors, such as policymakers or community members, with the aim to enable mutual learning processes between science and society [42].

Pandemic mitigation benefited from transdisciplinary approaches ([43] and [40]). The international science system should take its responsibility

in these approaches and harness the momentum by facilitating transdisciplinary research (TDR) approaches. The following considerations relate to the section about knowledge co-creation where the focus was on systemic policy conditions. Here, the perspective from academia and research funders shall be prioritised.

TDR, following [44], is challenging, slow [45] and complicated by heterogeneity of data [46] and epistemological differences [47]. Current incentive structures in academia favour individual disciplinary research [41]. Research funding tools usually follow disciplinary lines [48] and apply disciplinary quality criteria [49]. Also, conventional academic career metrics are not in favour of TDR [50]. Scientific publications matter in TDR – but also changes in practice, public communication, multi-stakeholder networks or policy reports are relevant [11].

## Recommendations

During the pandemic, several research funding agencies adopted new schemes to promote TDR [11]. TDR principles are incorporated in the French National Research Strategy 2014-20 or the Dutch National research agenda [11].

Research funders can incentivise TDR by taking several measures [51]. They could provide funding of long duration allowing for TDR to tackle societal challenges. The establishment of networks and centres of expertise in TDR should be supported. Testing of various mechanisms including sandboxes are promising to promote the development of rigorous TDR projects.

Funders might offer training workshops to researchers. Evolving goals are inherent to TDR. Therefore, funders should consider implementing proactive management and evaluation of TDR projects accounting for evolving goals. The emphasis on societal outputs besides established scientific outputs could be strengthened in project evaluation. Finally, the peer review process should be enriched with multi-disciplinary and multi-stakeholder perspectives

The academic community can support TDR via various measures [51]. First, TDR fields (e.g., one health or sustainability research) should be developed and acknowledged. Corresponding scientific journals should be promoted. Second, established academics should mentor young researchers willing to engage in TDR. Third, international TDR frameworks and quality standards should be de-

veloped by the academic community. Finally, it should suggest and support new indicators to value diverse research outputs.

These measures will bring science several steps closer to playing its crucial role in tackling complex societal challenges.

## Conclusion

By clarifying the role of science in policymaking and political processes, misuse and instrumentalization of science can be mitigated and false expectations towards science avoided. This is crucial for long-term credibility and effectiveness of science-based policymaking and requires scientists not to overstep their area of expertise, in particular in the public discourse.

A fruitful interaction between scientists and policymakers that can be swiftly leveraged anytime is facilitated by establishing interdisciplinary, diverse networks of scientists, based on regular trust-building activities. Governmental administrations are in a position to collaborate with scientific network actors towards this goal.

The pandemic demonstrated the value of open, accessible scientific information and data. This momentum should be harnessed to advance principles of Open Science, which strengthen the reliability, reproducibility, and rigour of research outcomes. All actors of the research ecosystem can take responsibility here.

Networks and processes of knowledge co-creation support the translation of scientific innovation into practice. They leverage stakeholders and their differing perspectives and expertise to find solutions in complex situations characterised by uncertainty. Research funders and governments should support them. Besides, they have a fundamental role to play when it comes to advancing transdisciplinary research.

Scientists, research funders and policymakers should face their responsibility and contribute to ensuring the long-term effectiveness of science as the global, fundamental system of knowledge generation – it has a critical role to play in tackling the gigantic, wicked challenges society is facing today.

## Endnotes

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