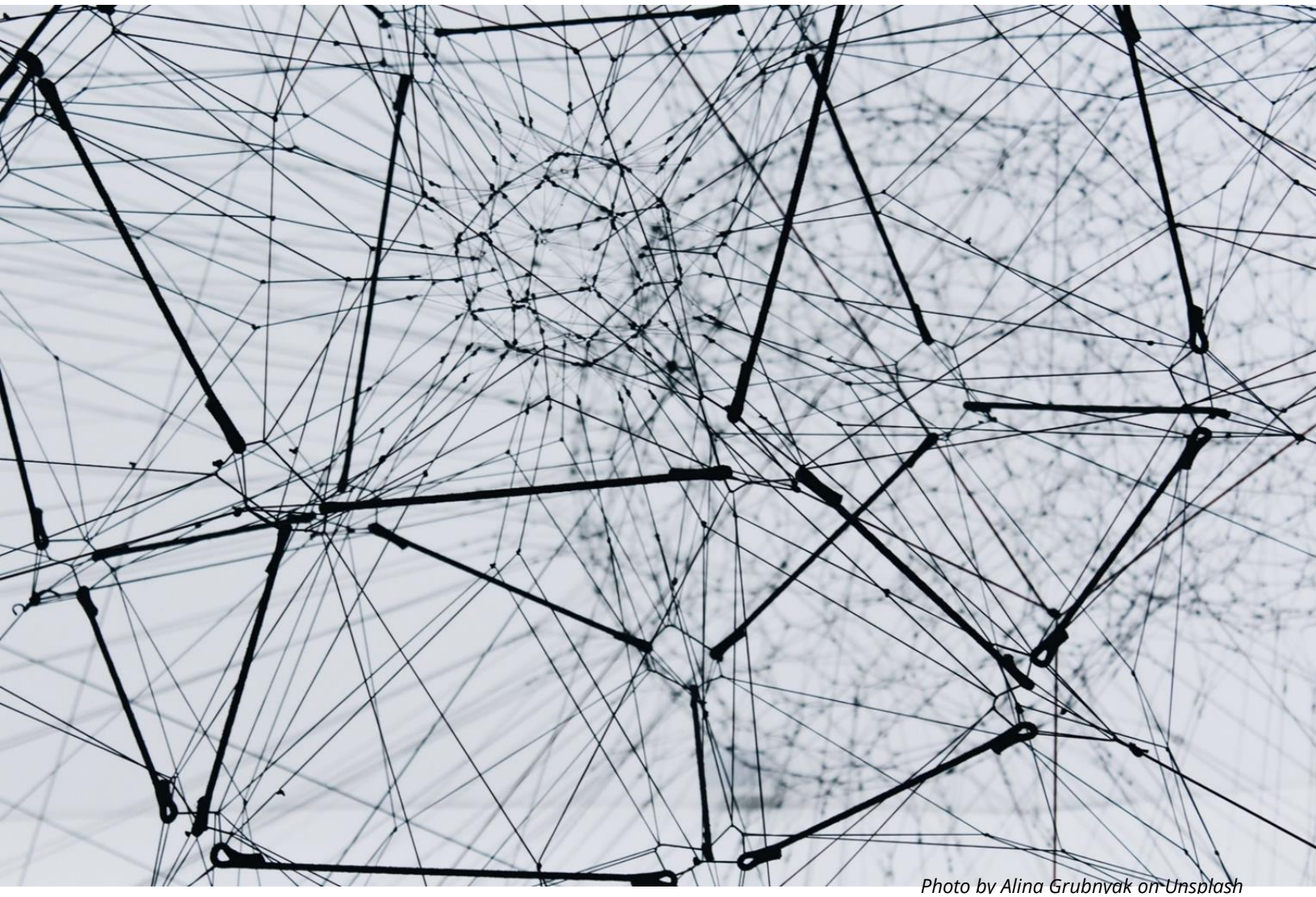

Photo by Alina Grubnyak on Unsplash

TRESCA

Trustworthy, Reliable and Engaging Scientific Communication Approaches

D1.2 Science Communication and Policy Trend Report

PROJECT DESCRIPTION

Acronym:	**TRESCA**
Title:	Trustworthy, Reliable and Engaging Scientific Communication Approaches
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TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report explores how policy-makers in fields of broader innovation policy and digitalisation with a link to the main pre-selected topics of the TRESCA project (i.e. information disorder and digital safety, environ-mental health, automation and the future of skills and work) consume science communication – also when dealing with the issue of false information – and how their habits potentially influence their policy decisions. This report sheds light on the way policy makers understand science communication and make use of it in their policy initiatives. The results of this report lead to policy recommendations in WP6.

The report focuses on the nature of influence science communication and policy have on one another. It is understood that science communication and policy mutually influence each other, however the goal of this report was to relate this to current and emerging trends that come or have come into being due to this relationship. The efforts in this task focus on the international policy level, the EU policy level and member state policy level.

The report contains four main sections. It begins with a theoretical overview on the specific characteristics of science communication with policy-makers that should be taken into account for effective interactions. We follow the same analytical framework as in D1.1 and organise our analysis around the following four main categories: (1) audience characteristics; (2) communicator characteristics; (3) features of the message; (4) type of media environment and communication channel adopted.

The second section showcases the general trends collected through a secondary desk research at an international level. In order to get the most comprehensive overview on the recent global developments, the report makes a distinction between trends already emerging in the last decades (since the mid-1990s) and the most current trends resulting from, or being accelerated by, the COVID-19 pandemic. The analysed trends cover the stronger engagement between science and policy stakeholders, a more reliable, accountable and open science communication, the increasing digitalisation and visualisation of science communication, the higher prevalence of fact-checking measures against disinformation, as well as the increased role of experts in policy-making.

The third section looks at the same trends through the lens of national desk research level (from Austria, Hungary, Italy and the Netherlands). It aims to complement and confirm the international directions at a more granular level. International and national good case practices highlight the findings of the desk research.

The fourth section summarises the trends gathered through 29 semi-structured interviews with the most relevant policy-makers at European and national level. The conclusions drawn are organised around the following topics in science communication: data sources and analysis, policy development process, stakeholder involvement, trust in science and science communication, strategies and approaches in communication with journalists, key elements, key challenges and opportunities of science communication in relation to policy.

The main findings are summarised in the conclusions. Further information on the methods and implementation of the interview process can be found in the Annex.

TABLE OF FIGURES

TABLE OF TABLES

1 INTRODUCTION

Science communication at the interface of policy making and social and technological innovation have to be analysed together. Recent publications (e.g. OECD, Science Barometer, all published in the first half of 2020) show just how important the relevance of this interface in the context of the COVID-19 pandemic is, highlighting ongoing discourse related to key concepts such as "information disorder" or more recently "infodemic". The global spread of Coronavirus has been accompanied by a wave of misinformation that is undermining policy responses and amplifying distrust and concern among citizens. The European Union has been actively tackling disinformation since 2015 with the aim to empower citizens and increase societal resilience. Beside other European key-protagonists against the COVID-19 infodemic, the Vice-President for Values and Transparency Vera Jourová recently highlighted the need of a comprehensive cooperation with social media platforms: "*Disinformation waves have hit Europe during the Coronavirus pandemic. They originated from within as well as outside the EU. To fight disinformation, we need to mobilise all relevant players from online platforms to public authorities and support independent fact checkers and media. [...] Our actions are strongly embedded in fundamental rights, in particular freedom of expression and information.*"[1]

"The crisis has become a test case showing how the EU and its democratic societies deal with the disinformation challenge."
(press release, 10 June 2020 - footnote [1])

Figure 1 EU Campaign against Coronavirus disinformation© Copyright European Commission 2020

[1] European Commission - press release. June 10, 2020: Coronavirus: EU strengthens action to tackle disinformation.

Due to the outbreak of the COVID-19 pandemic, the consortium agreed with REA to re-focus and extend this report by adding a separate chapter on trends initiated or accelerated by COVID-19, as well as considering the effect of the pandemic in all other parts. The TRESCA consortium immediately reacted to this challenge and has adapted and enhanced the original scope of the current report.

2 DATA AND METHODOLOGY

The report combines two main methods. First, comprehensive desk research was conducted at international, EU and national level for the purposes of better understanding current and emerging trends influencing the relationship between science communication and policy. Second, interviews with policy-makers were conducted between May and July 2020.

Policy-makers were interviewed in policy fields associated with innovation policy and digitalisation, specifically to the three main themes of the TRESCA project, which are policy-makers: **digital safety**, **environ-mental health**, **automation** and the **future of skills and work**. During the interviews, policy-makers were asked about how they consume, frame and use information coming from various science communication channels and produced in a variety of formats, and on whether this information helped them define their policy options and take relevant decisions. The science communication consumption patterns of interviewees policy-makers were considered, alongside their perceptions and engagement with scientists and science communication channels.

During the initial desk research phase, information came from previous studies, academic and non-academic publications, white papers and project reports, especially those produced within SWAFS, as well as related sources of information such as websites and project repositories.

The **desk research** phase was conducted within two timeframes: (1) recent trends that have been shaping in the last years (up to 2020), and (2) the trends emerging at the time of report writing (early 2020). This distinction became necessary because of the outbreak of the ongoing COVID-19 pandemic which significantly distorted the topics, channels and other characteristics of global and national science communication efforts and the interrelated policy responses.

For these two timeframes we collected the main information relevant for policy-making in the mentioned areas, such as data sources, scientific topics of interest and science

communication formats. A specific focus is laid on the current state of these issues, their evolution and the way this can influence policy-makers' decisions. Special attention was paid to the communication of findings from Social Sciences and Humanities (SSH) research related to Science, Technology, Engineering and Mathematics (STEM) developments in specific regarding the aforementioned three broad areas.

To underline our findings with practical information, good case practices of science communication were collected and summarised from each level and country (see Annex 2).

As a complementary activity, semi-structured **interviews** with the most relevant policy-makers and policy influencers on a transnational and national level were conducted to extend and validate the findings concluded through the secondary research. The interviews were based on six main question groups detailing different aspects of the policy-maker's relationship to science communication (i.e. data sources, scientific topics utilised, relevant science communication channels and formats, stakeholder engagement, dissemination of policy measures, open science). The concrete list of questions and related instructions can be found in **Annex 1.**

The **countries** involved in the desk research and interview process were selected such that they represent a balanced geographical coverage (Western Europe, Southern Europe, Central Europe, Eastern Europe), as well as a mixture between countries with high social trust (NL), medium trust (AT) and low trust (IT, HU), based on data from the European Social Survey.[2]

HIGH TRUST COUNTRY	MEDIUM TRUST COUNTRY	LOW TRUST COUNTRY
THE NETHERLANDS ↑	**AUSTRIA** ↔	**HUNGARY, ITALY** ↓

Table 1 Selected countries of the analyses

[2] European Social Survey (ESS). 2018. https://www.europeansocialsurvey.org/download.html?file=ESS8e02_1&y=2016

3 SCIENCE COMMUNICATION WITH POLICY-MAKERS – SPECIFIC CHARACTERISTICS

As defined in the SiS.net Horizon 2020 project's policy brief, science communication is *"the use of appropriate skills, media, activities and dialogue to improve individuals' awareness, involvement, engagement, interest and understanding of science."*

For the purposes of this report the individuals in the above definition are policy-makers. The science communication with policy-makers inherently holds such characteristics that are not representative for science communication processes with other types of stakeholders. These characteristics define what can be considered as *appropriate* skills, media or activities for raising policy-makers' interest in and understanding of scientific results and their willingness to engage with scientists during policy-making.

In a more and more polarized political world, if we want to put science and knowledge at the heart of political decision-making then we need to understand the policy-maker target group and the context within which they use scientific evidence. The following chapter intends to shed a light on how policy-makers might frame a policy problem and what evidence they take into account. This is often seen as a technical issue even though it is a highly political issue driven by institutional settings, values and identities. If scientists are more aware of how decision-makers frame evidence provided by them, they can help redesign the way policy-makers work together to take better decisions, prevent policy mistakes, counter misinformation and fake news, as well as enhance trust in experts and governments (Mair et al. 2019).[3]

As mentioned in Deliverable 1.1., the National Academies of Sciences, Engineering and Medicine (2017)[4] laid down four factors affecting public perception of science communication. The following short analysis investigates the factors influencing the policy up-take of scientific information along these four categories to assess the specific

[3] Mair D., Smilie L., La Placa G., Schwendinger F., Raykovska M., Pasztor Z., van Bavel R. 2019. Understanding our political nature: How to put knowledge and reason at the heart of political decision-making, EUR 29783 EN, Publications Office of the European Union Luxembourg.
http://doi.org/10.2760/374191.

[4] Committee on the Science of Science Communication: A Research Agenda, Division of Behavioral and Social Sciences and Education, and National Academies of Sciences, Engineering, and Medicine. 2017. Communicating Science Effectively: A Research Agenda. Washington, D.C.: National Academies Press.
https://doi.org/10.17226/23674.

characteristics of science communication deliberately aimed at policy-makers. Through this exercise we aim to summarize the complex direction of influence between science and policy in the communication process.

Audience characteristics

The audience analysed consists of policy-makers, with a narrower focus on policy-makers engaged in innovation policy and digital agendas. The audience of any science communication effort can be broadly divided into non-expert and expert stakeholders. The first case, when professional scientists address non-expert audiences, is called *science outreach,* while the expert-to-expert communication is often referred to as *science inreach* (SisNet 2020).[5]

Communication of scientific news and results with policy-makers is at the intersection of science outreach and inreach since the policy-makers targeted may have relevant scientific skills, knowledge and expertise, but this may not be true on the same level for all participants in the process. Even though possessing relevant scientific expertise, policy-makers are also prone to biases in reasoning and utilization of new scientific information, but the reason for this differs from the case of public perception. When encountering and interpreting scientific information, laypeople are heavily influenced by their background – e.g. education or scientific knowledge and skills – and personality traits – e.g. psychological traits, cultural and social predispositions, values and beliefs.

While policy-makers in some respects are also influenced by these features affecting everyone's understanding and perception of science, the above mentioned characteristics tend to be more uniform for policy-makers in a certain field than for the general audience, thus interpretation of scientific information does not vary as much. In many cases a "biased assimilation" can develop within networks of policy-makers homogenous in experience and insights. Here, policy actors tend to interpret evidence in a way that supports their prior beliefs and values. Scientific information challenging such common beliefs can in such cases have serious difficulties in deferring from the established interpretation of policy-relevant information.[6]

[5] SiSNet. 2020. Policy Brief on Science Communication | News | SiS Net. https://www.sisnetwork.eu/about/news/policy-brief-on-science-communication.

[6] Henry, A. D. 2011. "Ideology, Power, and the Structure of Policy Networks: Henry: Policy Networks." Policy Studies Journal 39 (3): 361–83. https://doi.org/10.1111/j.1541-0072.2011.00413.x.

Such network-level "biased assimilation" of policy-makers is influenced more by the formal *structures, procedures and networks* in which they operate when interpreting scientific information than by their *individual* personality traits.

In place of the new information being assessed based solely on the quality of its evidence (as suggested by socio-economic theory), policy actors filter this through their existing basic beliefs and preferred policy strategies concerning a particular, specialised policy area (also referred to as "policy core"). The perceived trustworthiness of information is also affected by how close the beliefs of the communicator conform to the "policy core". In most cases, shared beliefs are a necessary, but not sufficient condition for potential collaboration with the scientific community; in addition, policy-makers should also associate relevance and influence with a specific science field, institution, actor or communicator.[7]

The characteristics of the policy-maker audience is thus shaped by the policy-making organisation's and surrounding network's objectives, values and needs that are not always in line with scientific reasoning. It can therefore happen that even though policy-makers have access to and understand all the relevant sources of information, they still don´t use (or underuse) science in making policy options (National Research Council 2012).[8] The relevance and weight given to science depends on the policy context, institutional barriers and political considerations that shape the uptake of novel scientific knowledge even in such 'science-heavy' fields as digitalisation or innovation policy.

Therefore, effective science communication practices must first check, assess and understand the construction and aims of the underlying structure in which a policy decision is being made, rather than focussing on individual policy-makers' goals or characteristics. This structure does not always involve the organization itself within which a policy-maker operates, but also the network of organisations and individuals within which this organization is embedded.

Understanding which types of beliefs and values are more or less prone to "biased assimilation" and how the structure of policy networks may influence and is influenced by values and beliefs may help scientists to enhance their influence on decision-making. The

[7] Henry, A. D., and Dietz, T. 2011. Information, networks, and the complexity of trust in commons governance. International Journal of the Commons, 5(2). http://doi.org/10.18352/ijc.312

[8] National Research Council. 2012. Using Science as Evidence in Public Policy. Washington, DC: The National Academies Press. https://doi.org/10.17226/13460.

more complex a policy-making structure, the more difficult is for their actors to methodologically assess the trustworthiness of emerging scientific information, and the more difficult it is for scientists to effectively shape policy decisions.

Features of the message

The goal of scientific communication is to ensure that the audience receives and understands novel scientific information. In the case of policy-makers, scientific findings can be used for policy purposes. The purpose of science communication within policy-making should go beyond the mere explanation of scientific knowledge in order to facilitate the use of relevant information being used in the policy-making processes. For enabling a potential translation of scientific knowledge into policy recommendations or legal measures, scientists should consider several interrelated aspects.

First, the message should be formulated lay language, understandable to the target group. Scientific jargon in most cases should be toned down and re-aligned with the interests and needs of the policy-maker audience. Second, since in most cases scientific and policy stakeholders do not work together continuously (except for partnerships – see the following chapter), building up trust and understanding is crucial. Trust can be established through the mere reputation of respected scientific organisations or individuals, or through the use of intermediary organisations, but it is useful to validate the findings communicated to policy-makers. If needed, the nature of scientific inquiry and evidence should be accompanied with the results and recommendations put forward by scientists.

Finally, in a broader sense, scientists should understand what the compelling arguments are from the perspective of policy-makers, and they need to rely on those arguments instead of pretending to be communicating to their peers. If the aim is to use scientific results deemed relevant by scientific stakeholders, then the communicators should strive to understand as much as possible how science should be embedded in policy argumentation, and how science may provide the type of information likely to inform these policy arguments.

The definition of research priorities in the context of public policy-making obviously does not depend only on scientists. For this reason, degrees of agreement must be found between scientific institutions, scientists and decision-makers. Decision-makers must define their needs so that scientists can determine how, and by when, research can address these needs.

Politicians and scientists must bear in mind the level of uncertainty and the reliability of data that can be proposed in a decision-making scenario. This should include whether policy-makers asked for the research or it was rather offered by experts based on their own research, how the evidence and uncertainties were communicated, and how all of this was received and considered. If the research did influence any decisions, then it will be important to know how this occurred. If the research was not used in the decision-making process, it will be important to understand why this did not occur.

The uptake of the message is also seriously affected by other factors such as time. Usually, policy-makers operate on a tight schedule, under pressure from their policy networks and the general public with all considerations needing to be taken into account for deciding the message format. Digitalisation and visual techniques provide new opportunities for both overcoming time constraints and providing science knowledge in more accessible formats, using methods such as infotainment or storytelling.

In doing so, scientific messages should effectively fulfil one or more of the following tasks: (1) problem identification; (2) measurement of the magnitude of a problem; (3) review of alternative policy interventions; (4) systematic assessment of consequences of policy actions; (5) evaluation of policy results (National Research Council 2012).[9]

Communicator's characteristics

Science communication aimed at policy-makers can be understood as an act of social responsibility. This is a different orientation that that of education or awareness-raising, as is the case for scientific information communicated to the general public. Scientists engaging with policy-makers need to be aware of the fact that the approval and adoption of their work into policy decisions may have powerful influences on the general public's beliefs about scientific issues and their attitudes toward science-informed policy.[10] Thus, scientists as communicators ideally are driven by professional ethics and the aim to influence public policy to the best interest of the people according to their experience.

[9] National Research Council. 2012. Using Science as Evidence in Public Policy. Washington, DC: The National Academies Press. https://doi.org/10.17226/13460.

[10] National Academy of Sciences. 2018. The Science of Science Communication III: Inspiring Novel Collaborations and Building Capacity: Proceedings of a Colloquium. Edited by Steve Olson. Washington, D.C.: National Academies Press. https://doi.org/10.17226/24958.

However, the 'two communities' of scientists and policy-makers in many cases differ in the description, interpretation and evaluation of a given problem. This is mainly because scientists, as experts in their own specific field(s), usually have no formal or limited training in communication processes (towards the public and, in particular, towards policy-makers). Traditionally, intermediary bodies bridge science and policy and enabled better understanding between the two parties, but other solutions have also appeared in recent times such as the closer engagement of scientists in policy advisory boards or the direct communication of scientists to policy-makers and citizens through digital tools and methods. Many of these require scientists to better understand the language and needs of the relevant media environment.

In the age of misinformation and 'fake news', policy-makers need reliable scientific evidence on which policy decisions can be based more than ever. This raises the question of the relationship between communicators and audience. Unlike with the general public, policy-makers are generally involved with selecting the relevant scientific organisations (and individuals) communicating with them through established channels. This may range from a one-time mandate to the official involvement of scientists in advisory boards and other bodies (engagement and co-creation). While leading to higher trust levels at an organisational level, it may still constitute a trust issue at the level of society since in such cases communicators and audience may more likely be involved in the same network and may more likely share the same biases and predispositions. This may result in a distorted interpretation and uptake of research findings in policy decisions, notwithstanding the best interests of all stakeholders.

Type of media environment and communication channel adopted

Research shows that the use of science in policy-making is not a straightforward process between the provision of scientific information and a policy decision, but rather a complex endeavour including a broad set of actors and networks with feedback loops between scientists and policy-makers at each stage of the policy process (e.g. agenda-setting, policy formulation, budgeting, policy implementation, policy monitoring, policy evaluation, etc.) (National Academies of Sciences, Engineering and Medicine 2017).[11]

[11] Committee on the Science of Science Communication. 2017. A Research Agenda, Division of Behavioral and Social Sciences and Education, and National Academies of Sciences, Engineering, and Medicine. Communicating Science Effectively: A Research Agenda. Washington, D.C.: National Academies Press. https://doi.org/10.17226/23674.

To facilitate more effective communication, more sustained interactions between researchers and policy-makers were promoted that make researchers understand policy needs and circumstances and let policy-makers gain a better understanding of research agendas and processes. The role of traditional intermediaries was diminished, which led to a closer, more formal and institutionalised co-operation between scientists as communicators and policy-makers as receivers.

This meant a gradual move towards more frequent use of two-way communication forms with a higher focus on dialogue, engagement and co-creation processes, which also changed the communication channels adopted. Using the novel opportunities provided by digitalisation and ICT, traditional science communication methods such as science journalism, reports or books gave way to more interactive methods such as science cafés, science shops and various forms of internet-based interactions (e.g. online surveys or consultations).

This digital mediatisation means that scientists must be aware of the media language and needs of the new media environment. While traditionally science journalists, opinion leaders and other intermediaries have relieved scientists of this burden, today many scientists willing to act as communicators to policy-makers should have at least a minimal understanding of the language and needs of the surrounding media environment. Thus, scientists are better able to choose a channel that ensures a targeted and effective transfer of their message in today's media environment characterised by information oversaturation as well as the spread of misinformation and 'fake news' through different sources of questionable quality.

All of the above-mentioned characteristics of communication should be taken into account when checking and analysing the recent trends in the science-policy nexus. The inherent complexity of science communication with policy-makers entails that there is no 'one-size-fits-all' solution for ensuring a more efficient and streamlined communication process. This might depend on various country-, topic-, institution-, and context-related variables – and will be showcased in the variety of best practices portrayed in Annex 2. The described framework of specific characteristics is taken into account when we check the visible new trends in science communication with policy-makers in the field of R&D&I and digitalisation at the transnational and national level, using a mixed method of desk research and semi-structured interviews.

Since science communication with policy-makers happens in the above detailed complex structure, it is very complicated to ascertain how much role specific scientific inputs played

in the final policy decision. Current research literature argues that it is sufficient to assess whether science communication reached its basic objective, i.e. that relevant data or information is received and understood by those making policy decisions. Thus, it is enough to check whether the data or information was received, shared or discussed in a formal policy process (National Research Council, 2012).

We generally apply this 'use' approach in this report when discussing the recent and emerging trends in the science-policy nexus. We check the nature of mutual influence between science communication and policy through the lens of emerging trends born out of new ways to 'use' science at policy level.

We understand science 'use' in the broadest possible way, covering all policy context-dependent knowledge utilisation forms within the typology of Weiss, namely:

- Instrumental uses occur when research knowledge is directly applied to decision making to address particular problems;
- Imposed uses describe requirements to apply research knowledge by policy organisations in exchange of certain (financial) benefits;
- Conceptual uses occur when research influences or informs how policymakers think about issues, problems or potential solutions;
- Tactical uses involve strategic and symbolic actions, such as calling on research evidence to support or challenge a specific idea or programme (Weiss et al. 2005).

We must further note that even though the aim of this report is to describe the current and emerging communication trends born out of the evolving science-policy nexus on the international policy level, the focus is inevitably directed on developed countries, which make up most of the members of the analysed international organisations, such as EU bodies or the OECD. Therefore, the above-mentioned timing is seen as a starting point for new trends of science communication and its relation to policymakers is mainly valid for developed countries.

Science communication (and scientific research itself) was absent, isolated or lagging behind in many emerging countries for socio-economic and historical reasons and thus, specific social, language, cultural and structural barriers still constrain public science communication there (Fish et al, 2016). As Hin and Subramaniam (2014) point out, science communication is hampered by a lack of institutional mechanisms and inadequacies in the intermediary structures in many emerging countries, thus the newest science communication trends can

only be taken over or adopted from developed countries with a significant delay. This also entails that views in developed countries on what constitutes a good science communication programme may not be relevant in many emerging countries because of a complex mix of infrastructural, economic, educational and social barriers in terms of accessing, disseminating and using scientific information (by the public and by the policymaker audience) (Fayard, Catapano and Lewenstein 2004) .

This report aims to remedy this imbalance towards developed countries by including certain organisations in the report that are also extensively dealing with policy recommendations aimed at emerging countries, such as the WHO or the OECD.

4 Trends for Science Communication Connections with Policy at International and EU Level

4.1. The importance of the topic on the European level

The importance of the topic about better science communication in general, and in particular towards policy-makers in the domain of SSH research related to STEM developments, is more evident if we consider recent developments within the European Union. For example, Ursula von der Leyen, current President of the EC, in her discourse "A Union That Strives For More: My Agenda For Europe" presented six ambitions over the next five years for Europe.

- A European Green Deal: Emissions Trading System / 2050 climate-neutrality target / Carbon Border Tax / Circular Economy / sustainable food / single-use plastics
- An economy that works for people: small and medium-sized enterprises (SMEs) / social fairness and prosperity / Initial Public Offerings of SMEs / Economic and Monetary Union / Euro / United Nations Sustainable Development Goals / fair minimum wage / Unemployment Benefit / labour conditions of platform workers / youth unemployment / poverty / Work-Life Balance / cancer / gender balance / equality / gender / anti-discrimination / domestic violence / corporate tax system / tax fraud
- A Europe fit for the digital age: Artificial Intelligence (AI)/ 5G networks/ cybersecurity / human and ethical implications of Artificial Intelligence / technological sovereignty / digitalisation

- Protecting our European way of life: Migration and Asylum / rule of law / EU border/crime and terrorism
- A stronger Europe in the world: highest standards of climate, environmental and labour protection / child labour / fair trade / European Defence Union
- A new push for European democracy: Conference on the Future of Europe / disinformation and online hate messages

Some of these topics are typical of SSH research (i.e. migration), but most tend to be addressed with typical STEM solutions (i.e. electronic passport and border control). Disinformation seems also to be a top priority under the agenda of "democracy". Gender issues, discrimination and domestic violence are also typical SSH topics.

EU industrial policy aims to strengthen the competitiveness of Europe's manufacturing sector and the economy is aiming to help EU industries face global challenges – these challenges include talent management and retraining the workforce for Industry 4.0 jobs.

Aerospace and defence research are also getting traction. For defence, there is the European Defence Industrial Development Programme (EDIDP) and Preparatory Action on Defence Research (PADR), both of which are ending at the end of 2020, but they will likely prepare the ground for the next EU defence programme.

This showcases that our research focus – SSH research related to STEM developments around the areas of digital safety, environ-mental health, automation and the future of skills – will only gain importance in the near future.

As regards the need to communicate scientific results concerning these areas towards citizens in a more frequent and streamlined way, a recent survey offers useful insights. As shown in the figure below, people in Germany (1002 respondents), Poland (1003 respondents), and Spain (1000 respondents) who participated in the *2018 3M's State of Science Index*, said that they somewhat or completely agreed with the statement "I wish I knew more about science in general" (87%), while disagreed with the statement "As an adult, I don't see the point of now needing to understand science" (80%). The majority also agreed with the statement "It is important for everyone to have basic scientific knowledge regardless of their profession" (89%).

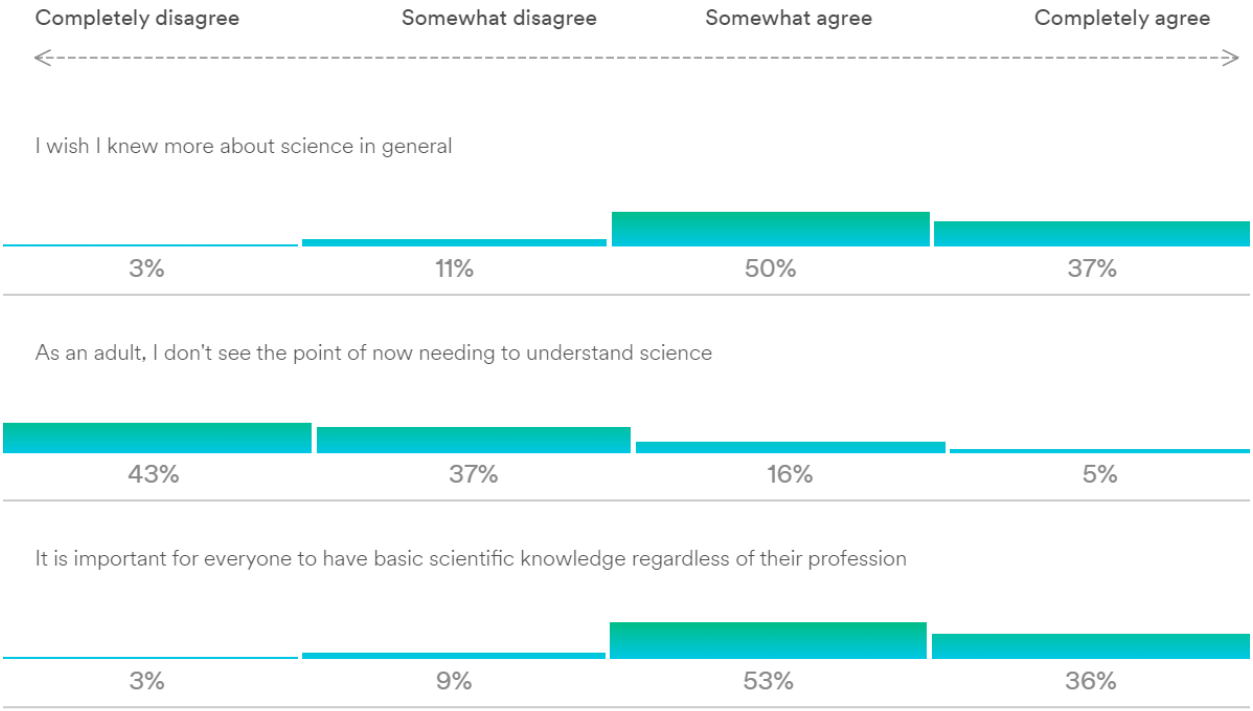

Figure 2 State of Science Survey Source: 2018 State of Science Index Study - Explore the Survey Data.

Another relevant source of data regarding public perception of science is the survey, conducted by *Wellcome Trust Monitor* in 2018, which involved over 140,000 people from 140 countries around the world. Among the main results it is worth noticing that:

- 72% of people said to trust scientists;
- over half (57%) of all respondents do not think they know much about scientific issues;
- 73% of people trust the opinion of a doctor or nurse on health-related issues; these professional figures are considered more reliable than the opinion of family, friends, religious leaders or famous people.

On the topic of vaccinations, the Wellcome Global Monitor has found that more than three quarters of respondents worldwide agree that vaccines are safe and effective -- 79% of people agree that vaccines are safe and 84% agree on their effectiveness. Worldwide, it is people with the lowest household income who have the least confidence in hospitals and the healthcare system.

With respect to gender differences in public understanding of science, the report highlights that men are more likely to recognize more scientific knowledge than women. This gender difference also exists when men and women report equal levels of knowledge. Globally, 49% of men say they know "a little" or "a lot" about science, compared to 38% of women.

4.2. Relevant trends prevailing until 2020

Digitalisation and the adoption of other innovative smart devices have influenced the multi-stakeholder and multi-disciplinary field of science communication. Experts such as Bucchi and Trench[12] argue that the early and mid-1990s can be considered as a trend shift when science communication took a leap forward and began its currently ongoing transformation by the emerging potential for scaling-up ICT and digital technologies combined with the establishment of a critical mass of relevant postgraduate programmes and PhD programmes leading to fundamental changes.

Since COVID-19 radically changed the picture of science communication in the field of innovation and digitalisation and the final outcome of certain new trends is not visible at the moment of this report therefore we analyse the relevant trends through a thorough secondary desk research of scientific and policy documents between the mid-1990s and the beginning of 2020. Taking into account the narrower core areas of the project, we focused our research on innovation and digitalisation trends in the science-policy interface primarily at the European level.

We consider the following general trends and patterns emerging and ongoing from the above-mentioned timing as the most relevant in this context:

Stronger engagement between science and policy

Most scientific advice is provided to policy-makers through ‘scientific assessment’, i.e. an expert assessment of the state-of-the-art of knowledge in a given field, as well as the implications of such knowledge. There are many ways to communicate these scientific

[12] Bucchi, Massimiano, and Brian Trench. 2015. “Science Communication Research over 50 Years: Patterns and Trends.” In B. Schiele, J. Le Marec & P. Baranger (eds) Science Communication Today – 2015: Current strategies and means of action (PUN – Éditions Universitaires de Lorraine, 2015)

assessments to decision-makers. Scientific advice is provided through a range of different mechanisms, dependent upon institutional, political and cultural factors (Allio et al 2005).[13]

However, there is a general trend at international and in particular EU level to include scientific evidence in the legislative and regulatory decision-making process by institutionalising the function within policy-making bodies. A stronger engagement between experts and decision-makers is built through various institutional mechanisms to ensure the integrity, quality and effectiveness of scientific communication systems. This model based on dialogue and engagement model more and more replaces the traditional communication models based on 'deficit' theory."

The deficit theory argues that it is primarily the lack of available scientific input which hinders policy-makers to consider expert opinion in their decisions. It is to be solved through one-way communication which entails the aggregation and translation of scientific information to policy-makers, e.g. through briefs or studies. Nevertheless, scientific evidence cannot simply be linearly translated to the policy-making process. The use of scientific information in policy-making does not only depend on the available information as deficit theory suggests, but also involves coalition-building, rhetoric and persuasion, accommodation of conflicting values and expectations (Contandriopoulos et al. 2010).[14] The science communication should take into account the specific characteristics of the policy-maker target group (see Chapter 3).

While we take into account the view of Trench (2008),[15] that more science communication models can co-exists at the same time in various setting, we still maintain that the European trend, moves away from the one-way linear communication, propagated by deficit theory, towards utilizing principles of the contextual approach, namely a more frequent and symmetric interaction between experts and decision-makers where the scientific community

[13] Allio, Lorenzo, Bruce Ballantine, and Richard Meads. 2006. "Enhancing the Role of Science in the Decision-Making of the European Union." Regulatory Toxicology and Pharmacology, Science and Politics - From Science to Decision Making, 44 (1): 4–13. https://doi.org/10.1016/j.yrtph.2005.08.008.

[14] Contandriopoulos, D., Lemire, M., Denis, J-L., and Tremblay, E. 2010. Knowledge exchange processes in organizations and policy arenas: A narrative systematic review of the literature. The Milbank Quarterly, 88(4), 444-483.

[15] Trench, Brian. 2008. "Towards an Analytical Framework of Science Communication Models." In Communicating Science in Social Contexts: New Models, New Practices, edited by Donghong Cheng, Michel Claessens, Toss Gascoigne, Jenni Metcalfe, Bernard Schiele, and Shunke Shi, 119–35. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-1-4020-8598-7_7.

plays a more proactive role (Miller, 2001).[16] This should be embedded in local systemic relations, meaning that there is no one-size-fits-all solution, but each institution and country may depend on different forms of science communication with policy-makers.

Such a shift for a non-linear public engagement approach was confirmed by Smallman, 2014[17] analysed the 50 most cited papers from the top-notch journal in the field, Public Understanding of Science in the period of 1992-2010 and found that from 2000s a majority of papers adopted the public engagement practices, while a decade before the majority still used 'public understanding models' (a rough equivalent of dissemination). This analysis tends to show a dialogic turn in science communication to a science and society model in the last decades:

On the following figure, this trend can be envisaged as moving towards the inside of the so-called 'public engagement onion'. which shows the different methods and degrees of involving the different stakeholders in engagement.

[16] Miller, Steve (2001). Public Understanding of Science at the Crossroads. Public Understanding of Science, Vol. 10, 115-120. https://doi.org/10.1088/0963-6625/10/1/308

[17] Smallman, M. (2014). Public understanding of science in turbulent times: III – Deficit to dialogue, champions to critics. *Public Understanding of Science,* Online First, 18 September 2014.

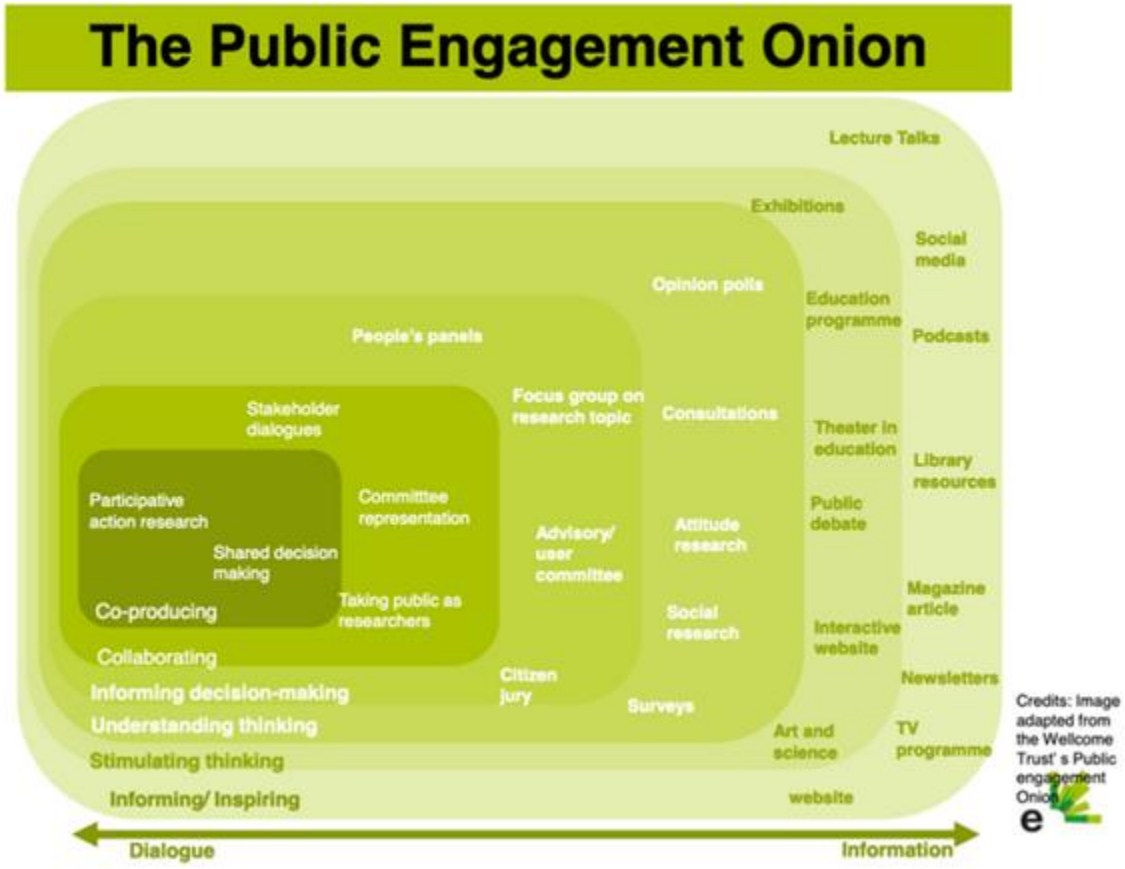

Figure 3 The Public Engagement Onion. Source: Ecsite, adapted from the original image by Wellcome Trust 2019

Analogous to the public engagement forms, there are at least three main methods for science communication with policy-maker audiences. The first approach is a **summarization** and **translation process**, based on the deficit model when expert persons or organisations collect and analyse evidence that they communicate to decision-makers through traditional (briefs, studies, guidelines) or more modern channels (websites, social media): In the Figure "The Public Opinion Onion" this communication method represents the informing and inspiring and stimulating thinking parts.

For instance, the UN's Scientific Advisory Board established in 2013 can be seen as a traditional forum for one-way science communication. The board is expected to advise on issues related to the interface between science and policy, in particular those related to sustainable development. The **second approach** of communicating science to policy-makers happens in the form of **brokering**. Broker persons or boundary organisations bridge science and policy-making by providing information and developing relationships between

knowledge producers (risk assessors) and knowledge users (risk managers). Boundary organisations facilitate the flow of information among researchers, policy-makers and other stakeholders while staying neutral (Bednarek et al 2016).[18] In the figure "The Public Opinion Onion" this communication method represents the understanding thinking/informing decision-making parts.

The International Science Council (ISC) is one of the most relevant such boundary organisations bringing together over 200 international natural and social science unions and associations as well as national and regional scientific organizations including academies, research councils, institutes and foundations. Through this unique network, ISC uses its scientific expertise to communicate science that is relevant to international policy issues, and to promote developments that enable science to contribute more effectively to major issues in the international public domain.

Euroscience is a unique boundary organisation in the science-policy interface in the sense that it brings together 2500 individual and 16 corporate scientific members from 75 countries and then represents them as individual professionals, irrespective of their institutional or employment affiliation. Thus, Euroscience is in a unique position to consult its membership and through its science policy working group provide the opinion of the scientific community on relevant issues to policy-makers through public statements.

The Organisation for Economic Cooperation and Development (OECD) can be considered such a boundary organisation in a variety of scientific issues. The organisation's science communication takes place through various formats, from policy briefs and studies through small and large events until social media presence. From TRESCA perspective, the Global Science Forum (GSF) is relevant since it functions as a forum for consultation among government officials and scientists from all over the world to formulate proposals on important issues regarding science and technology.

The **third approach of communicating science to policy-makers** is by **building partnerships** between members of the policy system and the scientific community. These are permanent relationships among researchers, policy makers, and practitioners that can benefit science communication directly by building understanding of science and trust: researchers come to understand local needs and circumstances, while policy makers and

[18] Bednarek A.T., Shouse B, Hudson C.G., Goldburg R. 2016. Science-policy intermediary from a practitioner's perspective: The Lenfest Ocean Program experience. Science and Public Policy. 2016

practitioners gain a better understanding of the process of research and their role in it. This higher trust and better understanding makes it possible to design research agendas and protocols that are responsive to the needs and goals of all parties (National Academies of Sciences 2017).[19]

In figure "The Public Opinion Onion" this communication method represents the collaborating/co-producing parts.

This shift in communication with political decision-making from traditional one-way methods towards partnerships can be observed at the European level. EU decision-making is informed and influenced by scientific evidence in an increasingly more formalised manner where stakeholders collaborate to co-produce administrative, legislative and regulatory acts. The changes started in the mid-1990s when expert groups started to increase in numbers and independent scientific committees were set up to provide scientific advice for the preparation of policy, as well as regulatory advice required by legislation. At the same time scientific advisory agencies were set up, such as the European Medicines Agency and the European Chemicals Agency and internal advisory bodies, such as the European Group on Ethics of Science and New Technologies (Rogers, 2011).[20]

The novelty of these agencies was the delegation of executive power to carry out risk assessments to a neutral agency however the responsibility for decision-making (risk management) remained at the Commission. These bodies operated in a format where in theory there was a demarcation between advice and action (or risk assessment and risk management), which in practice did not always work. These bodies represented the traditional form of science communication when experts give input to policy-makers at their request.

The Joint Research Centre (JRC) founded in 1957 has had the formal science advisory role since 1988. The JRC represents the first boundary organisation, going beyond the traditional expert role of agencies. As an in-house research service of the Union, it is at the interface

[19] National Academies of Sciences, Engineering, Division of Behavioral and Social Sciences and Education, and Committee on the Science of Science Communication: A. Research Agenda. 2017. The Complexities of Communicating Science. Communicating Science Effectively: A Research Agenda. National Academies Press (US). https://www.ncbi.nlm.nih.gov/books/NBK425719/

[20] Rogers, Michael D. 2011. "The European Commission and the Collection and Use of Science and Technology Advice." Chapter. In The Politics of Scientific Advice: Institutional Design for Quality Assurance, edited by Justus Lentsch and Peter Weingart, 115–36. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511777141.007

between science and policy with its scientific and technical staff that consist of one department of the Commission. It communicates scientific information to more than 20 DGs without having an own political agenda. JRC's activities cover policy anticipation, policy formulation, policy implementation and ex-post policy evaluation within a range of EU policies (Wilsdon and Doubleday 2015).[21]

Looking upon the scientific communication of these advisory and boundary organisations, the 2001 report of the Commission Working Group "Democratizing Expertise and Establishing Scientific Reference Systems" made therefore several recommendations regarding scientific advice, such as the mapping of expertise, making the advisory process more transparent and open, as well as to build better connections between stakeholders with advisory and decision-making roles in the system.

Based on these recommendations, a 2005 policy paper of the European Policy Centre (EPC) made a suggestion to establish a new, coherent policy for the collection, analysis and use of scientific data with the help of a newly set-up position of an independent Chief Scientific Adviser, which would coordinate the various sources of scientific advice to the Commission, and thus build a stronger link between advice and policy (Allio et al 2005).[22]

Such a Chief Scientific Adviser (CSA) role was established by Commission President Barroso in 2012 in a broader reform package (Moodie 2016),[23] but it did not fulfil the hopes that were initially placed into it.

The plan was to move forward from the brokering role of JRC to a real partnership between science and policy, but early on strong critics were formulated on the one hand by civil society organisations that there is too much influence concentrated in one person, as well as the activities of the CSA is not transparent and accountable (following the interests of different lobby groups). On the other hand, policy-makers were also dissatisfied when the CSA offered opinion in controversial issues which contradicted policy interests (e.g. in case of GMOs). There were also institutional weaknesses concerning CSA since minimal resources

[21] Wilsdon, J. and Doubleday, R. 2015. Future Directions for Scientific Advice in Europe. Cambridge: Centre for Science and Policy

[22] Allio, Lorenzo, Bruce Ballantine, and Richard Meads. 2006. "Enhancing the Role of Science in the Decision-Making of the European Union." Regulatory Toxicology and Pharmacology, Science and Politics - From Science to Decision Making, 44 (1): 4–13. https://doi.org/10.1016/j.yrtph.2005.08.008

[23] Moodie, John R. 2016. "Resistant to Change? The European Commission and Expert Group Reform." West European Politics 39 (2): 229–56. https://doi.org/10.1080/01402382.2015.1041824

were allocated to the system which was not integrated into the DG responsible for science and research and whose competences also overlapped with JRC and other agencies (Wilsdon and Doubleday 2015).[24]

Thus, the CSA position was scrapped by Commission President Juncker in 2014, and at his request, Commissioner for Research, Science and Innovation Moedas introduced a new Scientific Advice Mechanism (SAM) system in 2015. In place of one person, SAM consists of seven high-level experts whose work is supported by a 15-person Secretariat. The main novelties of SAM is that it is embedded within the Commission's system: it is located at DG Research and Innovation and thus has better connections to the College of Commissioners (direct reporting and operational support), as well as structured relationship with national academies and other Member State bodies (Klumpers 2016).[25]

SAM represents a true partnership between excellent science and high-level policy-making. It communicates in various formats, proactively choosing its own agenda and advising the Commission where Commissioner Moedas acts as an intermediary between supply and demand of scientific input.

[24] Wilsdon, J. and Doubleday, R. 2015. Future Directions for Scientific Advice in Europe. Cambridge: Centre for Science and Policy

[25] Klumpers. 2016. The European Commission's Scientific Advice Mechanism. European Commission. https://ec.europa.eu/research/sam/pdf/presentations/vilnius_2016/vilnius2016_johannes_klumpers.pdf.

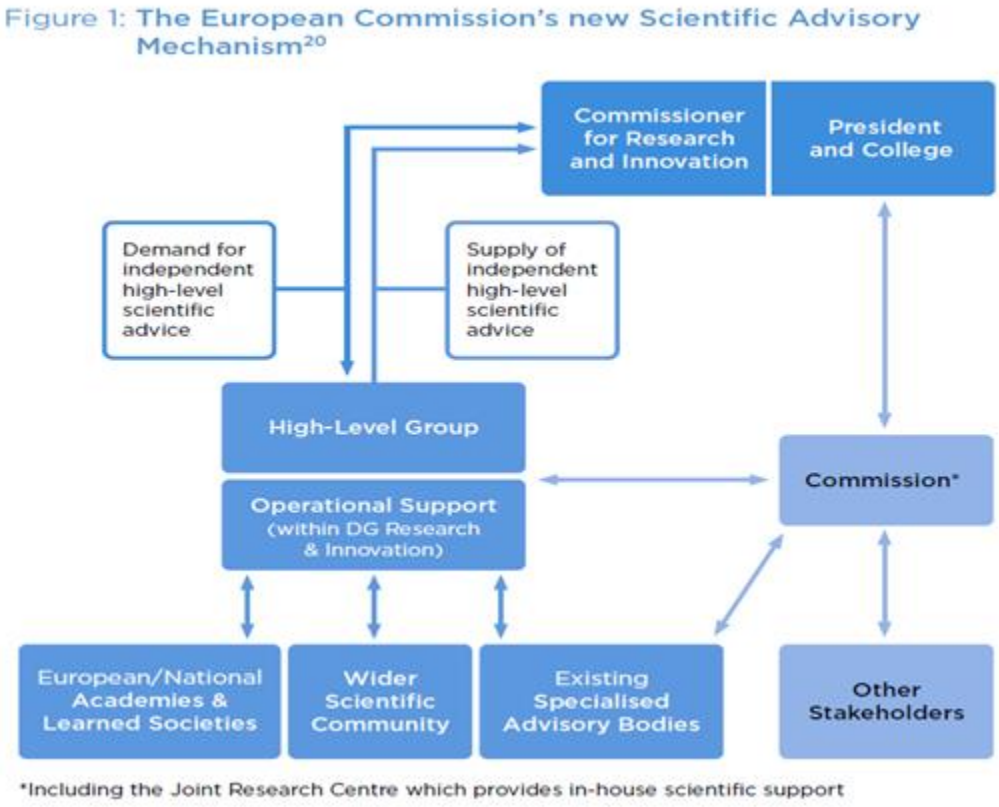

Figure 4 The Scientific Advisory Mechanism of the European Commission (Wilsdon and Doubleday, 2015)

As regards the European Parliament, its Scientific and Technological Options Assessment (STOA) was set up in 1987. After two reforms, it gained its current structure and mission in 2003-2004 from which date it can be considered as a partnership in the science-policy interface. Political oversight is ensured by the EP which decides on STOA's research priorities and approves its studies. With the support of external experts, STOA focuses on providing the EP with high-quality independent studies and identifying options for the best courses of action. In addition to studies, lectures and conferences are the preferred science communication format of STOA. Since STOA makes all its – non-scientifically written – studies and events public and strives to engage in dialogue with citizens on their implications, its

partnership ensures a broadening engagement towards citizen stakeholders (Wilsdon and Doubleday 2015).[26]

The 2001 report on democratization of expertise also foresaw the creation of new participatory mechanisms and ways to reform the traditional model of expertise itself. The purpose of these suggestions was to democratise the scrutiny of expert opinions by allowing a greater role for citizens. Thus, it recommended creating procedures such as citizen's juries, consensus conferences, focus groups or public hearings to represent public opinion in the interface of expert and policy-maker stakeholders (Turner 2008).[27]

There are certain good practices from Member States for such citizen engagement within the science-policy interface. The Danish Board of Technology organizes such participatory consensus conferences where experts communicate their factual knowledge in an actual, well-researched but controversial scientific topic to a selected non-expert panel of 16 persons representing the general population. The lay persons communicate among themselves and must reach an understanding of the issue, which will be taken into account in policy-making (Horst 2008).[28] In the UK, a 'line of argument' process was used at meetings where a mix of policy-makers, experts and external non-expert stakeholders jointly explored the diversity of values, goals and innovation needs around complex scientific issues concerning sustainability (Bielak et al 2008).[29]

These national precursors served as examples for the Commission: many initiatives for better citizen engagement in science and policy-making have been introduced since 2001. These consist of policy initiatives, research projects, actual practices, governance and

[26] Wilsdon, J. and Doubleday, R. 2015. Future Directions for Scientific Advice in Europe. Cambridge: Centre for Science and Policy

[27] Turner, Stephen. 2008. "Expertise and the Process of Policy Making: The EU's New Model of Legitimacy." Chapter. In Building Civil Society and Democracy in New Europe, edited by Sven Eliason. Cambridge: Cambridge Scholars Publishing

[28] Horst, Maja. 2008. "In Search of Dialogue: Staging Science Communication in Consensus Conferences." In Communicating Science in Social Contexts: New Models, New Practices, edited by Donghong Cheng, Michel Claessens, Toss Gascoigne, Jenni Metcalfe, Bernard Schiele, and Shunke Shi. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-1-4020-8598-7_15

[29] Bielak, Alex T., Andrew Campbell, Shealagh Pope, Karl Schaefer, and Louise Shaxson. 2008. "From Science Communication to Knowledge Brokering: The Shift from 'Science Push' to 'Policy Pull.'" In Communicating Science in Social Contexts: New Models, New Practices, edited by Donghong Cheng, Michel Claessens, Toss Gascoigne, Jenni Metcalfe, Bernard Schiele, and Shunke Shi. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-1-4020-8598-7_12

training methods (Nascimento et al., 2016).[30] JRC has recently developed a new citizen engagement inventory for practices, projects and organisations within the Commission and Member States.

A comprehensive list of methods for policy-maker engagement with science can be found in the interactive web platform of the European Science Engagement Association (EUSEA). This comprises among others debates, science cafés, societal hackathons, world cafés, scenario workshops, ritual dissents, etc.

Reliable, accountable and open science communication with policy-makers

The stronger engagement of scientists into policy-making via more formalised systems within international institutions can be understood as a strategic alliance building process with experts to enhance the competence and legitimacy of a given organisation (Moodie 2016).[31] This trend entails two risks: on the one hand, corporate influence may grow at the expense of other stakeholders as civil society and trade union groups warn the European Union (Alter-EU, 2014).[32] On the other hand there is a debate (within the broader issue of democratic deficit in case of the EU) that policies are becoming too technocratic and solutions are 'dictated' by experts and not considering broader societal implications and values.

In order to address these challenges there is a need for a science communication in the policy sphere which in itself is open, reliable and accountable (process dimension) and is based on open, reliable and accountable data sources (input dimension). In this way it can be ensured that evidence-informed decision-making is 'democratized', does not fall victim to specific lobby interests and remains or increases its procedural and outcome effectiveness.

As a key pre-requisite for a more open and trustworthy communication between scientists and political decision-makers, experts engaged in scientific communication with political decision-makers need to be proactive and, if need arises, to know which decision-makers to contact and in which way and through which channels. This necessity was highlighted in the

[30] Figueiredo Nascimento, S., Cuccillato, E., Schade, S., Guimaraes Pereira, A., 2016. Citizen Engagement in Science and Policy-Making, EUR 28328 EN, doi: 10.2788/40563

[31] Moodie, John R. 2016. "Resistant to Change? The European Commission and Expert Group Reform." West European Politics 39 (2). https://doi.org/10.1080/01402382.2015.1041824.

[32] Alter EU.2014. New Commission Must End Corporate Dominance of Expert Groups. Brussels

2005 EPC policy paper where a recommendation was made to draw up mandatory detailed guidelines for the presentation of scientific advice to policy-makers (Allio et al. 2005).[33]

Based on the core principles of openness, quality and effectiveness, the European Union has started to draw up such guidelines and make practical recommendations on communication with scientific experts (EU, 2004).[34] In the last decades, more such guidelines followed on how to develop more effective channels between the worlds of research and policy-making – for instance, results were obtained through an extensive survey process with leading academics, decision-makers and knowledge transfer specialists for EU (2008)[35] and EU (2010),[36] following the trend for a higher level of engagement in the science-policy interface.

These guidelines conceptualised the key priorities for deepening communication and strengthening the transfer of knowledge and experience between research and policy-making. They mostly highlighted practical means to use in the framework of FP projects, but did not provide a deeper understanding on how policy-making systems and processes work (i.e. the specific characteristics of policy-makers and the surrounding institutions and networks as regards to science communication). Horizon 2020 supported projects aimed at mitigating this basic knowledge gap, e.g. the EU Guide to Science Communication video series, but a more comprehensive easy-to-use guide covering both institutional and legislative structure and procedures, as well as practical communication hints is still missing. The American Association for the Advancement of Science (AAAS) has already compiled such a guide which starts with introducing the legislative process and bodies in US Congress, followed by practical communication advices structured around 10 goals (White 2011).[37]

[33] Allio, Lorenzo, Bruce Ballantine, and Richard Meads. 2006. "Enhancing the Role of Science in the Decision-Making of the European Union." Regulatory Toxicology and Pharmacology, Science and Politics - From Science to Decision Making, 44 (1). https://doi.org/10.1016/j.yrtph.2005.08.008.

[34] Publications Office of the European Union. 2004. "Collection and Use of Expertise by the Commission: Principles and Guidelines: Improving the Knowledge Base for Better Policies." Website. Publications Office of the European Union. April 28, 2004. http://op.europa.eu/en/publication-detail/-/publication/5543a691-9f67-4f68-bf1b-28b522b35545.

[35] European Commission. 2008. Scientific Evidence for Policy-Making." Luxembourg: Office for Official Publications of the European Communities. https://doi.org/10.2777/86708

[36] European Commission, ed. 2010. Communicating Research for Evidence-Based Policymaking: A Practical Guide for Researchers in Socio-Economic Sciences and Humanities. EUR 24230. Luxembourg: Publications Office of the European Union.

[37] White, Kasey Shewey. 2011. Working with Congress: A Scientist's Guide to Policy. Place of publication not identified: Aaas.

Another practice more widespread in the US is job-shadowing where scientists may gain a deeper understanding on the policy side of evidence-influenced decision-making. In the US, the Congressional Science Policy Initiate where experts and policy-makers are engaged in various ways (e.g. via hearings, technical assistance on legislation, organization of council of experts).

However, the EU followed suit with programmes such as the MEP-scientist pairing scheme which started in 2009. Organised by STOA, the scheme aims to support the development of relationships between MEPs and scientists to improve access to scientific advice and deepen scientists' understanding of the role of science in policy-making by letting scientists shadow their MEPs as during their parliamentary business. Scientists can attend committee meetings and meeting officials working in their relevant policy areas, and vice versa MEPs visit the workplace of scientists to experience how research is conducted in practice.

In order to support the better understanding of its policy processes concerning scientific advice and communication, the European Union seeks new ways to be more transparent in the usage of expertise. In reply to critics surrounding the Chief Scientific Adviser system, the selection of members of the Scientific Advice Mechanism was also a highly transparent process where a 3-member expert group evaluated the nominees based on well-defined criteria. As a first important step, the Commission made its online register of experts and expert groups publicly available in 2005.

On the other hand, transparency and accountability should not just be the concern of the policy-side but it also needs to extend to experts themselves as regards how evidence was collected, analysed, prioritized or transferred. Fostered by the European Commission, the ongoing general movement towards open science is also transforming science communication, giving rise to the practice of open scholarly communication addressing not only access to data, but also scholarly outreach and engagement with policy-makers (EU, 2016).[38]

Studies have shown that the question of accessibility is relevant for science communication towards policy-makers, in addition to trustworthiness of information or compatibility of

[38] Publications Office of the European. 2016. "Open Innovation, Open Science, Open to the World: A Vision for Europe." Website. Publications Office of the European Union. May 17, 2016. http://op.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1/language-en.

information with a specific decision-making process (Olesk et al 2019).[39] Spearheaded by private platforms for open science publishing, such as Research Gate, Academia.edu or Mendeley, the European Union has also recently introduced the European Data Cloud (EOSC) for an open, reliable, virtual, federated environment to store, share and re-use research data across borders and scientific disciplines and provide access to rich array of related service with new opportunities arising in the science-policy interface.

Recently COVID-19 has given further impetus to open science trends. Other platforms for open scholarly communication have been developed. The European Union has introduced its own website facilitating open data sharing and analysis concerning coronavirus research, with the support of which a record-breaking Coronavirus hackathon and Machathon was organised.[40]

There are other repository pages for open scientific information, such as the Coronavirus – big data response portal, the CORD-19 dataset run by the US White House Office of Science and Technology Policy, Google Cloud's Kaggle websites listing the most relevant 1500 projects concerning COVID-19 with the help of machine learning, or a novel coronavirus research compendium with the most relevant scientific papers maintained by Johns Hopkins University's (JHU's) Bloomberg School of Public Health, and there are also websites sharing open-source data on vital medical and engineering scientific data (concerning home-made masks). The latter was promoted by the Spanish minister in a recent official speech, showcasing policy recognition and use of reliable open-source platforms.

Other websites do not only act as open-access scientific information collections for citizens, academics and policy-makers, but also offer analyses based on the gathered scientific input. Policy-making bodies such as the European Investment Bank or OECD set up such websites for open scientific information dissemination.

A comprehensive outlook of the potential effect of COVID-19 on a series of socio-economic issues is provided by the European Investment Bank's (EIB) "Does this change everything" website. This website hosts articles and podcasts by EIB experts on topics such as climate action, data privacy, digitalisation, small businesses, etc.

[39] Olesk, A., Kaal, E. and Toom, K. 2019. 'The possibilities of Open Science for knowledge transfer in the science-policy interface'. JCOM 18 (03), A03. https://doi.org/10.22323/2.18030203.
[40] https://www.covid19dataportal.org/about

The University of Oxford's COVID-19 government response tracker platform systematically collects the different government policy measures taken to respond to the pandemic. Based on 17 health, socio-economic and (free movement) restriction indicators stemming from 160 countries, valuable scientific indexes and comparative analyses are provided to policy-makers intending to initiate better actions against COVID-19 in their countries.

OECD has had a narrower focus on research and innovation policies: its dedicated website on the science and innovation policy responses on coronavirus collects information on the science and innovation policy measures and arrangements its member states utilised to respond to the COVID-19 crisis. Collecting a wide-range of country-level information on science advice and communication, STI collaboration mechanisms, specific or novel STI measures and the virus's impact on the STI system, the website is a highly useful cross-country science and innovation information service that STI policy-makers may use when designing their own policies.

As a recent Bloomberg article states, we should be careful with generalisation but in some disciplines researchers will be more inclined to do science and science communication in more open, collaborative ways. This ongoing trend implies a landscape where open research-distribution channels and peer-reviewed journals exist side-by-side, having a significant impact on policy advice too.

Better transparency and higher openness however cannot decrease the reliability and excellence of scientific input used for policy advice. Even before – but certainly accelerated by – the COVID-19 pandemic, pre-prints, i.e. academic papers before peer-review or publication have gained in popularity and importance, as Science articulates.

The current situation where policy-makers have to make swift decisions tempts scientists to publish findings as fast as possible, but this may have a negative effect on evidence-based policy-making and the general trust in science. COVID-19 might have other disproportionate effect through these preprints, e.g. it is not sure that the best research gets first published and used (by policy-makers) since women's and early-stage researchers' research production has significantly decreased since the outbreak of the pandemic.

Open scholarly communication is partly made possible by the arrival of big data, and big data also helps to make it more reliable and accountable, ensuring its level of excellence. Big data is in this sense the flood of data provided as a by-product of electronic media and transactions. There were significant advances in large-scale data collection backed by a

significant growth in computing power and improved methods of analytical techniques enabling scientists to provide a much larger volume of openly accessible verifiable datasets and analyses thereof, which can be taken up by political decision-makers (Lazer et al. 2009).[41]

The WageIndicator Foundation serves as a good example for an organisation collecting and analysing worldwide big data, which is then openly published on a web platform with the intention of providing sound scientific evidence for labour market policies. Through its co-operation with the Global Labor Organisation (GLO), the Foundation is able to attract the attention of interested policy-makers by its continuously updated data on wages, income and prices, as well as on labour law and collective bargaining agreements.

The New Approaches to Economic Challenges (NAEC) initiative of OECD is another such example for an open and big data based scientific information sharing with policy-makers. Highly relevant experts in various topics around STI make presentations – using the advantages of big data – in a series of events to which OECD ambassadors as representatives of their national governments (policy-makers) are invited for discussion and engagement. Citizen stakeholders can also follow through a live web streaming.

NAEC presents a highly effective open form of networking between experts and policy-makers, but open science also allows scientists to be the distributors and promoters of their own data and findings without any boundary organisations, thus changing the role of traditional intermediaries. The once indispensable intermediaries are increasingly displaced or marginalised. Boundary organisations in the form of non-profits, industry groups, advocacy organizations and private-sector companies are circumvented by direct communication channels.

A survey conducted of 254 tenure-track faculty at the University of Wisconsin–Madison in STEM fields showed a widespread use of social media among scientists. Across ages, genders, and disciplines, 42% of respondents reported that they blog about their research. Almost 50% blogs, and almost 20% tweets at least once each month. In addition, being active

[41] Lazer, D., Pentland, A., Adamic, L., Aral, S., Barabási, A-L., Brewer, D., Christakis, N., Contractor, N., Fowler, J., Gutmann, M., Jebara, T., King, G., Macy, M., Roy, D., and Van Alstyne, M. 2009. Computational social science. Science, 323(5,915)

on Twitter amplifies the effects of more traditional communication, resulting in more citations for a scientist's publications (Liang et al. 2014).[42]

In addition, scientists are becoming more open toward public communication with journalists – also in the hope of influencing policy decisions. This is increasingly true for researchers in emerging areas with higher moral or political implications, such as GMOs or climate change, who intend to 'sell' their agenda through maintaining good relationship with the press. The result of a 2005-2006 survey with the participation of about 1,200 biomedical scientists from France, Germany, Japan, the United States, and the United Kingdom was that connections between scientists and journalists are quite frequent. 30% of researchers interacted with the media more than 5 times in the past 3 years, and 39% had 1-5 interactions. (Peters et al. 2008).[43]

However, despite this trend towards more open and direct communication, there is a countering trend in force, namely the polices that regulate communication between the scientific community and the media. Political decision-makers try to limit communication in the science-policy interface in a way that journalists must seek permission for an interview from the higher-ups of the publicly funded research institution where the researcher is affiliated. This might not be visible in the quantity, but in the quality of scientific information provided to journalists (if such permission is granted).

These trends against openness and accountability in science communication cannot be legitimised by political reasons however they can be justified for the sake of higher reliability and security. However, as the recent OECD policy recommendations warn policy-makers (and data controllers) should be transparent and accountable in their actions concerning data collection with the help of digital technologies, as well as only proportionate and limited restrictions on freedom of data transfer (e.g. between scientists and journalists). Political decision-makers should ensure the engagement and participation of a wide range of (scientific) stakeholders with a view to ensuring that the collection, processing and sharing

[42] Liang, Xuan, Leona Yi-Fan Su, Sara K. Yeo, Dietram A. Scheufele, Dominique Brossard, Michael Xenos, Paul Nealey, and Elizabeth A. Corley. 2014. "Building Buzz: (Scientists) Communicating Science in New Media Environments." *Journalism & Mass Communication Quarterly*, September. https://doi.org/10.1177/1077699014550092.

[43] Peters, H. P., D. Brossard, S. de Cheveigné, S. Dunwoody, M. Kallfass, S. Miller, and S. Tsuchida. 2008. Science communication: Interactions with the mass media. Science 321(5886).

of personal data serves the public interest and is consistent with societal values (OECD 2020c).[44]

The increasing digitalisation and visualisation of science communication

As underlined in the characteristics section, policy-makers take into account more than scientific facts and frame the provided scientific evidence in various ways when making a political decision. At least two other aspects, their political considerations (extrinsic aspect) and value preferences (intrinsic aspect) might play a role here. As argued by Mair, 2019 values are so important in driving political behaviour that they need to be considered from the initial development stages of the policy cycle through communication and information actions.[45]

The proper presentation of reliable facts is not itself enough for a successful communication with policy-makers. Scientific evidence should be repackaged in a digestible and accessible format, providing a narrative to policy-makers to which they can relate. One way to support this re-packaging is the more frequent use of visual and interactive solutions presented through novel digital channels, which can be observed in more and more countries. The most relevant visual methods include graphs, charts, process diagrams, maps or portraits. Such visual solutions are more and more likely to be shared not only by images but also by videos.

Many such online channels disseminating actual scientific facts through videos are available, for instance SciShow (https://www.youtube.com/user/scishow/videos), It's Okay to be Smart (https://www.youtube.com/c/itsokaytobesmart/featured) or Crash Course (https://www.youtube.com/user/crashcourse/playlists) have a wide following. All these pages offer educational interactive videos in scientific topics, following an engaging narrative. One of the most influential platforms is Kurzgesagt ('in a nutshell'), a German animation studio regularly providing short animated educational content on online channels. It discusses scientific, technological, political, philosophical and psychological subjects to a wide audience (over 12 million subscribers as of 2020). Their expertise helped

[44] OECD. 2020c. Ensuring Data Privacy as We Battle COVID-19. http://www.oecd.org/coronavirus/policy-responses/ensuring-data-privacy-as-we-battle-covid-19-36c2f31e/.

[45] Mair D., Smilie L., La Placa G., Schwendinger F., Raykovska M., Pasztor Z., van Bavel R., Understanding our political nature: How to put knowledge and reason at the heart of political decision-making, EUR 29783 EN, Publications Office of the European Union Luxembourg, 2019, ISBN 978-92-76-08621-5, doi: 10.2760/374191, JRC117161

them reach new grounds when the latest video on COVID-19 had more than 25 million views and attracted the attention of policy-makers.

The increasing digitalisation of science communication with policy-makers is connected to the changing roles and landscape of intermediary organisations. In addition to 'general' social media channels such as Twitter, there are new social networks specifically aimed at academic people where they can network and share their latest research with other interested peers, including experts from the policy side. A 2014 Nature survey shows that 88% of scientists and engineers around the world are aware of the most well-known academic social network, ResearchGate and half of them visited it regularly, although – in contrast to Twitter where less researchers are present but they are more active – used it most likely for maintaining a profile, posting work or discovering related peers and peer-reviewed papers (van Noorden 2014).[46]

Scientists are increasingly using social media to communicate directly and if the public— and not the media— catches up with some topics and they go viral then policy-makers can have a hard time to ignore this in their decision-making. Vice versa, policy-makers may decide to inform the public on scientific facts through their personal social media channels, circumventing journalists. If these 'facts' are distorted through their political interests, group interests or value preferences and correspond to the general view of the public, scientists may have to struggle hard to correct or protest against these information (Brossard et al, 2010).[47]

Visualisation is considered by some experts such an integral part of the scientific communication towards policy-makers that it has been included as a separate step within an interactive process for obtaining evidence for policy development, dubbed MAVS (mapping – analysis – visualisation – sharing). As experts Horton and Brownpointed out, evidence production and analysis often results in lengthy and often impenetrable reports, which make the process of transparent evidence sharing impossible and often counter-productive. Therefore, the best ways – such as infographics and other digital technologies – should be used to communicate evidence to which web-based national and international

[46] Van Noorden, Richard. 2014. "Online Collaboration: Scientists and the Social Network." Nature News 512 (7513): 126. https://doi.org/10.1038/512126a.

[47] Brossard D, Lewenstein BV. Communicating Science: New Agendas in Communication. Kahlor L, Stout PA, editors. New York: Routledge; 2010. A critical appraisal of models of public understanding of science: Using practice to inform theory. Pp. 11-39.

events and online publishing models provide new opportunities (Horton and Brown 2018).[48] MAVS is presented in the figure below.

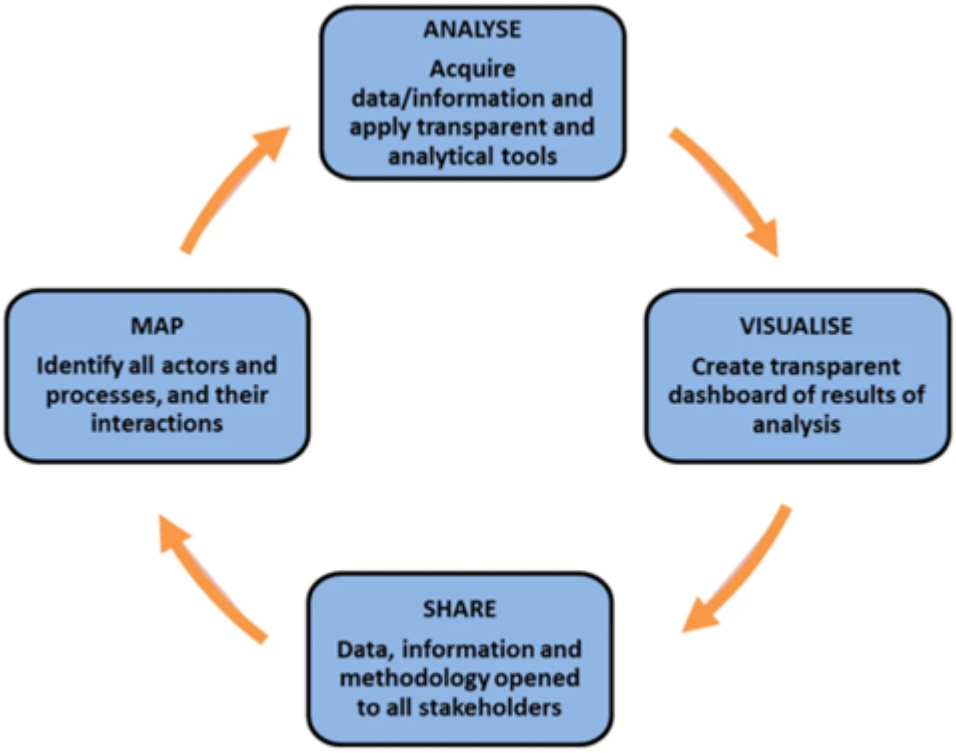

Figure 7 The MAVS evidence-informed policy cycle (Horton and Brown, 2018)

One specific web platform for a broader science-public engagement – with specific policy implications (at least in the US) – is the Reddit Science community's Ask Me Anything (AMA) series. Reddit is primarily a US entertainment social network and news website where registered users can vote posts up and down to determine their popularity and relevance. Reddit has specific topics, among which Science is quite popular with more than 19 million users. Since it has a system of verification, scientists tend to post reliable and accountable comments on Reddit in an open online environment. Thus 'ordinary' users can distinguish between verified expert opinion and random comments, with the support of voluntary moderators.

[48] Horton, Peter, and Garrett W. Brown. 2018. "Integrating Evidence, Politics and Society: A Methodology for the Science–Policy Interface." Palgrave Communications 4 (1). https://doi.org/10.1057/s41599-018-0099-3.

The AMA series are basically a crowd-sourced interviews where users could ask experts any questions in their related scientific expertise areas (pre-screened by moderators with at least a bachelor's degree in related science). The format and perceived image of reddit helped spread verified scientific information through the forums and the AMA series, which was well-received even by the most renowned scientists – e.g. Stephen Hawking took part in AMA. The AMAs provides a channel where interested citizens, scientists, science communicators, business and policy stakeholders can engage in a broad field of scientific issues in a relaxed, but moderated environment. In 2017, there was for instance a dedicated AMA on the topic of empowering scientists and engineers to engage in policy. More than 300 comments were answered by two high-level experts engaged in the science-policy interface.

Communication between scientists and political decision-makers through digital means – with the support of visual solutions – was also made more possible by the advent of big data. Creative interactive ways are utilised by engaged scientists to inform the public and influence policy-makers in their decisions. This ongoing trend was strengthened by the requirements posed by the COVID-19 pandemic when timely and reliable data was needed in easily understandable formats.

Data visualisation enabled by big data supported the publicly-funded international organisations to quickly establish and regularly update new COVID-19 web platforms. WHO has its own COVID-19 dashboard where interested people can explore the latest information on the virus in various visual forms and graphs. Due to the broad networking of WHO, political decision-makers are one of the primary target groups of such visualised data sets.

It is also an ongoing trend that public organisations collecting data form a partnership with other privately-funded organisations that are more able and inclined to put raw data into modern visual formats. For instance data collected by the European Centre for Disease Prevention and Control (EU CDC), an independent agency of the European Union is extensively used by Our World in Data, a scientific online publication using interactive charts and maps to present research findings to its readers, among them academics and policy people. While Our World in Data uses and analyses this secondary data for non-profit (research) purposes in an open way, private for-profit actors also make use of these data. For instance, Financial Times utilizes the same data sets (among them prominently EU CDC) to inform its readership on COVID-19 (with enhanced data visualisation for commercial purposes.

Visual mapping of physical distancing prepared by the Delft University of Technology specifically supported policy-makers in Amsterdam in their local policy making. The social

distancing dashboard shows with different colours the extent to which pedestrians and cyclists can maintain the compulsory distance of 1.5 metres.

Based on the interactive maps, policy-makers may decide where vehicles cannot enter so as pedestrians and cyclists have more room and higher safety. Building on the success of Amsterdam and other Dutch towns, the developers plan to extend the mapping to other European cities for policy-makers to use.

4.3. Trends emerging due to COVID-19 pandemic

The current COVID-19 pandemic serves as a new milestone in science communication in general, and in particular with policy-makers. The crisis highlighted some of the apparent issues in science communication and brought with itself both opportunities and challenges. In our view, the pandemic acted as an 'accelerator' of the already ongoing science communication trends described in the previous Chapter. Rapid policy decisions had to be taken in a really short time, amidst large scientific and political uncertainties and oversaturation of information. This emergency situation necessitated a strong and efficient collaboration of the scientific community and political decision-makers where accurate facts had to be timely selected and analysed in order to provide sound scientific advice.

Responsible policy-makers have realised the value of the emerging participative methods for scientific engagement in policy development, including more visualised and digital ways, and underlined the need for reliable, accountable and open scientific communication for evidence-based policy-making. This manifested in the evidently higher prestige of scientific experts: in almost all countries people and policy-makers turned for advice to reputable scientists, reversing the devaluation of facts in a 'post-truth world'. The emergence of new fact-checking and myth busting websites, in particular the recent set-up of a European hub, confirms this shift. The higher reliance on experts and such websites indicates an attempt to counter the increasingly more widespread fake news and misinformation.

In the following we detail two key trends in science communication with political decision-makers that are the continuation of previous tendencies and have recently been accelerated by COVID-19. The novelty of the COVID-19 crisis and the shifting nature of the evoked societal and scientific changes mean that we can at best provide an actual overview of these trends but cannot offer conclusions as to their outcomes and final relevance.

Spread of misinformation and fact-checking countermeasures

One of the problems exacerbated with the current COVID-19 crisis is the spread of misinformation and fake news that are spread among all segments of societies (not only among the less educated, which is a misinformation in itself). One underlying cause can be attributed to the information overload facilitated by social media channels which makes it difficult even for the most susceptible people to filter out true and false news regarding such a new phenomenon as COVID-19.

Social media channels provide the perfect place for spreading fake news since the information shared there does not involve a rigorous checking (or peer review) as in the case of traditional media (or scientific publications). Due to the nature of social media, people want to share the news as fast and as broadly as possible to feel engaged, without giving enough thought to fact-checking as they would do in other situations in the first place as an MIT study states. This can be true even for the most intelligent people who also tend not to employ their cognitive reflection and fall for cognitive biases (Aaroe and Petersen, 2018; Pennycook et al, 2015).[49][50] The UN has also realized the danger of this phenomenon and started its campaign #takecarebeforeyoushare to prevent or slow down the spread of disinformation on COVID-19.

A recent research on COVID-19 by Management Centre Innsbruck (MCI), a privately organized business school in Austria found that the recognition of fake news can be improved: people relying exclusively or predominantly on social media are more tempted to believe fake news than those who also consult traditional media forms. This is in part caused by individual biases reinforced by well-formulated 'easy-to-understand' social media news (e.g. offering a fast route to normalization). Due to the reinforcement of 'data' that the reader wants to believe in, fact-checking is not carried out; in particular, the source of the information is not verified – even by a simple browser search (Fiala, 2020).[51]

[49] Aarøe, Lene, and Michael Bang Petersen. 2018. "Cognitive Biases and Communication Strength in Social Networks: The Case of Episodic Frames." British Journal of Political Science. Cambridge University Press, 1–21. doi:10.1017/S0007123418000273.

[50] Pennycook, Gordon, Jonathan A. Fugelsang, and Derek J. Koehler. 2015. "Everyday Consequences of Analytic Thinking." Current Directions in Psychological Science 24 (6): 425–32. https://doi.org/10.1177/0963721415604610.

[51] Fiala. 2020. Innsbrucker MCI forscht zu Informationsverhalten in Coronakrise. Studie. https://www.horizont.at/digital/news/studie-innsbrucker-mci-forscht-zu-informationsverhalten-in-coronakrise-81109

The problem is exacerbated when fake news is being spread deliberately in the first place. This may happen due to conviction or for economic-political interests. In the former case people believe in such 'truth' because they perceive the actual news as fabricated reality which is propagated by the official sources due to the influence of some arbitrarily defined conspiracy theory actors, such as deep state, illuminati and other secret societies. In the latter case, certain polity entities play the most relevant role by strengthening information overload without a specific conviction in a certain cause. These actors have an embedded interest in spreading misinformation and thus destabilize their political-economic opponents, such as the institutions of the European Union or the governments of certain Member States.

Unlike propaganda, current misinformation campaigns lack ideologies or facts. The goal is not the persuasion of the audience but rather the spread of confusion and the devaluation of trustworthy news sources by overwhelming adaptive audiences with too many differing points of view. As Euronews correspondent, Peter Pomerantsev summarizes about Russian fake news: "Nothing is true and everything is possible.

Laypeople often unintentionally use 'tricks' in the hope of having more shares on social media, but conspiracy theorists and polity entities interested in sharing misinformation use opinion-binding methods on purpose. These may involve simple features weakening the use of our critical thinking and making lies more convincing, such as the addition of an image next to a statement, usage of descriptive language, reference to personal stories or familiar facts and scientific figures (often misconstrued or taken out of context). Even the simple repetition of an otherwise false statement can increase our belief in it.

Such deliberate sharing of fake news is also widespread during the ongoing COVID-19 pandemic. The methods have also become more sophisticated. Researchers at Carnegie Mellon University claimed that around 45% of the Twitter accounts spreading messages on the social media platform are bots. Although the specific perpetrators are yet to be surely identified the messages appear to be in similar fashion such as used by Russian and Chinese agents – false conspiracy theories are tweeted to cause panic and distrust in institutions. Such tweets claiming a connection between the spread of COVID-19 and 5G technology might have fueled the attacks on wireless towers in the UK.

Currently it has been revealed that fake news perpetrators do not only work with bots, but also 'employ' fake journalists. There were at least 19 fake personas that have placed more than 90 opinion pieces mainly about Middle East-related political issues in 46 different

(mostly right-wing) online publications. Sophisticated methods of tempered profile pictures, fake credentials and LinkedIn profiles, as well as cross-referencing was used by the unknown culprits who could get away with their fake news network for more than a year.

Using the opportunities provided by digitalization, and following the basic assumption of the 'deficit' model of public attitudes which argues that a lack of proper understanding or knowledge of the relevant facts causes people to fall back on unfounded beliefs and irrational fears of the unknown (Ziman 1991)[52] (in our case, a deadly new virus with dubious origin, symptoms and severity), the science community and policy-makers collaborated to take counter-steps by setting up "fact-checking" websites confuting COVID-19 fake news and/or re-affirming proven scientific facts.

OECD (2020) also recommends that governments should support multiple independent fact-checking organisations and websites in the wake of the coronavirus pandemic – other related key actions to complement technological solutions involve the use of human moderators, the voluntary transparency reports about COVID-19 disinformation and the improved media and digital literacy skills of users (OECD, 2020a).[53]

The possible counter-steps of the European Union were outlined in the Action Plan on Disinformation adopted in 2018. This joint communication aimed to step up EU efforts to counter disinformation in four key areas: improving detection, analysis and exposure of disinformation, stronger cooperation and joint responses to threats, enhancing collaboration with online platforms and industry to tackle disinformation, raising awareness and improving societal resilience.

One of the key methods was to set up or further develop online platforms countering fake news and disinformation. One of the most comprehensive websites in this regard is the #EUvsDisinfo platform which is a flagship project of the European External Action Service. In 2015 the East StratCom Task Force was set up with the participation of sixteen full-time experts coming from various communication science fields. Their task is to forecast, address and respond to Russia's ongoing disinformation campaigns disrupting the functioning of the European Union and its member states.

[52] J. Ziman.1991."Public understanding of science, "*Science, Technology and Human Values*, volume 16, pp. 99-105

[53] OECD. 2020a. Combatting COVID-19 Disinformation on Online Platforms. http://www.oecd.org/coronavirus/policy-responses/combatting-covid-19-disinformation-on-online-platforms-d854ec48/#section-d1e305.

The East StratCom's key objective is to raise public awareness and understanding about fake news, mainly focused on the countries in the Eastern Neighbourhood. Communication products are disseminated through social media channels, television and other media and public events – providing a proper mix of traditional and non-traditional science communication channels. A particularly relevant feature is the open-source repository of searchable databases on the most relevant current fake news (more than 6,500 collected thus far) – this is in line with the ongoing emergence of open-source science communication formats towards policy-makers.

The expert team behind the website is also engaged with policy outreach. The experts brief and train EU institutions, Member State governments, journalists, and civil society organisations, and regularly speak at international conferences. These products represent an important resource for political leaders, state agencies, researchers, think tanks, and journalists on a global scale, thus representing evidence-based science provision through communication experts.

The experts running the platform and its database responded quickly with a collection of the most damaging disinformation and fake news, as well as the early drafting of a special report to policy-makers assessing the narratives and disinformation around the COVID-19 pandemic on a global scale.

A novel EU initiative to create a fact-checking European Hub is the establishment of the European Digital Media Observatory (EDMO), which started its operation on 1 June 2020. The EDMO brings together fact-checkers, academic experts, media organisations and other relevant organisations to provide support to policy-makers. It has been set up in the framework of the above-mentioned EU Action Plan on Disinformation. When fully functional, the EDMO will promote scientific knowledge on online disinformation, advance the development of fact-checking services and support media literacy programmes. EDMO will also support public authorities assessing the implementation of the EU Code of Practice on Disinformation.

Other relevant websites aimed at countering misinformation include the WHO's myth-busters site, which checks and (dis)proves the most widespread information surrounding COVID-19. The US Department of Homeland Security (FEMA) launched its coronavirus rumour control website for similar purposes: the site helps the public distinguish between rumours and facts regarding to COVID-19 pandemic. Other examples for such websites countering misinformation can be found in the sections on national measures.

These websites all use different strategies to ensure the broadest possible dissemination of their messages. One successful tactic is to "fight fire with fire" and also use simple messages boosted with visual support to present the facts. This strengthens the already ongoing science communication trends of an enhanced visualization and digitalization. These messages are then passed through various communication channels, as many times and as fast as possible, to the different target groups.

It is however important to always review and ascertain the validity of facts provided by these sources. The COVID-19 pandemic makes a pressure on scientific actors to inform policy-makers (and citizens) on all up-to-date information as fast as possible. This has resulted in the rapid diffusion of science-related news and open access publications. Some of this information is published and shared through social media, which among others has increased the visibility of certain scientific blogs, websites or publications that many times do not conduct the proper review and verification in the first place. Even the biggest names in the business fall victim to the pressure of first publishing relevant results under the extraordinary circumstances of COVID-19, as showcased by the retracted article on hydroxychloroquine in Lancet.

Irrespective of the strategies and data verification, it seems that – at least in some important areas – the misinformation is gaining ground against scientific facts. For instance, an analysis carried out on 1300 Facebook pages about vaccination in 2019 found that anti vaccine pages have fewer followers than pro-vaccine pages but are more numerous, faster growing, and increasingly more connected to undecided pages. If this trend continues anti vaccine views may dominate online discussion in 10 years—a time when a future vaccine against COVID-19 may be critical to public health. A Buzzfeed news analysis shows that anti vaccine views have also raised their social media influence during the COVID-19 pandemic.

The #EUvsDisinfo website also reports such alarming findings, namely that various claims about the disintegration of the EU in the face of COVID-19 are trending on key social media platforms in all analysed regions. Among COVID-19-related content published by RT and Sputnik, articles covering conspiracy narratives such as that "the virus was man-made" or intentionally spread, typically received more social engagement than other factual, but less sensational stories.

This apparent struggle against misinformation networks can be attributed to some weak points of the key measures countering misinformation. One weak point is that their communication is primarily based on the principles of the deficit model. As discussed in the

previous Chapter, science communication with policy-makers should move over this traditional model for the sake of efficiency. This is true in this case too.

As a recent study underlines, in order to successfully counter misinformation, a narrow one-way communication of facts by scientists to policy-makers (and citizens) might not be enough. The communication should involve in a symmetric way experts, political decision-makers and journalists and take into account scientific uncertainties and social values. As a recent OECD study underlines, the efficacy of actions countering disinformation will depend on grounding them in open government principles, chiefly transparency, to build up systemic trust (OECD, 2020b).[54]

This means that scientific communication must recognise any uncertainties surrounding COVID-19 and refuse political influence to jump to premature conclusions, as well as admit that the current crisis requires fast decisions on trade-offs between social values and group interests (e.g. health concerns, civil liberties, labour market interests) beyond the realm of science. Science communication will be only effective if it embeds the best available scientific information within the set of uncertainties, competing values and trade-offs influencing policy discourses surrounding COVID-19.

The ongoing 'crisis' of the European Research Council (ERC), which culminated in the resignation of President Mauro Ferrari can be also attributed to competing values of research and politics, where the former wanted to keep the 'blue skies' research nature of ERC, while the latter was more interested in a focused call on COVID-19 research accused by its opponents as "a window-dressing public relations stand on the coronavirus crisis". President Ferrari was unable to deal with the inherent trade-offs between political and social goals within ERC as his new approach was unanimously rejected by the institution's Scientific Council.

Another weakness stems from the fact that they are inherently targeted against external sources, i.e. actors out of the relevant science-policy network, but are quite inefficient if an actor within the network spreads misinformation. The #EUvsDisinfo website does the same by focusing on the external sources of disinformation: Russia and China. The problem is that more and more democratically elected leaders are fuelling the spread of misinformation.

[54] OECD. 2020b. Transparency, Communication and Trust: The Role of Public Communication in Responding to the Wave of Disinformation about the New Coronavirus. http://www.oecd.org/coronavirus/policy-responses/transparency-communication-and-trust-bef7ad6e/#biblio-d1e501

The examples stem from EU elected leaders, such as Prime Minister Viktor Orbán in Hungary or Prime Minister Jaroslaw Kaczynski in Poland or various interest groups in the United States, including President Donald Trump.

And while the official institutional misinformation counter-platforms are still reluctant or not capable to take measures against such insider threats, the private sector has already taken steps. For instance, Twitter tagged the recent tweets of US President Donald Trump with fact-checking links. After facing the threat of a major advertising boycott, Facebook has recently also taken action to prevent the further proliferation of hate speech and misinformation. Misinformation networks linked to Roger Stone (President Trump's long-time political strategist) and Brazilian President Jair Bolsonaro were removed from the site. The EU also contributes to these counter efforts – stemming from private interests of leading social networks – by its Code of Practice on Disinformation. This voluntary self-regulatory code of conduct was signed by all major online social platforms in order to address the spread of online misinformation and fake news.

Some Member States have already moved forward in the fight against misinformation coming from all (internal and external) sources by promoting media literacy through allocating resources, providing relevant information and developing legislation. The strategic aim is to offer media education to people in all age groups to have better skills to assess the factuality of online news pieces. As a recent study highlights, media literacy training, broader civic education programmes, awareness-raising campaigns targeted at both the young and the older generations have the potential to counter the deliberate spread of misinformation (Szicherle et al.,2019). [55]

[55] **Szicherle**, Patrik, Adam Lelonek, Grigorij Mesežnikov, Jonas Syrovatka and Nikos Štěpánek. 2019. Investigating Russia's Role and the Kremlin's Interference in the 2019 EP Elections. Budapest: Friedrich Naumann Foundation. https://www.politicalcapital.hu/konyvtar.php?article_read=1&article_id=2418

Figure 8 Ways that public communication can support policy and fight disinformation Source: OECD (2020)

OECD (2020) has an overview of the recommended ways how public communication through the cooperation of policy-makers and scientists may support the fight against disinformation. This involves the timely provision of citizens with truthful and accurate information through their preferred channels and with an understanding of their behavioural and psychological biases, including fears, concerns and expectations; the provision of education about responsible content consumption and sharing; two-way dialogue and other participatory communication forms with citizens responding more directly to their needs; and the debunking of prominent misinformation.

The latter process (debunking) must be handled carefully since it essentially means a pre-emptive disclosure of small doses of misinformation in a way that highlights its logical flaws. The effectiveness of such an action is dependent on many factors, such as the proper presentation of core facts, explicit warning before repeating misinformation, provision of

alternative explanation and the use of graphs, as explained in the Debunking Handbook published by two leading Australian researchers (Cook and Lewandowsky, 2011).[56]

The above solutions all involve an increased role of expert opinion and involvement in the policy-science nexus, which is another emerging trend facilitated by the ongoing crisis, discussed in the next part.

A increased role for experts and scientists in policy-making

In the Covid-19 period between March and May 2020, we witnessed a media overexposure of scientific experts. In many cases they have limited themselves to proposing specific points of view and opinions on the pandemic and the possibilities of containment. However, they were also questioned on other more political issues and some of them proposed their opinions. This has led prominent political experts to predict an increased trust and legitimacy in expertise (Soete, 2020; Politico, 2020).[57][58]

This increased legitimacy and the more proactive role of scientists have not only been manifested in more expert media appearances, press releases, interviews or articles in COVID-19 times, but also by the establishment of websites striving to inform the policy-makers (and the public) on the new developments of the coronavirus. Relevant examples include a study on the needed mitigation efforts by the London-based Imperial College, addressed to UK policy-makers (Ferguson et al., 2020),[59] or the highly visual representation of the pandemic details compiled by the data analysts of Financial Times (another example can be found in the Hungarian desk research).

[56] Cook, J., Lewandowsky, S. 2011. The Debunking Handbook. St. Lucia, Australia: University of Queensland. November 5. ISBN 978-0-646-56812-6. [http://sks.to/debunk]

[57] Soete. 2020. Hammer or Nudge? Brief on International Policy Options for COVID-19. United Nations University 2020. https://www.merit.unu.edu/hammer-or-nudge-new-brief-on-international-policy-options-for-covid-19/.

[58] Politico. 2020. Coronavirus Will Change the World Permanently. Here's How. Blognews. POLITICO magazine. https://www.politico.com/news/magazine/2020/03/19/coronavirus-effect-economy-life-society-analysis-covid-135579.

[59] Ferguson, Neil M., Daniel Laydon, Gemma Nedjati-Gilani, Natsuko Imai, Kylie Ainslie, Marc Baguelin, Sangeeta Bhatia, Adhiratha Boonyasiri, Zulma Cucunubá, Gina Cuomo-Dannenburg, Amy Dighe, Ilaria Dorigatti, Han Fu, Katy Gaythorpe, Will Green, Arran Hamlet, Wes Hinsley, Lucy C Okell, Sabine van Elsland, Hayley Thompson, Robert Verity, Erik Volz, Haowei Wang, Yuanrong Wang, Patrick GT Walker, Caroline Walters, Peter Winskill, Charles Whittaker, Christl A Donnelly, Steven Riley, and Azra C Ghani. 2020. Report 9: Impact of Non-Pharmaceutical Interventions (NPIs) to Reduce COVID19 Mortality and Healthcare Demand. Imperial College London. https://doi.org/10.25561/77482.

The use of such information websites also highlights that the **reputation of (medical) experts, scientists and science communication have increased** during the COVID-19 pandemics. The crisis showed the value of timely and trustworthy information from scientists and other experts to policy-makers, and the need for effective communication. As the editor in chief of Science put it in a recent editorial, "This is a time when people are thinking about science in a way that they never have."

Central and Eastern European countries present an interesting case for the potential impact of the heightened role of experts during the pandemic. As Figure 9 shows Central and Eastern European countries had much fewer COVID-19 cases and suffered much fewer fatalities than Western-European countries. The underlying main reasons are still disputed – stemming from fewer testings to lower population density, lower life expectancy or fewer flights to China – but experts agree that the radical and fast restrictive measures (e.g. lockdowns, social distancing, obligatory masks in public places) were of utmost importance.

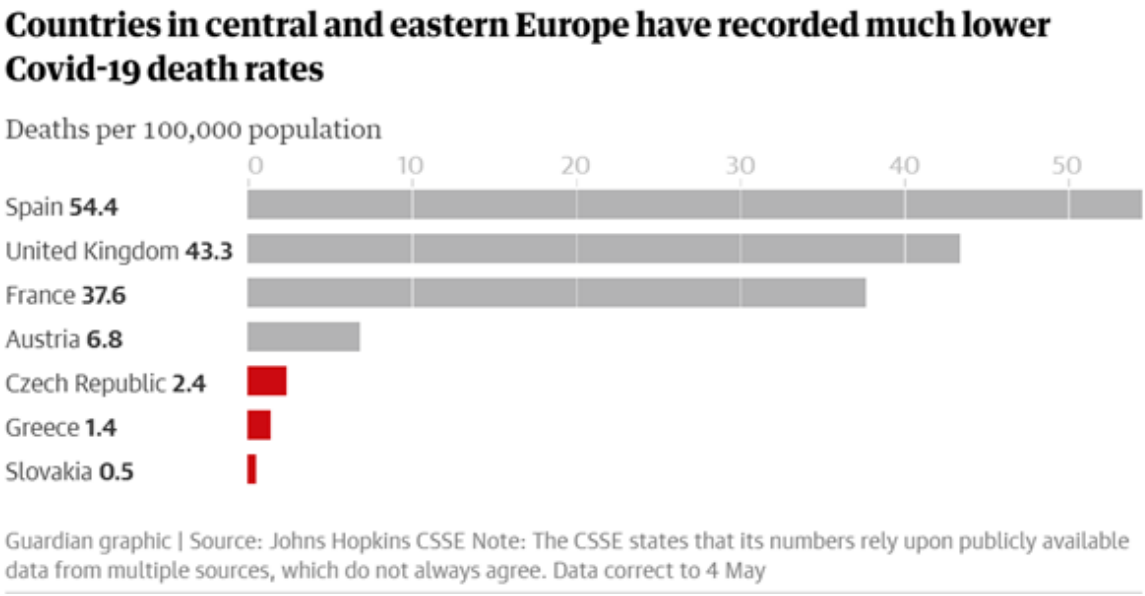

Figure 9 Guardian graphic Source: John Hopkins CSSE 2020

Paradoxically this early reaction might be a result of lower government effectiveness and institutional trust, fearing that the underfunded and struggling healthcare systems will be overwhelmed due to the surge of COVID-19 patients. In addition, the lower dissention towards the state obligations made people follow the strict regulations more obediently.

However, the inherent lower social trust towards the state and its institutions was counterbalanced in these countries. The counterbalancing mechanism worked due to the relatively high trust in scientists and their role in advocating swift lockdown and other restrictive measures (people turning to experts instead of politicians). As Figure 10 shows, altogether 77% of the Eastern European population had a high or medium trust in science in 2018 (with large country differences), which is above the world average of 72%, but lower than the comparable value of other European regions.

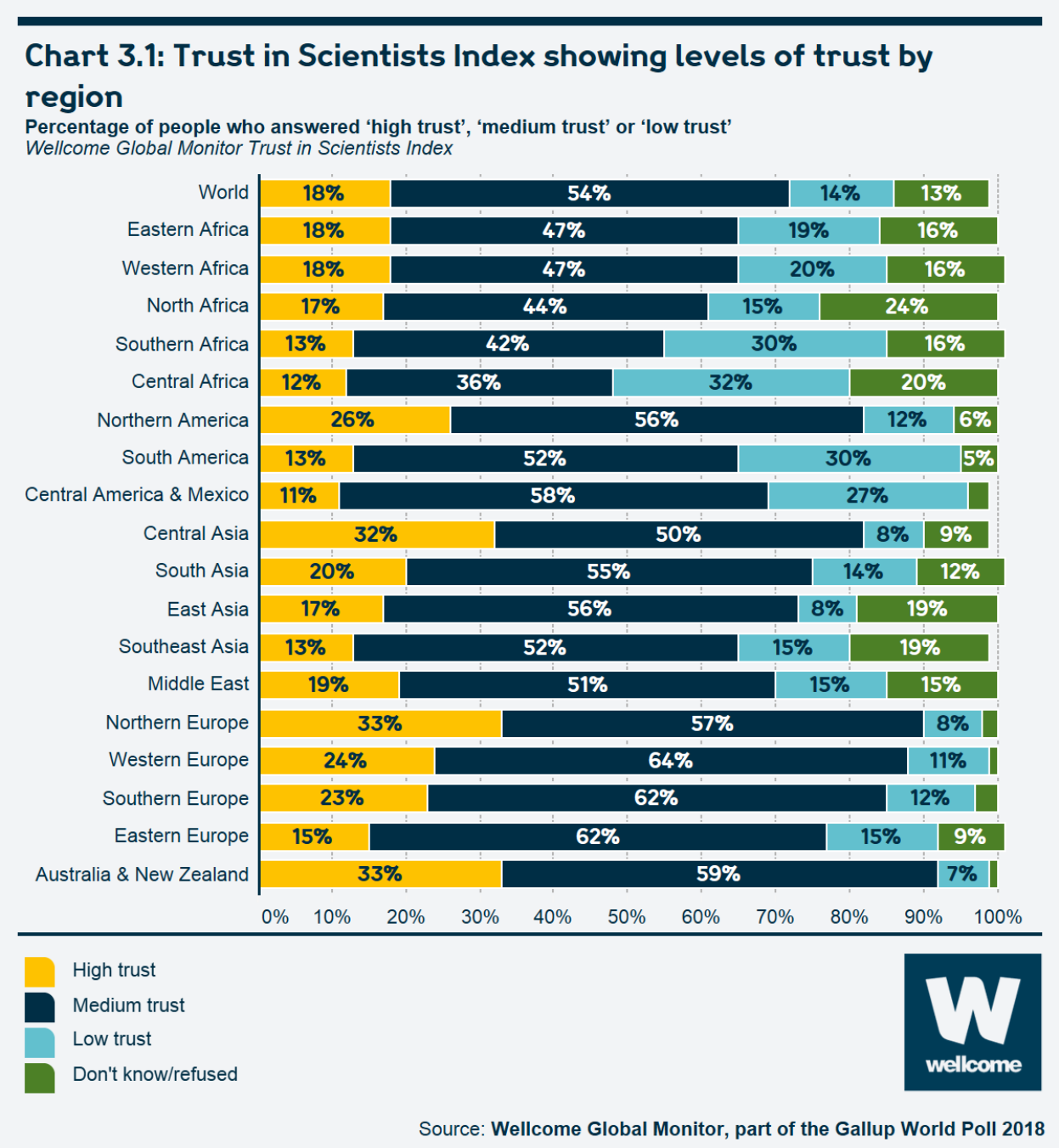

Figure 10 Trust in Scientists Around the World Source: Wellcome Global Monitor, part of the Gallup World Poll 2018

Central-Eastern European member states with separate ministries of health and health ministers with medical background acted faster and more decisively (e.g. Slovakia).[60] Another country usually not associated with best practices in recent time, Greece was also highly successful in containing the effects of the pandemic, mostly due to the appropriate communication between the government and its chief medical expert, Sotiris Tsiodras who alerted policy-makers to the pandemics and lead the country's prevention actions, including communication duties (daily response briefings).

The improved stance of these countries usually not on the sending side of best practices was further confirmed by the fact that Austrian Chancellor Sebastian Kurz also invited the Czech Republic and Greece to his 'first movers COVID-19 group' encompassed by the countries most successful (to date) in mitigating the effects of the ongoing crisis.

However, it is not clear whether the primary role of science over politics can be maintained even after the COVID-19 crisis. There is an inherent uncertainty about the origin, effects and treatment methods of the new coronavirus, due to which responsible experts lacking proper data are hesitant to give concrete answers to policy-makers or citizens demanding clear and fast solutions. In times of uncertainty, people are seeking safe points and want to have immediate certain answers, which they might not get from experts due to the specific nature of science based on a "trial-and-error" approach. It is at this point that they might turn their attention to a more readily digestible solution, provided by other actors, such as media celebrities, conspiracy theorists or politicians.

Decision makers are particularly attentive to the advice of scientific experts when dealing with emergencies, especially health emergencies. This type of orientation is based on the belief that scientific truths are the most credible to be proposed in public contexts since science offers objective evidence. This orientation is particularly used when risk situations are faced, for their evaluation and for making adequate decisions.

In the case of the pandemic experienced in Italy, it is noted that there are various institutions that somehow produce public risk communication but are not always well coordinated with

[60]Toshkov, Dimiter, Kutsal Yesilkagit, and Brendan Carroll. 2020. "Government Capacity, Societal Trust or Party Preferences? What Accounts for the Variety of National Policy Responses to the COVID-19 Pandemic in Europe?" Preprint. Open Science Framework. https://doi.org/10.31219/osf.io/7chpu.

each other[61]. In addition, it is noted that communication is almost always one-way with little chance of an interlocution with civil society organizations or citizens.

Some important reasons can be identified for developing public involvement in pandemic crisis situations such as COVID-19. First of all, it must be demonstrated that communication is closely linked to the places where knowledge is produced and the phenomenon that generates health risks is assessed. In this perspective, communication must follow all the various developments in risk assessment and risk management.

In the second instance, an adequate effort should be developed to communicate to the public as a proactive approach, avoiding being too abstract in the proposals. In this regard, it is possible to mention a communication made by an Italian doctor who stressed the importance of the use of the mask as a daily and familiar practice to follow such as that of the use of seat belts in the car. In this way, citizens are invited to play an active role in emergency management and to develop habitual behaviour.

A third element concerns the role of social science experts and the possibility of their involvement in the risk management process. In the case of Italy, the government has formed specific task forces to try to help citizens cope with the containment period. However, this type of policy must carefully consider the importance of involving experts and making sure not to confuse their role with that of the stakeholders who are normally very focused on their interests. Civil society organizations and citizens must be involved in other ways that can be achieved through forms of consultation or in the involvement of local committees (Simone, 2020)[62]. In this perspective, social science experts' involvement should be considered given they are tasked with broadening the spectrum of analysis and fostering a better understanding of the implications for citizens' lives that a pandemic can cause.

As a fourth element, the importance of the differences between the media used must be considered. In the case of the pandemic in Italy, as we will see later, traditional media have played an important role. At the same time, we must give relevance to the influence that

[61] Bucchi M., Saracino B. 2020. Italian Citizens and COVID-19: One Month Later – April 2020. Public Understanding of Science Blog. https://sagepus.blogspot.com/2020/04/italian-citizens-and-covid-19-one-month.html

[62] Simone A. 2020, Coronavirus: Lombardy lessons for policy and governance, Nature https://doi.org/10.1038/d41586-020-01502-6

social networks and the web can have, especially on a global scale, given the ease with which we can now get information on a global level directly from our smartphone.[63]

In the science-policy nexus, policy-makers should have the ultimate role in risk assessment and risk communication suggesting adequate counter-measures, deciding over many (sub-optimal) options based on political values. Due to their political history and cultural climate, Central and Eastern European countries are more likely to fall victim to the 'politicization' of scientific expertise. In the fight between individual rights and epidemiological safety, these countries tend to lean towards more safety, sacrificing freedom. For instance, Slovakia made a new law to harness telecommunication data to monitor the movement of people infected or suspected of infection. Other nations, like the UK and Japan, have faced vocal opposition to such techniques over privacy concerns.

It is also telling that – while in Germany, doctors, natural scientists and even social scientists and moral philosophers are also part of the advisory group of the Chancellor – Hungary does not have any independent external single scientists in its highest-level COVID-19 advisory board (only four persons with medical degree in state employment in the 11-person group).

In sum, it is still not clear that the current, short-term appreciation of experts will be sustainable in the long term. The uncertainty surrounding COVID-19 and the choices to be made between various (often contradicting) political values going beyond pure scientific facts will influence this process in each country in a different way.

The positive scenario is that the pandemic gives an opportunity to more people to get educated in the language and methods of science and turn back to scientific advice in other segments of their lives too.

The negative scenario is that the prestige of science will decrease in the long run because of a perception of 'inadequate' experts who cannot confidently provide instant answers to all questions regarding the coronavirus.

[63] Pellegrini, G. 2020. Coronavirus and public communication: the role of experts and decision-makers in the view of the public. *In book: Overabounding and Society, Sociological Essays on Love.* https://www.researchgate.net/publication/342438699_Coronavirus_and_public_communication_the_role_of_experts_and_decision-makers_in_the_view_of_the_public

However a recent study found that communicating uncertainty and admitting not to have a readily available 'panacea', exerted only a minor effect on trust in academics and science communicators.[64]

Bearing this in mind in their communication with policy-makers, experts should not shy away from telling the facts to the best of their knowledge, taking into account the specific characteristics of policy stakeholders and the science-policy nexus discussed in previous Chapters. As Anthony Fauci said, "I take the tack that I will say what's true and whatever happens, happens," – his approach helped to raise the prestige of his US coronavirus task force among the general population and made it indispensable for policy-makers.

The EU's recently adopted a new seven-year budget unfortunately seems to confirm a negative scenario since research and science was one of the areas with a severe budget cuts at the end of the negotiations. As Martha Agostinho, coordinator of EU-Life said, "In a time when politicians and citizens look to science to find the miraculous solution to the COVID-19 crisis, the top leaders decide to cut the research budget – how insane is this?"

5 Trends for Science Communication Connections with Policy at National Level

5.1. Austria

Austrian research institutions and universities, for example the Austrian Academy of Sciences (OeAW) and the Medical Universities, are regularly consulting policy-makers from government institutions and the Parliament. Offering their expertise to official decision makers is a part of their legal obligations.

Relevant researchers are also included in the crisis consulting boards. For example: The Austrian Federal Ministry of Health "Coronavirus Taskforce", which provides medical and scientific advice.

Cross-border crisis communication and the case of Ischgl

In the beginning of March, authorities in Germany and Nordic countries began identifying the Tyrolean ski resort village of Ischgl as a major COVID-19 hotspot. A number of infections

[64] Marthe van der Bles et al., 2020. The effects of communicating uncertainty on public trust in facts and numbers. PNAS April 7, 2020 117 (14) 7672-7683. https://www.pnas.org/content/117/14/7672.abstract

were eventually traced back to the village with transmissions having occurred from late February onwards. After initially questioning the risks, authorities in Tyrol placed the entire village in quarantine on 13 March. On 18 March, provincial governor Günther Platter finally decreed a lockdown throughout the province of Tyrol.

On the evening of 16 March, the state government of Tyrol had a chance to explain during a TV show on the Austrian Broadcasting Corporation (ORF). Bernhard Tilg, State Councillor for Health, was a guest on one of Austria's major news programmes via video link. During this TV show he stressed that authorities had done everything right. In succession, the accusations against the provincial government grew louder, and opposition parties were demanding the resignation of the State Health Councillor.

Apart from Iceland and Norway, other European countries have reported cases of COVID-19 from returning Ischgl vacationers, including Denmark and Germany. Parallel to massive failures in the crisis communication, an international image damage became obvious. To give an example, Manfred Lucha, Minister of Social Affairs of Baden-Württemberg, Germany, responded the following on the mismanagement: "Our problem is not Iran, but Ischgl.

Crisis management system and fake news task force by the Austrian government

Austrian Federal Ministries have implemented a crisis management system in order to provide stakeholders with regularly updated information within its remit on the latest developments in the COVID-19 outbreak.

Above all, the Federal Ministry of Labor, Social Affairs, Health and Consumer Protection (the German title in short: BMSGPK) takes a leading role in the nation-wide communication plan and provides regularly updated service information which can be accessed online. All COVID-19 related laws and decrees are also listed and accessible via the ministry's website. Furthermore, a visualisation of statistics on COVID-19 in Austria is provided. The epidemiological curve shows the actual increase in the number of people who tested positive and shows the dynamics of an epidemic over time (see also the second example of a Good from Austria in Annex 2).

In addition, the Austrian Federal Ministry for Digital and Economic Affairs (BMDW) provides a general online portal to COVID-19 related issues in a national, European and transnational context.

Figure 11 COVID-19 information portal by the BMDW

Beside press conferences by the Austrian government, held several times a day, major members of the government followed a social media strategy to inform on the COVID-19 crisis in Austria. In March, Federal ministers and their teams published nearly 2000 postings and generated about 1.7 m user interactions – about 75 % of the published postings had a focus on COVID-19. Favourite platform for social media communication was Facebook.

According to a representative poll by the Austrian independent Gallup Institut, 77 % of the Austrian population was satisfied with the information given in traditional media such as TV and newspapers but also online news portals, above all quality media such as ORF online, derstandard.at and die Kleine Zeitung increased outreach.

The Austrian government kicked-off a digital crisis team in the middle of March to counteract fake news collaborating with a taskforce at the Federal Ministry for Inner Affairs. On 27 March, the Federal Ministry for European and International Affairs started a communication campaign in 16 languages to prevent the spreading of fake news among Austrian population with a migration background.

Fact checker platforms such as Mikama or the fact checker by the Austrian Press Agency (APA) contributes with their regular service also to COVID-19 fake news crisis.

At the end of April, a public discussion on measures and decrees as well as concerns related to a fear-based communication strategy in the context of COVID-19 by the Austrian government has started. On 27 April, the Ö1 Morgenjournal, a radio format of the Austrian

Public Broadcasting Corporation published details on a meeting of the Austrian Federal Chancellor with experts in the beginning of March taking into consideration to force the Austrian public to precaution with strong narratives on potential consequences of the COVID-19 pandemic. In succession, the Austrian political opposition reacted with heavy critics. In parallel, some Austrian media and communication experts put a claim to stop "message control" by the government and missing transparency in data presentation.

5.2. Italy

In Italy, policy-makers usually retrieve information either from government or research organizations in the specific sector they are dealing with, or the politicians themselves act as authorities or experts.

There are certain challenges for science–policy co-production. These derive from (1) the institutionalized lack of knowledge and competences to implement new science held by administrative agencies – at all levels of government; (2) the difficulties in adapting a new scientific paradigm to existing institutional settings; (3) and, more in general, from the different missions, interests, priorities, objectives and organizational cultures in the scientific and institutional communities. The results reveal that new science did not lead to desirable/better policies when it was inappropriate for the existing institutional/decision structure or when it was too complex to be used by practitioners. Further, new policies that are not grounded on robust scientific evidence cannot be applied by practitioners, especially in the initial phases of policy implementation.[65]

When examining these challenges in the narrower framework of innovation policy and digitalization, policy-makers focus on the digitalization of public services, public administration and educational system.

At the end of 2008, the government launched the "Digital Italy Plan", with the aim of completely digitalising the communications infrastructure. In 2010, the EU's ambitious Digital Agenda was integrated in the Plan. Investments in the amount of around 8 billion euros over 10 years for infrastructure and around 2 billion euros for electronics and software services are envisaged.[66]

[65] Anna Scolobig, Mark Pelling. 2015. The co-production of risk from a natural hazards perspective: science and policy interaction for landslide risk management in Italy. Natural Hazards 81(S1). DOI: 10.1007/s11069-015-1702-1

[66] Josef Schmid and Rolf Frankenberger On the Way to Welfare 4.0 – Digitalisation in Italy

In spite of these investments, Italy still lags behind the digitalization leaders in Europe, as confirmed by the Digital Economy and Society Index rankings from 2016, where the country overall is listed on place 25 (DESI 2016). More recently, digitalization was given another boost to manage the Coronavirus emergency, for example by promoting smart working.[67]

Despite its barriers, the ongoing digitalization in Italy changes the preferred channels by shifting the communication from traditional media to digital media. With regards to policy-makers, they still tend to communicate through traditional communication channels, such as television and newspapers, but the new media channels such as social networks, online newspapers and institutional websites are increasingly being used. Also, YouTube is used more frequently combined with social media, articles and websites, as external links or embedded videos.

Certainly, this type of media made **communication more interactive, the frequency became higher and the dissemination faster.** Policy-makers in particular official organizations and ministries move towards digitalization and they do so through reforms (from top to bottom) which are then communicated through social networks, newspapers and television.

This is highly visible in times of the CODIV-19 emergency, when social media is used more often by digitalization and innovation organizations as well, from several times a week to several times a day. Politicians and governors communicate through newspapers, radio and television interviews, which are then uploaded to YouTube.

In social networks, the main policy makers of innovation and digitalization, MIUR and the Ministry for technological innovation and digitalization, use very textual communication (especially on Twitter) with occasional photos or simple graphics, but mainly videos or external links to online articles or their own websites.[68]

As mentioned above, the Ministry for technological innovation and digitalization is boosting smart working because of the COVID-19 emergency.

In particular, CODIV-19 makes certain dynamics on how politics get relevant information more visible. Different types of political actors act differently. Luca Zaia, president of the Veneto region talks about himself as a “we”, thereby also including the health system, he sets himself up as an authority and uses technical terms such as "primary contagion", "cluster", "we discovered the coronavirus during a simple investigation of people who were classified

67

68

as seasonal flu syndrome". This is politics internalizing the objectives and terms of the (health) research system.

Attilio Fontana, president of the Lombardy region, uses a different approach by acting as an intermediary between science and citizens: he invites the population to "listen to scientists and the Higher Institute of Health above all ". Fontana went to quarantine, because one of his collaborators was infected, "following the guidelines of the Higher Institute of Health – Istituto Superiore della Sanità" to "preserve and defend the people around him" and lead as an example in "this battle". This showcases one of our general findings on the changing (roles of) intermediaries in the science communication-policy nexus.

The direct intervention of policy-makers as intermediaries can be seen as an act against the contradictory role played by traditional media intermediaries. The media strongly influences public perceptions on science (for the general public and policy stakeholders). The credibility of scientists and the legitimacy of science itself is no longer undisputed since the current public opinion of Italians, in particular regarding the contents of scientific communication, passes through schools, the media, museums, events and the health system, and about two-thirds of the adult population has no relationship or has negative relations with science in Italy, while even the most penetrating forms of disclosure used so far reach half of the population at a maximum.[69]

Furthermore, the media does not only influence public perceptions but also shapes and reflects the policy debate. Few decisions are made by policy-makers and stakeholders without the media in mind. Given this role and influence, there have long been concerns about distortion and hype in news coverage of biomedicine and biotech. The orientation towards hype is viewed internationally by many scientists, ethicists, policy-makers and government officials as the primarily shortcoming of the media.[70] This tendency for overhyping leads to the recent, extreme example of Italian politicians having to ask the media to stop focussing all their attention on the death toll, in order to avoid further panic by the population.

On a more positive note, it can also be concluded that both presidents – with slightly different communication methods – expressed their trust for the health system and lead by example to encourage the population to follow scientists' directions. This **enhanced trust in scientists** by policy-makers is also confirmed on the highest political level, since in a recent

[69] Centro Interuniversitario Agorà Scienza “Come cambia la comunicazione della scienza. Nuovi media e terza missione dell’università” a cura di Sergio Scamuzzi e Andrea De Bortoli, Il Mulino 2012.

[70] Bubela et al. 2009. Science communication reconsidered. Nature biotechnology.

interview about COVID-19, Luigi Di Maio, the Italian foreign affairs minister, congratulated and showed trust in the Scientific Community.

The foreign minister also showed concern for some **fake news** circulating about COVID-19. He invited Italians to rely only on official news, particularly on the official bulletin of Civil Protection.

This is linked to the rising concern about fake news and their effect on public opinion. For this reason, Italy has launched different fact checking websites, some generic, some sector specific, for instance: factcheckers.it, pensierocritico.eu/fact-checking.html, bufale.net, pagellapolitica.it, etc.

In addition to official organizations, a scientific community and scientific journal with fact checking procedures and a peer review, **Reviewer Credits,** was born. "ReviewerCredits is a small startup company, launched in 2016 by two enthusiastic active researchers, Giacomo Bellani and Robert Fruscio. It is accredited to the University of Milan-Bicocca. Its core business is the development, maintenance and upgrade of an online platform which has the purpose of certifying peer reviews and conference talks."

They also invite to check the reliability of data delivered by official organizations (in particular the Health System and the Civil Protection), from which they themselves gather the information through meetings, press releases and direct contacts.

Good case practice of science communication 1 – Italy

Short title: Cyber Risk management

Short description of the practice: The Italian digital agency (AgID) has activated an evaluation and data processing tool for digital safety.

Scope: National, regional and local with different services. The agency has launched a plan for the identification of the services to be studied, which is divided into: a) vertical services: provided by the public administration (PA) to citizens or employees, without the action or intervention of intermediaries; b) transversal services: provided most of the time from PA to PA, they offer fundamental and transversal functions in support of vertical services, standardizing delivery methods. This category includes the enabling platforms identified by the Triennial Plan for IT services to citizens (electronic signature, payments etc.).

Policy areas affected: digital safety

Main stakeholders: regional and local public administration

Duration: ongoing

Methodology:

The tool is accessible in web mode with the credentials of the SPID Public Identity System. The tool is designed to guide the user through the various stages of the Risk Assessment: definition of the primary and secondary characteristics of the service and assignment of the criticality profile to the same; assessment of the possible impacts deriving from the loss of RID (confidentiality; integrity; availability) linked to economic, reputational, legal and operational aspects; identification of threats, security checks and calculation of risk levels; preparation of the treatment plan; risk monitoring over time.

The self-assessment process can take place in two distinct ways, chosen by the user when starting the procedure: by service: each phase of the process, from the assignment of the criticality profile to the risk analysis, is carried out on all services. The PA must respond to the security checks provided by the tool and applied to each service. for PA (simplified procedure): the administration must respond to the security checks provided without providing specific indications for the service.

The two methods, which must be considered as possible subsequent levels of approach to the risk management process, offer different degrees of reliability: the execution of the service assessment leads to high reliability profile results; the easier and faster assessment method for PA offers results with a lower degree of reliability, as it operates on aggregate data and at a higher level of approximation.

Impact: enhanced science inreach and outreach in the field of digital safety

Important links: https://www.sicurezzait.gov.it/cyber/

Good case practice of science communication 2 – Italy

Short title: Ministry of Health - John Hopkins charts

Short description of the practice: Journalists and organizations during COVID-19 crisis use this tool to communicate updates on the virus' spread.

Scope: To inform on the virus' spread

Policy areas affected: public health

Main stakeholders: Population

Duration: ongoing

Methodology: In particular, on the Civil Protection website, the John Hopkins tool can be found and consulted. The John Hopkins University map is a visually clear tool to understand where and how the virus is spreading and where the number of infected is increasing or decreasing. Many online newspapers have utilized this map to report the daily news about the virus, especially during the first month. Later on, due to criticism of the morbidity of counting the dead, this tool began to be used mostly by the Civil Protection and the Ministry of Health, along with other similar interactive maps.

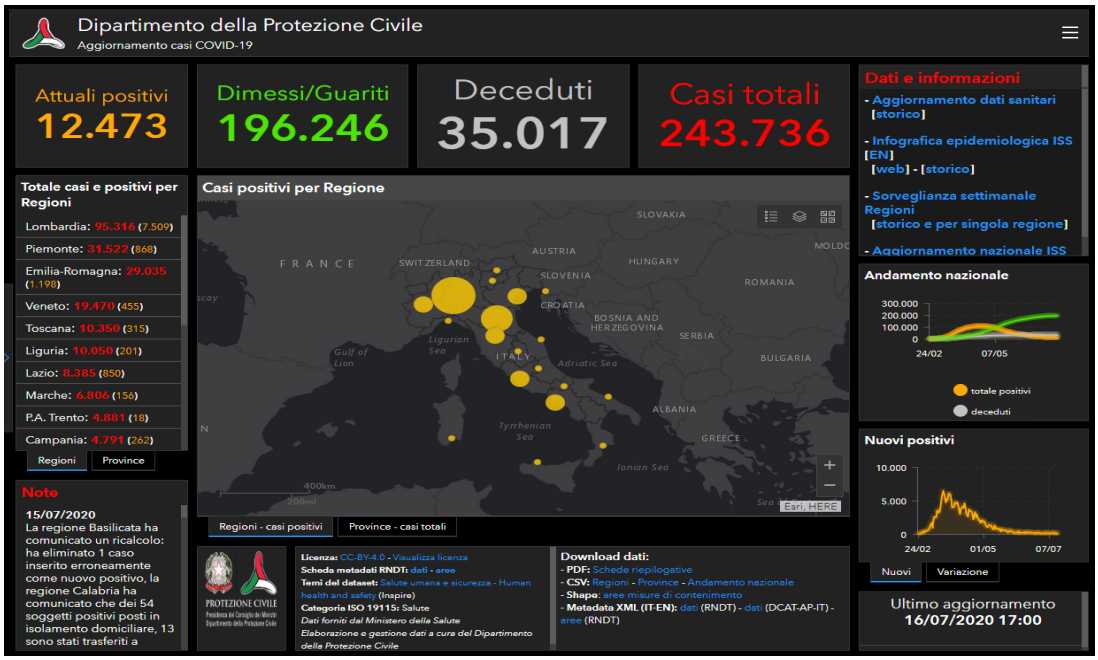

Figure 16 Updated number of COVID19 cases

Source: Dipartimento della Protezione Civile

REGIONE	POSITIVI SARS-CoV2				DIMESSI GUARITI	Deceduti	Casi totali	Incremento casi totali (rispetto al giorno precedente)
	Ricoverati con sintomi	Terapia intensiva	Isolamento domiciliare	Totale attualmente positivi				
Lombardia	164	23	7.322	7.509	71.032	16.775	95.316	80
Piemonte	159	6	703	868	26.536	4.118	31.522	7
Emilia-Romagna	88	9	1.101	1.198	23.566	4.271	29.035	46
Veneto	31	2	422	455	16.968	2.047	19.470	29
Toscana	12	2	301	315	8.908	1.127	10.350	12
Liguria	28	0	173	201	8.285	1.564	10.050	8
Lazio	175	9	666	850	6.687	848	8.385	9
Marche	3	1	152	156	5.663	987	6.806	1
P.A. Trento	1	0	17	18	4.458	405	4.881	0
Campania	23	1	238	262	4.097	432	4.791	4
Puglia	11	0	57	68	3.926	548	4.542	1
Friuli Venezia Giulia	7	0	90	97	2.901	345	3.343	4
Abruzzo	17	0	103	120	2.745	468	3.333	2
Sicilia	6	0	148	154	2.695	283	3.132	17
P.A. Bolzano	6	0	94	100	2.286	292	2.678	1
Umbria	5	0	5	10	1.362	80	1.452	0
Sardegna	4	0	7	11	1.232	134	1.377	1
Calabria	5	0	60	65	1.064	97	1.226	8
Valle d'Aosta	1	0	1	2	1.048	146	1.196	0
Molise	1	0	8	9	414	23	446	0
Basilicata	3	0	2	5	373	27	405	0
TOTALE	**750**	**53**	**11.670**	**12.473**	**196.246**	**35.017**	**243.736**	**230**

Figure 17 "Aggiornamento casi COVID-19" in an updated format for journalist

Source: Dipartimento della Protezione Civile

This is common in most of the newspapers, but a few still attach a link or an infographic that explains the data in a visual way, such as La Repubblica)

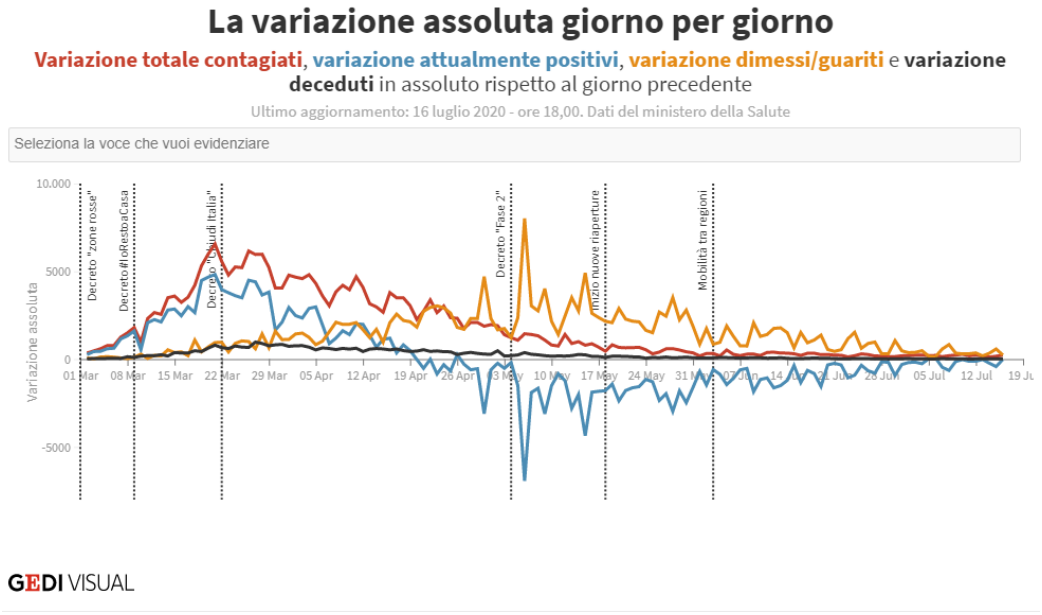

Figure 18 Daily absolute variation

Source: GEDI VISUAL

Impact: enhanced science communication about coronavirus

Important links:

http://opendatadpc.maps.arcgis.com/apps/opsdashboard/index.html#/b0c68bce2cce478eaac82fe38d4138b1;
http://www.protezionecivile.gov.it/attivita-rischi/rischio-sanitario/emergenze/coronavirus;
http://www.protezionecivile.gov.it;
https://www.corriere.it/speciale/esteri/2020/mappa-coronavirus/;
https://covid19.who.int;
https://lab.gedidigital.it/gedi-visual/2020/coronavirus-i-contagi-in-italia/

5.3. The Netherlands

Digitization and digital safety are high up on the agenda of the Dutch government. The Netherlands is considered a digital leader in Europe, with a history of early digitization and concrete strategies to increase digitization in the future. Digitalisation has started relatively early in the Netherlands, and in the past years, digital technologies have increasingly been trusted to improve public services. Since 2006, Dutch residents are able to submit their tax returns online via their national identification number and a so-called DigiD (short for Digital Identity). Since its introduction, the DigiD has been expanded to enable almost all services of public authorities to be performed online. Examples include requesting unemployment benefits, communicating change of address or applying for a building permit.

These services are facilitated by a Municipal Personal Records Database (GBA) which contains personal details of everyone who lives in the Netherlands. The personal information includes details of employment, marital status, children, bank account details and health insurance. Most of this information is collected automatically, because changes in employment, marriage etc. are linked to the national identification number. The national identification number is widely used, and it is required for several services that are not directly related to government issues (e.g., opening a bank account). The information collected in the Municipal Personal Records Database enables public authorities to perform and automate their tasks, such as paying benefits and collecting taxes.

Dutch authorities are not shy to highlight the many benefits of digitization of public services for Dutch residents. They speak of a compact government with "an effective public administration, close to the people, that brings out the best in individuals and communities".

Despite the benefits, Dutch public authorities are also aware of the importance of digital security, and they communicate these clearly on the government website: "If you conduct online transactions with public authorities, it is very important that nobody else should be able to use your identity. Information relating to private citizens and businesses is therefore rigorously protected, and access to them is strictly regulated. The Personal Data Protection Act regulates how organisations handle personal information."

In a highly digitized country, like the Netherlands, where sensitive personal information of its citizens is stored in databases and accessible to different authorities, the question arises: how do policy-makers decide which digital innovations are safe, and how do they communicate this to citizens? The answer seems to lie in strengthening the cooperation between government authorities, fundamental and applied research, and relevant companies.

A case in point is the Dutch Digitalization Strategy 2018-2021, which was presented by the State Secretary for Economic Affairs and Climate Policy, the Minister of Justice and Security, and the State Secretary of the Interior and Kingdom Relations in June 2018. The strategy plan highlights the close collaborations between government and research institutes. *Groundbreaking research and innovation* is the first of five focus areas specified in the strategy plan. Government authorities recognize that digital challenges such as privacy protection and cybersecurity require expert knowledge and research. As such, the strategy plan includes cooperation between the government and research universities, universities of applied sciences and other knowledge institutions. Concrete actions include partnerships in the field of big data, cybersecurity, blockchain, artificial intelligence, 5G and quantum computing. Furthermore, they aim to strengthen connections with the National Science Agenda, as well as the Digital Society Research Agenda of the Association of Universities in the Netherlands. These kinds of cooperation between government authorities and research institutions often take the shape of co-creation events, sharing data infrastructures, or co-creating educational events for specific target audiences (e.g., schools).

The aims specified in the Dutch Digitalization Strategy are annually reviewed and re-evaluated. As part of the review, Digital Summits are organized in cooperation with business, the scientific community and civil society organisations.

Apart from involving the business and science community, the strategy plan also explicitly emphasizes the importance of keeping citizens on board. The aim of the digital transformation is not only to benefit the labor market, but the society as a whole. As such, the government communicates news and developments surrounding digitalisation via their official website called 'Digital Government'.

The COVID-19 crisis has demonstrated the strong collaborations between policy-makers and experts in relevant research areas. Lockdown measures related to the corona virus were decided in close consultation with the Netherlands National Institute for Population Health and the Environment (in Dutch: Rijksinstituut voor Volksgezondheid en Milieu or RIVM). The RIVM is an independent research institute that advises the government, most importantly the Ministry of Health, Welfare and Sport, on how to promote public health. During the COVID-19 crisis, the RIVM collected and published official numbers of infections, hospital admissions and fatal cases on a daily basis. The research institute also explained their findings in accessible language and facilitated interpretation of the numbers and trends. The content of the RIVM website is presented in both Dutch and English, which makes it accessible to a larger public. As such, the RIVM website served as the official communication platform for the general public to access reliable information on covid-19 infection cases.

Since the outbreak of COVID-19 in the Netherlands, Mark Rutte (Dutch Prime Minister), and members of relevant ministries have given several press conferences. What stands out in their communication to the public is how often they stress the role of experts and scientists. In his historic speech of March 16th 2020, Rutte for the first time addressed the public directly. In this speech Rutte made clear that government decisions are informed by experts and that they are to be trusted "the answers to all questions begin with the knowledge and experience of experts. Let us hold on to that". He proceeds to praise the work and recommendations of the RIVM (Netherlands National Institute for Population Health and the Environment). The COVID-19 crisis team around the prime minister, officially called Outbreak Management Team, consisting of several specialists from the RIVM, such as the director of the RIVM, an infectious disease specialist, a microbiologist, a GP, a company doctor, a lung doctor, an intensive care doctor and a virologist. This team of experts discusses and communicates recommendations that serve as input for relevant ministries and the prime minister to develop and approve measures to fight the covid-19 crisis.

Good case practice of science communication - Netherlands, example 1

Short title: "Only together we get corona under control"

Short description of the practice: Since the first COVID-19 lockdown measures were introduced in mid-March 2020, the Dutch government has been broadcasting a series of video, audio and written materials about how to collectively keep the coronavirus in check. The campaign is a direct translation of recommendations that the government received from an independent research institute, namely the Netherlands National Institute for Population Health and the Environment (in Dutch: Rijksinstituut voor Volksgezondheid en Milieu or RIVM). The RIVM is the official information platform for data research on COVID-19, and it serves as the main advisor to the government for health issues.

Under the slogan "Only together we get Corona under control", they remind citizens that everyone is in this crisis together. They call the public to action with simple messages framing the new norm: "We wash our hands, we stay at home and we keep a distance", "Let us pay a little more attention to each other", "Only if we persist together, we protect ourselves and each other" and "Only together we get corona under control". These same messages are repeated in short 30 second video clips that are aired on television and YouTube. They also appear in short 30 second audio clips aired on the radio as well as in several information brochures, infographics and posters. All these communication materials are freely available for download and use on the government website.

The messages quoted above are not only repeated in communication materials, but they also frequently feature in the prime minister's speeches during COVID-19 press conferences that have been regularly held since March 2020.

Scope: National scope

Policy areas affected: Covid-19 lockdown measures

Main stakeholders: General public. Special efforts were made to include marginalized groups in two ways: 1. simplified infographics were specifically designed for people with mental disabilities, and 2. infographics were translated into Turkish, Tigrinya, English, Arabic, Polish, Farsi, Chinese and Somali.

Duration: Since March 2020 and still ongoing

Methodology: Short videos were broadcasted on TV and YouTube, audio recordings were spread on the radio, and infographics disseminated online. All materials are freely available via downloads.

Impact: It is difficult to measure the direct impact of this science communication practice. However, it is clear that with relatively unrestricting lockdown measures, the Netherlands was able to flatten the curve and to soon ease the few lockdown measures that were initially introduced. Dutch news report high compliance with the recommendations promoted by the "Only together we get corona under control" campaign, namely to keep a 1,5m distance and to stay at home as much as possible. However, it should be mentioned that channels other than the campaign promoted the same behaviours, for example, press conferences with the prime minister, news channels and social media.

Important links:

https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/coronavirus-beeld-en-video/communicatiemiddelen-campagne

Good case practice of science communication- Netherlands, example 2

Short title: Knowledge Labs

Short description of the practice: Knowledge Labs is a series of collaborative projects involving researchers from the Erasmus School of Social and Behavioral Science at (ESSB, Erasmus University Rotterdam) and representatives of the City of Rotterdam, as well as other knowledge institutions. The collaborative projects seek to share and co-create knowledge in order to answer questions about a diversity of social challenges surrounding the city.

Scope: Municipality

Policy areas affected: Knowledge Labs cover a wide scope of policy areas related to the city. Each Knowledge Lab focuses on one specific policy area. Examples include livable neighborhoods, urban big data, vulnerable youth, urban labour market, urban infrastructure, and health.

Main stakeholders: Citizens of the City of Rotterdam

Duration: Since 2012 and still ongoing

Methodology: The primary methodology is a series of labs where representatives of the Municipality of Rotterdam and researchers from Erasmus University share and co-create knowledge about real-life challenges that are present in the city (e.g., vulnerable youth,

big data, health). The research agendas of the lab are set collaboratively by both representatives of the municipality and the university. Depending on need, representatives of other knowledge institutes are invited to participate. The ultimate aim of the Knowledge Labs is to support the municipality in creating evidence-based policies.

Impact: 10 Knowledge Labs are currently ongoing and they have each generated relevant new knowledge in their respective focus areas. The measurable output includes numerous academic publications and policy reports with concrete recommendations for how to make the city more livable.

Important links:
https://www.eur.nl/en/essb/society/city-rotterdam
https://www.mdpi.com/2071-1050/10/6/1893/htm

5.4 Hungary

Pursuant to Act XL of 1994 on the Hungarian Academy of Sciences (MTA), "the MTA, at the request of the Parliament or the government, shall provide professional opinion on all issues in its competence, in particular with regard to science, education, society, environment and economy". This paragraph means that it is the primary responsibility of MTA to inform policy-makers on scientific issues in Hungary.

In the field of R&D&I, the National Science Policy Council serves as the main advisor to policy-makers, in particular the Ministry of Innovation and Technology. This is a high-level body composed of the President of the Innovation Alliance, ministers responsible for innovation and finance, the President of MTA and the most important research institutions, as well as the most influential innovative companies. The lower-level information flow to this strategic body goes through the individual participating institutions and their networks.

Even though spending on R&D reached a record level of 1.53% in 2018 (with an increasing trend, but still far from the envisaged 3% for each EU member state) the country is still lagging behind in many innovation areas as evidenced by its overall rate and long-term growth pattern measured by the European Innovation Scoreboard (EIS).

One of the reasons for this is the insufficient connection between various stakeholders in the innovation ecosystem (in the 2019 EIS, in addition to finances and intellectual assets,

linkages between private and public actors are one of the weakest points of the country), which may also be due to the inefficiencies in science communication towards policy-makers. The root of this problem can be also seen in the above mentioned Act on MTA since it also only determines science communication arising from the needs of the policy-makers, but not the proactive role played by the scientific community, e.g. in the form of analyses to policy-makers.

There are more proactive individual experts and expert groups or institutions initiating discussions and networking with policy-makers but recently it was still a top-down policy shift which aimed at involving experts more closely in collaboration and co-production in R&D&I and digitalisation. Thus, the methodology of elaborating strategies in the related fields always involved prominent experts coordinated by policy-making bodies. This was the case for the Digital Well-being Programme 2.0 in 2017 (coordinated by the Association of Digital Economy and the Digital Well-being Non-profit Ltd functioning as ministerial background organisations), the National R&D&I Strategy in 2018 and the National Smart Specialisation Strategy in 2016 (both coordinated by the Hungarian National Research, Development and Innovation Office (NKFIH)).

The update of the latter strategy for period 2021-27 is currently ongoing in the framework of which new digital methods, such as an online questionnaire is also utilized for citizen engagement. In relation to setting up a strategy with the broadest possible stakeholder engagement, a series of national consultations were organized for Territorial Innovation Platforms and for the National Innovation Forum.

This is in line with the objective of professionalizing science communication along the whole innovation ecosystem, which was announced by the then-president of NKFIH in 2018. A new science communication methodology was adopted with the aim of supporting better linkages between scientists, policy-makers and the general public. One practical objective is to support the better participation of Hungarian researchers in international schemes, due to which science communication will be part of the evaluation criteria set in future tenders and calls for proposals.

The enhanced importance of science communication in general and towards policy-makers was also underlined by the first Master's course specialized for science communication starting in 2011 at the Eötvös Lóránd University (ELTE) – the first such programme in Central-Eastern Europe. As a pre-requisite applying students (around 50 each year) had to have a Bachelor's Degree in some engineering, natural science, IT, agrarian or health field. However,

showcasing a break in the continuity of government priorities, this 4-semester programme titled "Science communication in natural sciences" was short-lived since – without prior consultation of the relevant academic stakeholders – the government abolished it in 2018. Thereafter, interested students can currently only attend specific science communication programmes at PhD level in Hungary. It is to be seen whether new lower-level scientific communication courses or academic programmes will be (re-) introduced in the future.

In relation to the new science communication methodology, the open access to research has also been promoted. Hungary was among the first five EU Member States to officially support the so-called golden open access solution. To support the practical implementation of the open science principles of the OECD and the European Union in the fields of legislation, government policy, strategy, financing, organization, communication and science evaluation, an Open Science Expert Committee was set up with the participation of renowned experts under the auspices of NKFIH.

Maybe not unrelated from the positive top-down promotion on more responsible, transparent and open science communication, but also running in parallel and in some ways in front of it, many bottom-up initiatives were founded that facilitate science communication towards previously unserved population groups.

SCIndicator (SCIndikátor) is the first science communication mentor programme run by the Women in Science (Nő k a Tudományban) foundation with the aim of giving a chance for young researchers and students to develop their communication skills. Szertár, one of the Hungarian scientific communities aiming among others at the popularization of science is also part of this programme. Both private organisations are professional partners of the NKFIH, signaling an increased interest from the policy-making side for popular science communication.

The COVID-19 pandemic has also facilitated these ongoing science communication trends. COVIDEA idea and start-up competition is an example of quick reaction to changed funding needs with the involvement of policy-makers as intermediaries between innovation policy experts and potential applicants. But not only policy-makers took advantage of science communication with experts in mitigating COVID-19-related issues, but also experts reached out to policy-makers offering support through science communication methods, such as the online information platform Koronavírus Kisokos, utilizing the trust and good reputation of scientists among the Hungarian public.

Good case practice of science communication – Hungary, example 1

Short title: FAQ on COVID-19 pandemics

Short description of the practice: The website **"Koronavírus Kisokos"** is a very thorough but still understandable and informative website on all medical and social news related to the COVID-19 pandemics in Hungary. The content of the website was compiled by Hungarian biologists (assisted and revised by other scientists and medical doctors) with the aim of mitigating the spread of fake news and providing a trustworthy surface about news for the general public and policy-makers.

The content is broadly divided to categories related to the crisis, such as "Pandemic", "Spread", "Defense", "Disinfecting", "Symptoms", "Testing", "Care", etc., also giving practical advices for instance on making protective masks at home in the most proper way. The validity of the content is ensured by the reputation of its authors and the relevant citations provided throughout the site.

The website was widely disseminated by relevant news portals, major scientific sites (Hungarian Academy of Sciences) or popular medical QA sites. As further shares of mainly local community portals prove the website was widely used for counteracting the dissemination of 'fake news' on COVID-19, giving instructions for people on proper defense mechanisms and avoiding panic due to controversial or insufficient informal (and also formal) news.

The best practice can be understood in the Hungarian context since the country has a low social trust, in particular towards policy-makers, but has the highest trust in scientists and medical professionals in relation to the COVID-19 crisis (the official government website has an average trust of 40%, while 65% trust scientists). While the Hungarian central government was slow to react and did not provide enough transparent and useful information in the early period of the crisis (arriving later in Hungary than in Western Europe) therefore a need arose for such an "infotainment" website written and supervised by scientists which could be used as a background material for local policy recommendations by mayors (e.g. wearing of masks, which is still not compulsorily at national level).

Scope: National – mainly used by the local governments (councils) for spreading information on COVID-19 in their municipalities

Policy areas affected: environ-mental health, misinformation

Main stakeholders: academic researchers, general public, interested policy-makers at any level using information for evidence-based decision-making

Duration: Website was fully operational on 1 April and is regularly being updated

Methodology: internet website (science outreach from scientists to laypeople and policy-makers); engagement of stakeholders ensured by suggestions of relevant topics

Impact: awareness-raising tool supporting the containment of misinformation and ensuring better enviro-mental health of general public and policy-makers; as well as background material for (local) policy recommendations

Important links: https://koronavirus-kisokos.eu

Good case practice of science communication – Hungary, example 2

Short title: COVIDEA idea and start-up competition

Short description of the practice: The Hungarian National Research, Development and Innovation Office (a background organisation of the Ministry of Innovation and Technology; hereinafter: The Office), with the policy support of the Ministry announced an **idea and start-up competition** on 23 April 2020 with the aim of supporting solutions in different policy fields that can help alleviate the new challenges in the current epidemiological, health, economic and social crisis caused by COVID-19.

The preferred thematic areas were defined as broadly as possible (e.g. solutions decreasing the spread of disease, as well as easing the situation people with risk factors, including all types of ideas that can have a measurable social benefit), but for the purposes of TRESCA, solutions enhancing environ-mental health deteriorating due to social distancing, as well as labour market measures contributing to the more efficient use of state resources and services are of the highest importance.

Individual persons who cannot themselves implement their project ideas can apply in the "idea" category (in case of winning, their obligation is to prepare a feasibility study), while the "project" category is open for non-profit organisations, start-ups and SMEs willing to implement their project ideas. The former category will award max. HUF 2.5m (approx. EUR

7.250) for 5 ideas, and the latter category will award max. HUF 57m (approx. EUR 165.000) for 15 projects.

In light of the current situation, the Office made the application as simple as possible (less red tape), while also involving an innovative element in the 2-stage process: the pre-screening is done by an expert jury of innovation policy experts, but the final stage involves a 3-minute video presenting the idea for support to a 5-member jury made of relevant expert of the innovation ecosystem. The main award criteria are social benefit and feasibility (timeline and budget).

The Office as a relevant policy-maker supports the implementation of projects by connecting partner organisations in the scientific field (e.g. universities, research organisations, spin-offs, incubators) with winning applicants through direct engagement and awareness-raising. Thus the Office makes the co-creation of innovation projects between citizens/businesses and relevant experts/scientists possible through intermediary activities.

Scope: National – application is possible from the whole area of Hungary

Policy areas affected: COVID-19 related innovative measures, for the purposes of TRESCA, environ-mental health, labour market solutions, digital approaches are the most relevant

Main stakeholders: The National Office for Research, Technology and Innovation as policy facilitator and intermediary between scientific community (supporting organisations in implementation of projects) and citizens/businesses (applicants – main project implementers)

Duration: The call for proposal was published on 23 April, 2020 with a first-stage application deadline of 7 May, 2020 – the awarding of projects is ongoing

Methodology: The policy-maker acts as intermediary between innovation policy experts and the applicants, thus ensuring a bridge between citizens/businesses and the scientific field through its excellent network with the relevant stakeholders in the innovation science ecosystem in Hungary. The specific channels used to bridge experts with applicants in the project phase is not detailed.

Impact: This practice of science communication between citizens/businesses and experts with the aim of implementing innovative COVID-19 mitigating projects through the facilitation of the policy-maker enhances the active collaboration between innovation policy theoretical experts (academia, research organisations, universities), practitioners coming

from the scientific field (spin-offs, incubators), as well as businesses and laypersons (providing ideas and implementing projects with the support of experts).

Important links: https://nkfih.gov.hu/covidea

Other (optional): An exact impact assessment will be only possible after the finalisation of the first round of the call – the impact of the ongoing trend of expert involvement in decision-making (see expert juries and also innovative methods used, e.g. video) and implementation, partly accelerated by the COVID-19 crisis, could then be evaluated.

5.5. Summary of national findings

Four countries, namely Austria, Hungary, Italy and the Netherlands were analysed from the perspective of the communication between scientists and political decision-makers in the field of innovation and digitalisation. The partners used secondary research of available relevant online and offline scientific and political documents, based upon which the following conclusions were drawn.

Scientists are regularly consulted by policy-makers in various formats, but there is still a prevalence of traditional methods, e.g. written notes or briefs submitted to policy-making boards or persons. Trends are slowly changing, if at all: if scientific advice is not given via the traditional one-way communication, such as policy notes or briefs then selected experts are involved in official advisory boards. In certain countries there is a central expert body assigned with scientific communication and advice, e.g. in Hungary the Academy of Sciences has the primary responsibility with specific expert-policy groups dealing with innovation and digitalisation.

Recently, scientists have also been included in the advisory boards concerning the new COVID-19 virus. However, the urgency of the pandemic showed that the traditional methods may not be fast and comprehensive enough in this communication situation. This led to the use of novel methods, e.g. fact-checking platforms, institutional websites, online newspapers or social media campaigns where policy-makers could disseminate the (scientific) evidence-informed decisions to the broader public in less time. Various fact-checking websites have especially gained in importance during the pandemic: policy-makers realized the political and social benefits of such platforms countering the spreading of fake news with the help of experts.

As regards topics, digitalisation is gaining ground in all analysed countries. It does not matter whether a country is a frontrunner or a follower in digitalisation, the trend is towards an accentuated relevance of digitalisation, in particular aimed at providing better public services. For doing so open science methods are used towards greater stakeholder engagement. Engagement between government authorities, research institutions, citizens and businesses often take place through co-creation events, sharing data infrastructures, or co-creating educational events for specific target audiences (e.g. schools).

The digitalisation brings a higher reliance on visual solutions too when scientists and policy-makers use at least photos, videos, links to external articles or simple graphics when communicating online (e.g. through YouTube or Twitter).

The COVID-19 pandemic has also had different effects on politicians in the sense how they placed themselves in the changed science-policy interface. Some of them internalized the values of science and tried to act in the capacity of experts, while some rather took on an intermediary role, circumventing the role played by traditional news sources (see Italy for a more detailed overview).

The proliferation and sustainability of these digital methods, as well as of the changed science communication role of policy-makers will surely vary on a country basis after the COVID-19 crisis, but currently – due to lack of data in this short time frame – nothing more concrete can be added.

We can neither be sure whether the enhanced trust in scientists observed around the countries will be a lasting trend or not. High-level Italian and Dutch government officials have explicitly expressed their appreciation of scientists for providing the general population with reliable and verified data and information in trying circumstances.

6 INTERVIEWS WITH POLICY-MAKERS AND POLICY-INFLUENCERS

Between May and July 2020 altogether 29 semi-structured interviews were conducted with relevant transnational and national R&D&I policy-makers to find out more information on the current focus, data sources and channels, as well as relevant trends of science communication between policy-makers and the scientific community.

The outbreak of the COVID-19 pandemic and the ensuing national restriction measures made it difficult to organise the interviews as originally planned. In addition to a slight delay

in planning, the interviews were predominantly held through virtual methods, including phone conversation, Skype, ZOOM and GoToMeetings platforms, based on the preference of the interviewees, as well as taking into account relevant data privacy regulations.

The breakdown of interviews per country is as follows: seven transnational, seven Austrian, five Dutch, five Hungarian and five Italian interviews. All interviews followed the same, pre-approved interview guidelines annexed to this report. The interviews were summarized by the national teams in a few pages, following the main interview questions, after which the same teams also compiled the final overview of findings presented in this Chapter (see also methodology in Annex).

The findings follow the same structure for all countries, providing relevant insights on science communication with R&D&I policy-makers as regards to the following key topics: data sources and analysis, the policy development process, stakeholder involvement, trust in science and science communication, strategies and approaches to communicate policy decisions to journalists and science community, key elements of science communication in relation to policy, key challenges of science communication in relation to policy and opportunities.

6.1. Interviews with transnational policy-makers

Altogether 7 interviews were held with international policy-makers in the field of R&D&I. These interviews showcase a higher diversity in terms of institutional fields and responsibilities – 1 interviewee is working for a macro regional Managing Authority, 1 interviewee has been employed at the European Institute of Innovation and Technology Digital Node, 1 interviewee is the Head of the Liaison Office of his home country, and 4 interviewees are working for the European Commission in different positions, responsible for areas linked to TRESCA. The seven interviewees have a consistent representation as regards their level of position since all of them serve in mid-level policy officer positions. Thus, the interview summary can be considered to give a fair overview of this mid-level policy perspective on science outreach with policy-makers at a transnational level.

Data sources and analysis

The interviewees mostly mentioned the lack of formalized – or formal list of – data sources for science communication within their organisation. Therefore, they mostly use data sources deemed trustworthy and reliable in general, such as Eurobarometer, Eurostat, JRC scientific information, Research Executive Agencies (REAs), OECD policy briefs or national

statistical data. The EC has also subscriptions to different libraries covering off- and on-line sources. The EITI also predominantly uses scientific information coming from its paying member organisations.

The interviewees also say that direct communication with scientists is crucial (at their policy position level). This is undertaken in different ways dependent upon their specific workplaces, coming through written information from Project Lead Partners or Officers or via (semi-) permanent official meetings, roundtables and other consultation events when a certain topic requires it. These meetings serve the purpose of advising policy decisions and strategies (e.g. industrial strategies).

The policy development process

Due to the highly formalized nature of their working places, all interviewees admit that there is an approved way of policy development process which all actors must strictly adhere to. This was not substantially influenced by new trends in communication with scientists. As one interviewee claims, "potential delays in policy-making are not caused by engagement and consultation problems but rather the set rules of decision-making at the European level which requires a strict formal procedure."

The organisations of the interviewees get information from their trusted data sources, get in touch directly or indirectly (meetings) with experts, retrieve scientific information from Member States or procure a study for scientific evidence before decision-making. These findings are validated through various means at the later stages of decision-making, e.g. via expert group meetings. This is a streamlined way of co-creative policy development process at transnational and European level.

Stakeholder involvement

Interviewees mention the various types of events organised by their respective organisations as the most valuable opportunities to bring together scientists, experts and policy-makers in the R&D&I field together. Such events can take many forms, such as roundtables, workshops, conferences, focus groups or smaller stakeholder meetings.

Due to the nature of their organisations, three interviewees also mention the prominent role of Member States and local actors played in stakeholder engagement: the insights of relevant experts are collected and analysed on national or local level and then arriving at the

higher level. They find this process democratic since all Member States can use such methods as they see best fit to their country's circumstances.

One good practice mentioned by an interviewee was implemented by the European Parliament where certain MPs take on the role of scientific 'ambassadors' and facilitate the communication of scientists and policy-makers. Unfortunately, lobbying is often based on individual interests therefore it is strong but not sustainable in many cases.

Another good practice was the recently organized #EUvsVirus Hackathon and Machathon where a record-breaking number of stakeholders along the quadruple helix was engaged in a holistic and mission-oriented co-participatory approach. The upcoming R&I days were also mentioned as a future opportunity for such a broad engagement initiative.

Trust in science and science communication

Interviewees are of the opinion that – despite the ongoing efforts of European-level policy bodies – there is still a mistrust (or misunderstanding) between scientists and policy-makers due to which communication efforts are often sub-optimal. Three interviewees mentioned the specific problem that researchers respect too much the 'hierarchical order' and do not engage creatively with policy-makers even though it would serve their interests. They tend to rely upon the official channels and let their Directors do the necessary communication and lobbying with policy-makers even though policy officers (such as the two interviewees) tried to engage with them many times during their tenure.

A variety of potential reasons for this behaviour was mentioned, e.g. scientists do not feel that communication is their duty, are busy, have different perspectives and do not know the proper channels or language. The other interviewee – with previous work experience in Silicon Valley – assumes that this is because entrepreneurial attitude is not as much needed for getting funding in Europe as in the USA. In the USA, communication and engagement between policy-makers and researchers is much more required and widespread since funding is also more dependent upon scientists' communication efforts and ability to sell their ideas to funding bodies faster than their competitors.

He also mentions a US good practice for trust-building when relevant researchers are invited by the Department of State to work in a respective government institute for one year and gain necessary knowledge and expertise in their respective field(s), but from the 'other' side (policy-making). The researchers thus understand the expectations and decision-making

mechanisms better and when they return to their research organisations, a better communication and collaboration with policy-makers can start.

At the European level, trust can be also enhanced by the shift towards open science and innovation, which is manifested in the set-up of such new institutions as the European Data Cloud (EOSC), Open Research Europe Platform. This happens in the context of better reproducibility of (social) science which is of utmost importance to more relevant, transparent and cost-effective research.

Strategies and approaches to communicate policy decisions to journalists and science community

The general consensus of interviewees is that it is the duty of their organisational departments responsible for communication to engage with (science) journalists therefore no official strategy exists at their level (policy officer), except for being open and available for journalistic purposes. One interviewee was a communication officer who was in daily contact with journalists but also confirmed that communication is done within the department responsible for press relations. They claim to be open to give interviews or be at the service of journalists until the co-operation is based on the mutual principles of transparency, responsiveness and openness. In this regard, two interviewees mentioned misrepresented or “cherry-picked” information by a journalist.

Key elements of science communication in relation to policy

As one interviewee puts it, “the background noise gets louder in the field of digitalisation, and in the entire STEM field, therefore there is a growing need to communicate in a clearer, simpler, more engaging way.” More interviewees confirm a trend towards more visual solutions and other interactive online formats of science communication – e.g. social media, most frequently mentioned Twitter – to policy-makers (mentioning the need for clear, concise and eye-catching communication messages and formats). The usage of such new channels depends on the target groups and objectives (level of engagement) of the communication campaigns.

The use of more visual solutions is connected to another new element in science communication with policy-makers, namely that many meetings previously held face-to-face had to be organised in an online format. As one interviewee explicitly put it, before the COVID-19 outbreak the stance on online meetings were rather negative (only done in the

most necessary case), while now the advantages of such meetings are more pronounced, for instance more interactivity, more visual solutions, cost benefits, time efficiency (for both stakeholder groups), a higher level of flexibility in topics and organisation (more people can participate with much less preparation), and the participation of genuinely interested people (not being there only for the 'side incentives').

Key challenges of science communication in relation to policy

Interviewees are of the opinion that the current COVID-19 pandemic may drastically change the long-term R&D&I trend. At the EU level, this will not primarily manifest in the formulation of new topics – which would not even be really possible with the long-term fixed mandates and procedures of the policy-making bodies interviewees are employed at – but through the pace with which digitalisation-related topics will be taken up by the policy sphere and the general public. E-commerce, e-learning and such solutions necessitated by the lockdown measures have already become mainstream areas to be dealt with in the scientific and policy areas too.

Another challenge is the increased proliferation of fake information to which European-level policy-making bodies could only react, but not proactively prevent it. This is now strived to be solved by various measures, such as specific websites and online services against misinformation, as well as targeted communication campaigns. The COVID-19 EU data portal, the European call on science communication (SwafS-19-2018-2019-2020: Taking stock and re-examining the role of science communication) are mentioned as good practices.

For these campaigns to be successful, the mistrust between the scientific community and policy-makers should be mitigated. As one interviewee told us, "the most important step would be that policy-makers would get out of their bubbles in Brussels and find new and improved ways to engage with scientists. The interests of scientists should be arisen to which the recently launched EC information campaign can be seen as a good practice. However, this campaign can be only successful if information reaches to a more granular level, e.g. regions or institutions in Member States."

Opportunities

The Commission and other transnational policy-making bodies have finally realized the threat posed by misinformation and fake news on the core values of the European community and launched communication campaigns and other counter-measures. This

process was accelerated by the COVID-19 crisis. If these campaigns and measures are successfully and effectively carried out, the whole European community will be a winner.

In relation to this, communication campaigns and a broader discussion have also started on the relevance of R&D&I, and one interviewee specifically thought that R&D&I and science in general can be a winner of the current COVID-19 situation since people will again understand and appreciate the value and role of science in society and economy. For instance, the basic messages (but not details) of the European Green Deal are fairly well-known even among not science-savvy citizens too. In his opinion there is a huge opportunity to gain (back) people's trust and realize an increased role of experts in policy-making at European level. This shift is evidenced by the 13.5 billion euros increase in Horizon Europe budget thanks to the response to COVID-19 crisis.

The crisis also made the European policy bodies use more creative formats (e.g. in dissemination and exploitation campaigns) where a 'brand' building operation of R&D&I is ongoing in the collaboration of members of parliaments and other policy stakeholders, experts and media representatives. This also contributed to a related shift towards a more open relationship with other stakeholders, such as businesses. Even though it will be differently named and implemented in Horizon Europe, digitalisation-driven open science and RRI will almost surely play a more accentuated role in the future at programme and project level. As one interviewee says, "RRI will be better mainstreamed." This provides an opportunity to reach a higher level of trust in the entire science-policy nexus at the European level.

6.2. Interviews with national policy-makers

6.2.1. Austria

In Austria altogether seven interviews were held, three policy-makers on national level, one policy-maker on regional level, two policy advisors on national level and one knowledge coordinator on municipal level interviewed with the following main conclusions.

Data sources and analysis

The interviewees primarily use a variety of large, relevant and inherently trustworthy research support services making social science data accessible. In addition to more general international players (e.g. UNO, Eurostat, OECD, IMF or World Bank), several Austrian good

practices were mentioned based on interviewees' expertise, among others the Austrian Research and Technology Report, the Unidata, the Statistik Austria, the database Dimensions or the open data portal of Austria.

The latter hosts an Austrian COVID-19 information portal) which is used by one of the interviewees involved in the national expert advisory group on COVID-19. This shows the rapidly varying field of data sources used. The stakeholders must be ready to extend their horizon and look for new data sources, which seem to quickly be provided by the policy-makers, even in such highly volatile periods as the COVID-19 pandemics.

These quick changes in the landscape make it necessary for interviewees to also rely on data sources collected by themselves. This is mostly done online – also using the most up-to-date social media sources, such as Twitter – and with the support of Austrian scientific networks and platforms that operate trusted websites. One interviewee expresses the relevance of German language newspapers on a daily basis. One interviewee also claimed that his main data sources are his own colleagues, who in turn use their sources to research information for the interviewee. These data sources mostly cover the secondary data from scientific reports and studies needed for the work of policy-makers and advisors.

The policy development process

There is a tradition of participative policy-shaping in Austria which is visible from the interviewees' answers. There are certain well-established forms of embedding scientific input to the policy decision-making process in R&D&I. One interviewee explicitly refers to 2008 as a cut-off date for a paradigm shift before which "the ministries developed the political measures on their own and presented them afterwards. Nowadays, it is commonly agreed that stakeholders have to be engaged as early as possible to gain more creative insights and solutions."

The first such process was a big stakeholder consultation, which led to an in-depth STI policy strategy discussion. The results of this discussion shaped a recommendation of a specific STI strategy. Afterwards several stakeholder engagements have been initiated by the organization, as well as by the Ministry responsible for science.

Policy-making organisations draw on the expertise of scientists in the R&D&I field in various ways: the studies and analyses commissioned by policy-makers are only done by experts from universities or certified research organisations. The research platforms mentioned as

good examples play a pivotal role as official networks in the science-policy nexus. There is a shift towards open-source platforms for political decision-making processes. As one interviewee underlines in the light of the current COVID-19 pandemic, the "COVID-19 data platform for researchers, for example, has an advisory board, composed of experts from policy, research and law, who accompanies the accreditation process."

Stakeholder involvement

The interviewees, in particular policy-makers on the national level, mention first and foremost the importance of networking for stakeholder engagement. The relevant actors prefer to involve themselves in scientific platforms and networks in the framework of which their interests can be better communicated and represented towards policy-makers.

Austrian Platform for Research and Technology Policy Evaluation (fteval): functioning as a network of trusted researchers comes up in more interviews as a good practice. The Open Science Network Austria (OANA) is also mentioned, which could be the facilitator for future changes in the science-policy nexus. In the narrower field of health technologies, one interviewee referred to the Austrian Health Targets Platform where a broad range of different stakeholders can engage themselves and can participate in the process. A more local-level interviewee mentioned best cases for such networks in Vienna, e.g. the Social City Wien or the municipal department of innovation in Vienna.

Relevant events also serve as good opportunities for policy makers for being confronted with new and innovative ideas that can be later taken up by (local) policy-makers and supported financially. Successful events mentioned include the Austrian Social Impact Award) or the 2018 science festival that lasted for a week and welcomed more than 30.000 visitors.

One interviewee also underlines the importance of personal communication between scientists and policy-makers because "this way, policy-makers can talk to, build trust with, and heed the advice of someone they know personally, which has a greater impact than dossiers and scientific analyses." The interviewee stresses that the political world operates with different kinds of capital than the scientific world, and that policy-makers have to accommodate this difference: speed, novelty, and dramatisation in the form of good stories with a clear problem and solution are paramount to policy-makers, while scientists, on the other hand, often fear being misrepresented in the media. Therefore, the needs of all actors need to be accommodated in the view of this interviewee.

Trust in science and science communication

Based on the overall picture, Austrian policy stakeholders claim to value openness and find the strengthening of principles towards open science important. Interviewees also see that the adherence to clear and unambiguous open science policy is crucial to ensure trust in science communication. As one interviewee puts it, since more and more data are collected through digital products, there are fundamental questions arising, such as "how can those data be made accessible? What are reasonable standards? Who is allowed to use them? What has to be done by the producers, what by public authorities?"

As another potential challenge related to maintaining trust for science communication with policy-makers, the set-up of reliable and trustworthy novel social media channels can be mentioned. Since more interviewees felt that such new channels, for example Twitter or blogs might be utilized more to spread news and force communication on specialized topics, a strategy for ensuring the credibility of such sources should be looked upon.

In contrast to open science, responsible research and innovation (RRI) is viewed more sceptical by many interviewees. While agreeing with its increasing importance, one interviewee called it a "fig leaf that does nothing to address structural shortcomings within the (R&D&I support) system". In this respect, he worries especially about innovation policy, and the engagement of the public in such innovation policy, as well as concomitant research. However, he is hopeful that the mission orientation of Horizon Europe might change this. Another interviewee admits that RRI is talked much about, but it is still not part of the corporate culture within his policy organization.

Strategies and approaches to communicate policy decisions to journalists and science community

A dichotomy is perceived with regard to communication approaches with journalists. Policy-makers involved in more centralized, higher-level policy-making bodies tend to be more passive and leave the communication to their responsible department also having a corporate communication process and policy. Multiple channels are utilized by organisations in this regard; for instance, social media and press releases/public relations work, targeted email-communication, newsletters. The interviewees based in such organisations do not

usually engage directly with journalists, if they do then it is done through personal connections (not in a systematic way).

On the other hand, interviewees from smaller organisations rather identify themselves the relevant journalists and form alliances with them, which was mentioned by one interviewee as “an effective instrument to create impact, in part because you are then harder to be ignored by other decision-makers”. If handled well, this strategic alliance-building between the scientific community and journalists may give a stronger voice to experts in policy-making in the field of STI too.

The connections are also more modernized in such a personalized network because the use of social media, such as Twitter was also mentioned, in addition to the traditional forms of (science) journalism. However, in larger organisations there tends to be no general social media account because this would be rather difficult due to the dimension and nature of the policy-making organisation.

Key elements of science communication in relation to policy

As visible from most of the interviews, platforms such as the Austrian Platform fteval play a key role in achieving a better common understanding between policy and scientific stakeholders in Austria (the mentioned platform has for instance institutional members from ministries, agencies, evaluators and research institutes). The maintenance and extension of these platforms and their work with the most up-to-date data possible is crucial for the success of science communication with policy-makers in Austria.

The platforms showcase a key feature of the Austrian science communication between R&D&I experts and policy-makers, namely the more and more accentuated role of open science and access and the related principles. The picture painted by the interviewees showcases a landscape where a more open co-creation process may evolve out of the current system. Some organisations strategically involve, and some programmes are strategically designed to engage non-traditional stakeholders.

The facilitation of open science is also strengthened by the uptake of new communication formats, which was mentioned by several interviewees. Mostly the new opportunities provided by social media channels were underlined, in particular Twitter was mentioned in several cases, but also websites and blogs were added as new data sources and engagement methods.

Key challenges of science communication in relation to policy

As mentioned, a key element in science communication is the use of trusted platforms enabling evidence-influenced decision-making in R&D&I. One of the key pre-requisites of such well-functioning platforms is the up-to-date access to primary data. However, as pointed out by one interviewee, some databases, such as the Statistik Austria are still not completely available for research purposes even though scientists in Austria long demanded (increased) access to such primary data sources.

This is related to a broader debate in Austria about the accessibility of research data within certain databases for secondary use. In general, such data should be open pursuant to the Austrian Act on Research Organisations, but for the technical implementation and political clarification, an additional decree would be needed, which is still blocked by the relevant minister(s). The issue of secondary research use for such databases emerged during the current COVID-19 pandemic too since some experts publicly voiced concerns about the COVID-19 data at the data.gv.at portal hinting at a potential data leak. This was resolved by an updated version of the data portal in question.

Such high-level policy challenges are also highlighted by one interviewee mentioning the changes in government strategy as a cause for preventing the final implementation of a new platform. The idea of establishing a common research funding database had already been included in the previous government's programme, a feasibility study had been conducted and a concept paper was supposed to be presented before the election in 2019. All this policy preparation (co-creation) work was halted when the new government decided not to take up the scientific expert information any longer in its official programme.

Opportunities

The current debate on the regulation of open source formats – while the principles of open science are considered important by the stakeholders in the innovation ecosystem – may pave the way for a more strategic science communication between experts and policy-makers where databases are readily accessible for research purposes in a way that is institutionally sound and ensures the protection of sensitive data. This is especially important for quantitative social science research. One interviewee claimed that the current Austrian government has committed to addressing this issue in their term of office.

This change would help to foster the already ongoing paradigm shift towards more co-creation for evidence-influenced policy decisions in R&D&I. The relevant work and networking undertaken in the various STI platforms, as well as the more and more strategic alliance between (science) journalists and researchers have already set the stage and may act as facilitators. International co-operation in the field would be also beneficial – here the current COVID-19 pandemic helped to gather momentum towards more openness with other countries as an overview on various (ad-hoc) activities in regards to COVID-19 and STI of other EU countries was compiled using input of other international STI councils/advisory boards.

6.2.2. Italy

In Italy 2 MP and 3 policy advisors on the national level, were interviewed with the following main conclusions.

Data sources and analysis

Respondents use two main sources of information for their work. The first is institutional, looking for news on sites of the European Commission or of the national authorities responsible for research, science and technology. The second one is scientific and concerns the set of magazines and resources that offer the opinion of scientific experts on various topics.

Some also consult experts directly by consulting their network of contacts in which they have great confidence. The selection of the news takes place by establishing priorities and verifying the sources, even though institutional sites and the most authoritative journals from the scientific point of view represent a generally credible and reliable resource.

Respondents generally use official channels such as websites and newsletters. Overall, first-hand information is preferred, and social networks are rarely used. Social networks are viewed with some suspicion because they process information and do not often give indications on the sources from which the data is collected.

The main information for their work is collected through official reports or press releases. It is emphasized that there are two communication plans, amore internal and institutional one in the relationship between public decision-makers and experts and a more popular one dedicated to the information to be transmitted to the public.

In recent years the pace and speed of scientific information has changed a lot. The advent of social media and the possibility of direct communication between public decision-makers and the public has contributed to producing a large mass of data which has sometimes also generated confusion.

The policy development process

Usually the formation of a policy line takes place through some consultations that take place at a political level through expert commissions. Obviously this activates lobbying mechanisms that can have a significant influence on public decision makers. “Lobbies and associations are very good at political lobbying, that is, in bringing certain interests to the attention of political decision-makers” (IT1).

There is also a possibility for expert groups to advice politicians on crucial issues, such as the Covid-19 pandemic. In the period between March and May, for example, task forces were set up to evaluate, manage and identify suitable forms of public communication. The institutions where the interviewees work use rather traditional tools: press releases, press conferences and contacts with journalists. In general, it can be said that new ways to communicate with the public or to receive feedback from the public have not been tried alongside the official channels.

Stakeholder involvement

Various tools have been used to involve the various stakeholders, including consultations at the European level, which have sometimes had good results. In the case of scientific and technological issues, however, it has to be noted that there are still many discretionary mechanisms for forming committees or panels of experts. Therefore, a shared strategy of institutions, scientists and civil society organizations for involvement in relevant issues is still unclear. In the case of COVID-19, for example, task forces formed to try to study and manage the problems of the pandemic have not managed to develop and attract real involvement of large sectors of civil society.

Trust in science and science communication

Investigations into the Italian public opinion and the public´s trust in science show that Italians have great faith in scientists and institutions. During the interviews this orientation is reiterated, even if no precise indications are traced on how this trust could be maintained

or increased. In summary, it can be said that communication is seen more as an institutional obligation than as an opportunity to create a dialogue with the public.

Strategies and approaches to communicate policy decisions to journalists and the scientific community

The interviewees report a rather traditional type of communication strategy, in which the institutions present themes and lines of intervention to the media, passing through some preferential channels such as press and television. A precise communication strategy linked to social media is not recognized. In the case of social media, it has to be noted that politicians often use them directly to speak with the public, a phenomenon that occurs in many parts of the world to obtain immediate visibility and direct consideration of the public. The controversies that can arise with the use of social media have also been highlighted. “Non-institutional way of communication (such as Facebook) was used with consequent controversy” (IT3).

Key elements of science communication in relation to policy

What emerged during the interviews highlights that the type of public communication promoted by the world of politics is still quite vertical. It is a top down approach between politicians, experts and citizens. The use of a classical deficit model is still present and we also have to take into account that “the newsworthiness of a scientific fact is not associated with the times of the scientific community” (IT2). To adapt to the speed of communication that we experience today, communicators had to acquire new skills by using various tools for different themes and scientific facts. This represents an advancement in the diffusion of scientific knowledge because important scientific topics can be transmitted to several audiences simultaneously.

Key challenges of science communication in relation to policy

The point of view of the interviewees allows us to identify some critical areas that emerged during the COVID-19 pandemic. First of all, the overexposure of the experts during the Covid-19 lockdown has created much embarrassment for decision-makers who must take the most important public decisions at the end of the risk assessment process. «I repeat: politics must listen and be supported by science but then it is up to politics to make decisions. The incapacity of politics makes science become "the voice of God» (IT4). An interviewee also

stressed that a certain crisis in the credibility of science is an international phenomenon and does not only concern Italy.

Secondly, the search for visibility and direct and quick contact with the public can create communication short circuits by requiring politicians to give answers on scientific topics that require more time and greater reflection. Finally, although the European Commission is strongly driven to develop RRI programs, they often remain rather theoretical and fail to change the organizational and communicative culture of those working in the world of research.

Opportunities

Recent changes in communication tools and in how the public can approach scientific issues require new ways of interaction between scientists and public decision-makers. If on the one hand the distance between experts and the public has narrowed, some processes of scientific knowledge that require long times and substantial investments cannot be accelerated. Scientific issues of great public relevance can be addressed with the involvement of civil society organizations and citizens, but require a new way of communicating by public decision makers and scientists that is not just occupying the public space with one's own interventions. Combining listening and involvement mechanisms with spaces for direct communication could be one of the most effective ways to guarantee correct communication between the various social actors.

6.2.3. Netherlands

In the Netherlands three policy advisors on national level, one knowledge coordinator on municipal level and one knowledge coordinator at a national level knowledge institute were interviewed with the following main conclusions.

Science communication is not often directly a part of daily activities of policy makers in the Netherlands. The organisational structure of Ministries and seemingly the municipality is that the involved specialties are divided over several departments: Policy, Research/Knowledge acquisition, and Communication. The processes of data / knowledge gathering, policy development, and communicating to stakeholders exist alongside each other. While these departments connect and collaborate, it shows a clear separation of the three disciplines involved in this particular study for T1.2.

This division on the ministerial level is reflected on a municipal level, as pointed out by NL Interviewee 4.

As such, science communication often has a limited role in the daily work activities of policy makers, or only minimally. Policy makers do not consume science communication for their work, nor do they participate in (regular) science communication activities. Additionally, extensive research into themes and context for particular policy (areas) is conducted by dedicated departments and civil servants.

Use of scientific insights should be strengthened/intensified, according to the interviewees. The ministry makes use of information that is available both internally as externally through desk research, through authorizing studies, policy evaluations and existing databases. Traditional methods of data collection are most commonly utilised. The ministry hardly used new technology-driven methods of data collection and processing.

Policy advisors / makers / officers are often highly knowledgeable of / experienced on the topic they work on. So while they are not actively involved in collecting science communication and in-depth research, they are aware of the developments in their field. As NL Interviewee 1 states, this helps determine the validity/reliability/value of research/science communication. Namely, if the outcomes of a study diverge significantly from the body of knowledge, it can be an indication that the study should not inform policy development. However, both NL Interviewees 3 and 5 highlight the significance of finding opposite perspectives. Disregarding a study, data, perspective or other source should not be done without careful consideration.

Data sources and analysis

In the Netherlands, traditional sources of information are most commonly used. The use of technology-driven data collection and analysis methods is limited. Desk research and collecting insight from their professional network are universal for the NL Interviewees. The type of data source does differ, depending on the focus of the ministry or organisation. For example, NL Interviewee 1 relies on large-scale quantitative data studies, as these are the most useful for policy development in his area. The risk of such studies is that it focuses on individual perspectives and moves away from generalizable outcomes. NL Interviewee 5 in turn explicitly relies on qualitative interviews, as his work centres on the collection of various perspectives on a theme or topic, to explore and feed the public debate.

However, when ad hoc decisions have to be made and time is scarce, such as during the COVID-19 pandemic, communication lines are shortened and direct contact to key persons is sought to discuss options and potential consequences.

The interviewees did not name significant transformations in data sources or analysis methods. This is not surprising if the adoption rate of innovations and technology-driven methods is low. However, even the traditional formats have undergone a transformation. The traditional and extensive reports with many long annexes and lists of detailed graphs have changed into short 'agenda' style documents with fewer graphs and fewer details. Currently, a balance between the two styles has been reached. Recent reports are more dedicated to the analysis of the various sources used. There are more graphs with references to the text in annexes, as well as a long list of references of the reports that were used. So the whole report sheds more light on the analysis behind everything.

What becomes more important with quantitative data is building a narrative. In the words of the interviewee: "Kerngetallen" (key figures) do not tell the complete story, so it is important to find the narrative. Systematic collection of good and bad examples is therefore imperative – and to combine with the key numbers into a narrative.

While the interviewees are not directly involved in the data collection and analysis process, they are aware of criteria for involving data sources their colleagues use.

The most important factor is the reputation of the source - organisation, stakeholder, or individual. For example, the Rathenau Institute, the Raad voor Bestuur (Public Administration Council) and other reputable research/advisory institutions are considered to publish highly reliable and relevant material for our set of interviewees. NL Interviewee 3: "Policy is applied work - so these reports often include advice/suggestions/lessons learned that already help policy makers to think what the results in the report may mean for their field. Scientists are needed in this process because they can think of the very long term effects of specific results/policy that is derived from it."

The policy development process

Everything is progressing much faster, there is a lot more information available, access to information has grown as well. The policy cycle CAN go quicker, but that does not always happen, according to NL Interviewee three. NL Interviewee five explains that: incidents that may or may not be actual incidents do lead to public/political debate and thus initiate policy

change or speed up the development process. Events that previously would have gone unnoticed, can now cause a domino effect. A key factor in this process is social media, which has enabled sharing of information. It has become an important platform to express and share concerns, which may contribute to parliamentary discussions. According to NL Interviewee one, some topics would not have entered the public sphere at all if social media had not been this widely adopted.

Stakeholder involvement

There are many stakeholders involved, on national, regional, and local levels. Stakeholders are usually represented in advisory and interest groups, or other forms of collectives. In normal times, the stakeholders are approached to respond, or publications from these groups are involved in the analysis. It is clear that ministries, municipality and the knowledge institute have a leading/directing/initiating role in this process.

We do not have to talk with everyone, but we have to ensure we involve as many viewpoints as possible. You try to convince people to participate, but if they do not want to you cannot force them. But you need to involve their/a similar perspective, so you find a group/person/other with a similar view and ask them to be interviewed.

In COVID-19 times, there is not always time to involve and negotiate. Sometimes communication lines are shortened by getting in touch with key persons directly, in order to speed up the collection process and get information as soon as possible.

Conversely, lobbyists know how to find you and are persistent. You have to actively try to create a distance with them, so this is almost the opposite from other stakeholder groups. Additionally, the ones that actively lobby are often the problems in the field - they feel that the policy/law will obstruct them and they are trying to convince you to change the policy you are developing.

Trust in science and science communication

Generally, science and scientists enjoy the most trust compared to other areas in the Netherlands. People no longer (seem to) automatically recognise the authority of scientists/academics. NL Interviewee five compares this to the position of religious leaders in the Netherlands. Several factors influence this: Dutch citizens are more educated than ever and critical of societal developments. More (mis)information is accessible (via Internet)

than ever and it becomes more difficult to separate credible information from misinformation.

When scientific research leads to results that touch on a particular interest or stake, it will involve human emotions. That is when people will start to inform themselves and ask more critical questions and identify controversies.

Controversy often focuses on science and scientific outcomes. But often, the reason behind this is that there are often broader concerns that are not addressed sufficiently, according to NL Interviewee 5. “Often, nobody is really looking for more uncertainties, but if they are hidden or ignored, people will focus on those as a way to discredit the research. More research or scientific results will not help you get out of controversy.” His advice is to involve and communicate the broader concerns and stakes in science communication. Not every concern has to be honoured, but you have to engage in a conversation.

Interestingly, as soon as scientists team up with governments or organisations, that level of trust diminishes. The suspicion exists that these institutions pay and thus influence the results, as pointed out by NL Interviewee five. Increasingly, “organisations use science to answer their (business-related) questions - and it is what you should want - science should benefit society. So that is an interesting paradox”.

He adds: “As an organisation/government/client, you may be faced with results you do not like, but you just have to deal with that. Denying or hiding such results is going against the public case. But also, when a research report is published that pleases the ministry, they publish a celebratory press release. This is something you should absolutely not do! That’s putting oil on the fire [sparks the discussion].”

One of the identified challenges of science communication is that a study has to be condensed into a short message of a few paragraphs or less. This removes the space to add footnotes or discussion of the results, and thus removing the context. Additionally, there is also a form of competition going on, not necessarily among different forms of science communication (or research), but ‘everything requires attention’, so you have to stand out. But how can you develop a message in science communication that justifies the actual meaning of the research *and* so it stands out?

According to NL Interviewee four, science communication should lead readers to the actual research paper/report/dissertation it is reporting on, but that hardly ever happens due to

time constraints, unwillingness, or other reasons, which adds to this problem. Who (of the general public) even does that anymore, and can we actually still expect that of people?

Strategies and approaches to communicate policy decisions to journalists and science community

Contact with journalists and the science community is facilitated by the communication department of ministries, municipalities and knowledge institutions. Communicating to journalists and scientists is not in the scope of the Interviewees' responsibilities. Communication about policy is only possible once the policy has been presented to parliament. Until then, it is only available internally (in the ministry/department).

The role of journalists is quite important in communicating policy, especially when potential negative consequences may result from the policy. NL Interviewee one stated: "Bad news sells. And the resulting public outcry can result in a new round of analysis and, depending on the outcomes, changes in the policy. For example, the policy to allocate funds from Alpha and Gamma to Beta sciences has been negatively received. Currently a review is ongoing about the financial impact of this particular policy, and how it balances with the other impacts the policy is projected to have."

Particularly, the changed position as an authority figure has had its consequences according to NL Interviewee five: "This makes different demands to how scientists communicate their research, and it makes different demands of the way policy makers refer to science as support for new policy."

NL Interviewees were unable to comment whether top-down communication practices had changed due to new science communication practices and formats, as it is not a core activity of them. However, several NL Interviewees discussed key components of science communication in relation to policy based on their experience in the policy domain.

Key elements of science communication in relation to policy

First, transparency is key. Science communication should include reflections on the methods, perspective that was taken, and potential criticisms that may apply.

Second, and related to the first point, science communication should address the uncertainties that still remain after concluding a study and the assumptions that lie at the basis. "Science becomes interesting when something is at stake."

Third, science communication should respond to the stakes and emotions. In the words of NL Interviewee five: "You won't solve distrust in science with more science. You have to respond to the emotions and fears that cause people to distrust science."

Fourth, unbiased framing of press releases and science communication more generally is essential to remain trustworthy.

Fifth, if science communication is based on a quantitative study, appropriate context can be provided by developing a narrative and including best/good and unsuccessful examples.

Key challenges of science communication in relation to policy

One of the key challenges that were identified is getting noticed among all other aspects of life that require attention.

In relation to the previous challenge, the title and message content should catch the eye but still do justice to the outcomes of the study it talks about.

Furthermore, multiple interviewees highlighted that academia/science should be more active in science communication and valorisation. They acknowledged that academics/scientists get little to no time for it, however, they would advise universities to change this. Similarly, policy makers also have limited time to search and read science communication and especially the reports that are behind it.

Increased understanding between the scientific community and policy makers can be strengthened by implementing opportunities for collaboration and organising (informal) events where new connections can be generated.

Opportunities

Based on the interviews, it seems that the current situation in the Netherlands is relatively old-fashioned - policy development is based on the built-up expertise and experience of policy makers and reports from reputable institutions.

One opportunity that the Netherlands would potentially benefit from is the modernisation of data collection and analysis methods/tools and vary data sources.

Further, a stronger connection to developments surrounding data collection, analysis, science communication and related practices and developments on a European Union level would be advantageous.

6.2.4 Hungary

Between 20 May and 17 June 2020, altogether 5 interviews were conducted in Hungary. Considering the difficulties arising with the ongoing COVID-19 pandemic, all interviews were held in online format, without recording as per agreed with the interviewees. two policy-makers on national level, one policy advisor on municipal level, one policy advisor on national level and one knowledge coordinators at a national level knowledge institute were interviewed with the main conclusions summarized below.

The interviewees had all different backgrounds and specific expertise in relation to innovation and digitalization policy and thus represented a wide spectrum of Hungarian stakeholders covering the policy areas to be studied in project TRESCA. One interviewee is a key RRI expert in innovation policy, currently working for a major Hungarian university and having links with local and regional level policy-makers; one interviewee used to be an advisor to the Minister responsible for innovation in his capacity as professor (emeritus) in the field of future of work (digitalisation of labour market); one interviewee is currently an advisor to the Rector of a major university dealing with innovation in the creative industries, and has an extensive knowledge in the field of technology transfer and smart specialisation gathered in private and public organisations; and two interviewees are working as Head of Departments for two major state players in Hungary: the National Research, Development and Innovation Office and Digital Well-being Non-profit Ltd (both background organisations of the Ministry of Innovation and Technology).

One shortcoming of the set of interviewees is that, in spite of repeated attempts, no interview could be held with an employee directly working for the Ministry of Innovation and Technology however we consider the information gained sufficient for analytical purposes that aligns well with the secondary research findings.

Data sources and analysis

As for the main data sources, it seems so that scientific information used for advising policy-making is gained through two main sources: (1) the traditional sources, i.e. journal articles, policy documents or methodological documents prepared by experts deemed reliable and

trustworthy by the relevant organization of interviewees (nowadays often outsourced to intermediary consultants); and (2) information coming through more personalized connections when policy-maker may get in touch with and ask for advice from an expert directly – in this case, the interviewees can themselves ascertain the reliability of information sources.

Interviewees tend to agree that the biggest issue is information oversaturation therefore the incoming scientific data should be as easily digestible as possible – here visual solutions or new channels, such as online videos could play a higher role than today. These have already begun to get round in Hungary but still are not as relevant as in other countries.

The policy development process

The most important method is still the session of various boards and other bodies where scientists and policy-makers come together to discuss strategies and other policy documents. These usually take place in the format of expert groups gathering around crucial issues – the highest level of this is the National Science Policy Committee which comes together to discuss the strategic decisions in R&D&I at certain regular intervals.

Another option is the use of advisory notes or recommendations prepared by researchers to such policy-level meetings prior to the sessions. This is getting more formalized, relying on knowledge of whole organisations and not individual experts. For instance, there are contractual relationships between scientific advisory organisations, such as universities, in particular their competence centres, and policy-maker bodies in certain areas, such as digitalisation.

The role of personal connections in lobbying activity also should not be underestimated. One interviewee mentioned a concrete example of the successful lobbying activity of his research-performing organization with the relevant ministry to include certain topics in the upcoming national RIS3 strategy. Such non-formalised relationships still shape the policy development process complementing (or substituting) the official channels.

Stakeholder involvement

The influential policy-makers involve experts well-known in a specific area and showing interest in policy-level cooperating in their strategic decisions. The formalized advisory group sessions are the most common way of such stakeholder involvement.

At a less strategic level, online and offline consultations take place, two recent successful examples of which is the elaboration of the national RIS3 strategy and certain new multilateral R&D&I funding schemes. In relation, prominent role of interactive conferences and smaller events among the scientific, business, citizen and policy actors in R&D&I and digitalization was also underlined by certain policy-maker interviewees.

There is a new trend of organizing roadshows in several locations to get relevant information first-hand from a broad set of innovation ecosystem members, which can be attributed to a changed government policy. Such roadshows were carried out in the field of digitalisation, RIS3 and innovation in recent years. The latter (encompassing two separate rounds of roadshow in the field of innovation) can be seen as a good practice since it strives to build up territorial innovation platforms around local innovation centres (usually universities or/and research centres) comprised of all actors along the quadruple helix (public bodies, municipalities, start-ups, businesses, researchers)

Another good example for a successful conference bringing together innovation policy stakeholders was the CUBCEE conference (University and Business Cooperation in Central Europe) held in 2019 in various topics, e.g. technology transfer, joint collaborative research, spin-offs, smart specialization, government role and science parks.

If implemented and followed up in a proper way, these roadshows should also contribute to a more effective engagement of scientists and experts to the policy-making process. It is one way to utilise the mutual benefits of science communication with policy-makers, while another engagement method is the use of intermediaries, in particular technology transfer offices.

At a less strategic level, there is also a higher level of stakeholder (researcher) engagement and co-creation in the preparatory and monitoring phase of Hungarian R&D&I (support) schemes. Based on the relevant interviewee's opinion, the stronger and earlier involvement of stakeholders had the effect of a better approved set of calls for proposals which is more aligned with the needs of the end-users (potential applicants).

Trust in science and science communication

There is an assumption that scientists are still trusted by the general public and the policy-makers, in comparison to other stakeholder groups, and this trust can be still increased in a positive scenario after the COVID-19 pandemic. In relation to measures needed to enhance

trust in science, the majority of the interviewees ascertain the increasing relevance of open science and access. Even if, based on the major findings, it seems that the bureaucratic system, the scientific (dis)incentives and financial considerations still hinder the higher prevalence of open science, data or methodologies in Hungary there are already positive trends on micro (project) level, such as the compulsory 'open access' part of the project application for national R&D&I grant applications.

The situation is similar for responsible research and innovation – another area relevant for trust – where the increasing importance is again underlined, but concrete measures have only recently started to be implemented. For example, the "Digital Thematic Week" programme in the framework of which RRI is integrated into early (primary and secondary school) science education.

The increasing relevance of RRI and open science is also confirmed by the fact that a new working group dealing with these two topics has been set up under the leadership of the Deputy Director of the office, in cooperation with the University of Debrecen and the Hungarian Academy of Sciences.

Strategies and approaches to communicate policy decisions to journalists and science community

Communicating to journalists is not among the responsibilities of the interviewees, it is arranged from top-down by their organisations. As mentioned, the traditional way of journalism prevails where the Ministry and its background organisations, as well as the Hungarian Academy of Sciences arrange the communication framework in science journalism. It depends on the personal stance and activity of policy-makers and advisors whether they want to be at service to journalists, but time consideration, as well as respect of the official process – where often individually you cannot give official comments to journalists – keep the formalized traditional system alive.

All interviewees find the role of journalists very relevant in the outreach science communication process, but only one of them mentions the use of new social media journalism which again hints at a slowly changing media landscape in the country.

Key elements of science communication in relation to policy

The interviewees all alluded to or mentioned problems of connecting the two stakeholder groups in the science-policy communication nexus. There is a misconnection stemming from different perspectives on objectives, time horizon and language.

One ensuing trend therefore is the growing role of intermediary organisations, i.e. mainly consultants taking over the role of scientific data provision and analysis towards the policy sector. These consultants 'speak' the language of the policy-makers and have the necessary resources and time to provide their services, in contrast to overburdened researchers. Another interviewee mentioned technology transfer offices within universities taking on such intermediary roles and mentioned a recent national call for proposal with the aim of building out a technology transfer office network as a good practice.

The increased role of intermediary organisations is strongly connected with the issue of trustworthiness since these consultant firms have to be selected through procurement procedure to compensate for the 'lost' trust provided by the more direct connections between policy and science experts, or the pre-screening process carried out by the policy organisations themselves.

Key challenges of science communication in relation to policy

The thematic areas with which stakeholders had to deal with have increased: more and more often, one must 'wander' out of his or her specific field to gain a better picture. This would call for a more systemic and less fragmented data collection and analysis process where personal connections are getting less important (which was mentioned as one of the primary data sources by all interviewees). However, the picture is not clear-cut in this case; while the interviewees indirectly working for the Ministry alluded to positive changes towards a more formal data collection system in R&D&I and digitalisation other interviewees were less optimistic.

Among other, the lack of time for both stakeholder groups (policy and research), the lack of incentives of scientists to engage in policy dialogue, the different language used by scientists and policy-makers, as well as the 'silo' approach within the polity itself (where various ministries involved in R&D&I do not properly transfer information and communication among themselves) were mentioned as hindrances to a more systemic communication the scientific community and policy-makers.

At a less strategic level – in relation to the Hungarian R&D&I (support) schemes – similar problems prevail since it is often problematic to convince researchers of the value of cooperation and they often have problems in understanding the English ('Brussels') jargon of the programmes.

Opportunities

The face-to-face gatherings and in particular the newly implemented roadshow-type events can be effective in mitigating certain problems preventing a better science-policy communication, such as fragmentation, different needs and languages spoken, but there are systemic problems mentioned by interviewees that are more difficult to overcome. For a really effective engagement of experts in policy-making, regulatory changes, for instance in IPR, better formalized science education and more international collaboration would be also needed, e.g. to explain experts why and how to build links with policy-makers.

Certain changes seem to have been started that can have a positive effect in the future and where the cooperation of various stakeholder groups is needed. The relevant policy-makers strive to push for a more bottom-up stakeholder involvement, and new support schemes are introduced to boost the international R&D&I co-operation and project participation of Hungarian researchers.

The COVID-19 crisis also brings opportunities because certain topics gaining in relevance, such as artificial intelligence; digitalisation, automatisation, healthcare issues and other COVID-19 related changes in the labour market are taken up and promoted by scientists, contributing to a hopefully higher interaction between experts and policy-maker in the post-COVID-19 period too.

6.3. Summary of interview findings

Data sources and analysis

The data sources used by policy-makers is influenced by the overall trend of **increasing speed and volume of scientific information.** The introduction of new media channels, in particular social media contributed to a large mass of scientific data available for policy-makers, but also highlights the issue of reliability. Social networks are still considered less reliable than traditional sources since they often do not indicate the source of their data.

Therefore, most of the policy-makers still rely on the official data sources deemed reliable by their institutions, which include the most well-known national and international scientific information sites, such as Eurobarometer, Eurostat, JRC, UNO, IMF, World Bank, OECD. The policy-makers also utilize scientific information gathered through the commissioning of studies and other policy papers by their own institutions.

The second most important data source is the offline and online resources offering the insights of scientific experts on various topics. In most cases, the policy-makers themselves build up these databases where the direct communication and engagement with scientists. Personal relations are crucial – this is more accentuated in special situations when urgent decisions have to be made, such as in the COVID-19 crisis, and is also dependent on the political culture of the country (e.g. Hungarian policy-makers seem to rely on personal connections more often than their Western counterparts). For this, policy-makers have to be knowledgeable or experienced in the topic they are dealing with; otherwise they would not be able to determine the reliability and validity of the research and science communication.

In this regard, most policy-makers view the current situation as a challenge since they must be ready to extend their horizon and look for new data sources in an ever-increasing 'sea of information'. However, this information overflow has not yet resulted in significant transformations in data sources which may be attributed to the fact that the adoption rate of innovations and technology-driven methods is low. Some policy-makers already experiment with turning to more modern data sources, such as Twitter or online blogs (varied by country to country – more mentioned e.g. in Austria or Hungary than in the Netherlands).

However, even the traditional formats have undergone a transformation. The traditional and extensive reports with many long annexes and lists of detailed graphs have given way to shorter 'agenda' style documents with fewer graphs and fewer details, showcasing not only key figures but also telling a narrative.

The policy development process

In each country and at the transnational level, there is an approved way of policy development respected by all partners where consultations and engagement of experts most likely take place at the political level through expert committees. The utilization of such expert groups was enhanced in recent times (one interviewee explicitly refers to 2008 as a

cut-off date for paradigm shift) with the aim of engaging expert stakeholders as early as possible in policy decisions to gain more creative insights and solutions.

Expert groups have been increasingly crucial in policy development during the COVID-19 pandemic, both Italian and Austrian policy-makers refer to corona task forces set up to manage scientific communication or data collection (including also an advisory board of experts from policy, research and law). In Hungary, such expert groups were also formed around the institutionalized co-operation between policy-making and scientific institutions.

Depending on country context, other instruments and methods influence policy development, not only in corona times. Italian and Hungarian interviewees underlined the importance of individual and institutional lobbying shaping the interests taken up by political decision-makers, while in Austria an accentuated role is given to scientific and research platforms bringing together political and expert stakeholders.

Stakeholder involvement

The country and transnational policy representatives ascertain that many stakeholders on national, regional, and local levels are involved in the policy-making process. All countries have formalized and more informal advisory and interest groups, or other forms of collectives where expert stakeholders are represented and can express their views towards political decision-makers.

The involvement of experts in such expert groups is achieved through various ways, all fostering networking between policy-makers and the scientific community. The most common method for such stakeholder involvement is the various types of events organised by policy-makers or intermediary organisations. Such events may take the form of roundtables, workshops, conferences or smaller stakeholder meetings and serve as the most valuable opportunity to connect the scientific, business, citizen and policy actors in R&D&I and digitalization. In Austria, there is also a prominent role played by various STI platforms in stakeholder networking and involvement.

There is a general remark, in particular brought up by Dutch, Hungarian and EU-level interviewees – that the policy side, namely the EC, the ministries and municipalities have a leading and initiating role in this engagement process where a more pro-active role of the scientific community could be envisaged. This may be hindered by the still many discretionary mechanisms for forming committees or panels of experts and a lack of shared

engagement strategy of institutions and scientists (explicitly quoted by Italians, but also valid for other countries).

As many interviewees mentioned, in COVID-19 times, there is not always time to involve and negotiate in expert advisory groups. Therefore, communication lines were shortened by getting in touch with key persons directly, in order to speed up the collection process and get information as soon as possible – the relevance of personal connections were highlighted by Hungarians where this kind of more direct links are more relevant even in 'normal' times.

Trust in science and science communication

In all the interviewed countries, there is a general trust of the public in science and science communication (at least until it is not intertwined with the political sphere) which is higher than the trust in the majority of other national stakeholders.

However, there are challenges diminishing this trust level in recent times, among others the increased spread and relevance of fake news and misinformation, combined with a public which is more educated, has more information sources and gets more and more sceptical or critical towards scientific results. There is an inherent communication issue contributing to this trend, namely that complex scientific findings must be condensed into short messages of a few paragraphs or less. This removes the space to add footnotes or discussion of the results, and thus removing the context.

Thus, many interviewees add an increasing relevance to open science and access (and to a lesser degree, RRI) to solve such problems stemming from communication gaps. The adherence to clear and unambiguous open science policy is crucial to ensure trust in science communication. This can also involve the set-up of reliable and trustworthy social media channels with clearly formulated guidelines.

Similar communication problems also often contribute to mistrust (or misunderstanding) between scientists and policy-makers. Policy-makers feel that communication is seen more as an institutional obligation than as an opportunity to create a dialogue with public opinion. To build up trust, experts should strive to engage more with policy-makers for intrinsic benefits to which they should get proper support from policy-makers.

Strategies and approaches to communicate policy decisions to journalists and science community

The interviewees present a traditional type of communication strategy with journalists and the science community where it is the primary duty of their relevant organisations to engage with these stakeholders. The organizational communication strategy determines the most important topics and lines of intervention to the media that are passing through some preferential channels such as press releases and television appearances.

There are already signs that social media will play a higher role in this form of communication but generally no precise communication strategy is linked to social media at the institutional level. It depends on the individual initiatives of mid-level political decision-makers, as well as their organizations' official policy whether they exploit the opportunities provided by social media. On a higher level, politicians tend to use social media channels to communicate directly with the public, gaining immediate visibility, but at the same time raising trust issues. In some countries, such as Austria, a trend can be observed where policy-makers in smaller institutions are more inclined to utilize social media channels in communicating with experts.

Key elements of science communication in relation to policy

The most crucial element influencing today's science communication in relation to policy is the availability of more and more information through an increased number and type of data sources. Nevertheless, the traditional top-down approach between policy-makers, experts and citizens still prevail but in order to adapt to the increased speed of communication, science communicators had to acquire the skills of using various tools for different themes and scientific facts.

This adaptation of traditional methods has been accelerated by the COVID-19 crisis which resulted in the proliferation and better acceptance of online meetings, the use of more visual solutions in traditional science communication formats, as well as the adoption of non-traditional science communication channels, such as social media or Twitter.

The measures introduced due to COVID-19 strengthened these already ongoing trends. If handled well, such changes contribute to a better diffusion of scientific knowledge because important scientific topics can be transmitted to several audiences simultaneously, paving also the way for the better utilization of open science and RRI principles in the process.

Several criteria must be met to handle the uptake of new science communication methods and channels for the highest benefit of all stakeholders. Transparency is key, related to increased level of trust within the communication landscape, as well as to open science and

RRI. The unbiased framing of science communication is essential to be trustworthy. Furthermore, science communication should respond to stakes and emotions – thus effectively counteracting fake news and misinformation – but also not shy away from addressing uncertainties, providing appropriate context, developing a narrative and showcasing good practices to inform policy-makers and the public in general.

If these criteria are not met then it is possible that the role of intermediaries, such as consultants will increase in science communication with policy-makers. For instance, in Hungary there is a growing trend of using such actors to mitigate the disconnection between experts and policy-makers stemming from their different perspectives on objectives, time horizon and language. This is because experts currently cannot meet the above criteria to comply with the requirements of the changing science communication landscape.

Key challenges of science communication in relation to policy

The transformative trends of science communication in relation to policy have been strengthened and accelerated by the current COVID-19 crisis. The interviewees do not per se agree in what new topics will be shortly taken up due to the pandemic, but rather see an increasing speed with which topics around R&D&I and digitalisation will become relevant and must be dealt with.

This is connected to another key challenge, i.e. the increased proliferation of fake information to which most policy-making bodies could only react, but not proactively prevent them. This is now strived to be solved by various measures, such as specific websites and online services against misinformation, as well as targeted communication campaigns.

However, in order to deal with the increased flow of information and counteracting the rising level of misinformation, a more systemic and less fragmented data collection and analysis process is needed. This involves the lessening importance of private links between scientists and policy-makers (e.g. in Hungary) and the regulated access to and use of primary data for research purposes (see ongoing debate in Austria).

The main related challenge here is to build an increased understanding between the scientific community and policy makers where, on the one hand, academia/science should be more active in science communication and valorisation and, on the other hand, politicians should take responsibility for their communication (in particular when – for political reasons – they communicate with haste on scientific topics that would require more time and greater

reflection) and involve experts in a proper way in decision-making (listening to their advices, but not shifting responsibility for decisions on them).

The changed links between scientists and policy-makers in communication should be strengthened through the adoption of RRI principles in national or EU-funded schemes. The European Commission is strongly supports this, but based on national expert opinion they often remain rather theoretical and fail to change the organizational and communicative culture of those working in the world of research.

Opportunities

The recent changes in the speed of information flow, the communication tools and methods, as well as the way the public can approach scientific issues require new forms of interactions between scientists and public decision-makers. The proper combination of advisory, engagement and involvement mechanisms with spaces for direct communication could be one of the most effective ways to guarantee a more efficient updated communication between the various actors in the R&D&I landscape.

The COVID-19 crisis brings opportunities for this because certain topics gaining in relevance, such as artificial intelligence; digitalisation and automatisation help to set up more interactive interactions between experts and policy-makers. This may give rise to a higher level of trust in the entire science-policy nexus in Member States and at the European level.

In addition, a stronger connection to developments surrounding data collection, analysis, science communication and related practices and developments on the European level would be advantageous. Data collection and analysis methods/tools and data sources are being modernized (see the ongoing Austrian discussion), the biggest ensuing opportunity of which is the faster availability of more reliable data. Coupled with novel communication tools and channels, this would enable the EU (and Member States) to proactively deal with such unexpected crises as the COVID-19 pandemic.

It would furthermore be advantageous against the further spread of misinformation and fake news by external agents. The currently running websites, campaigns and other measures could benefit from fast and reliable data sets. This could also link to broader discussions that have also started in certain Member States on the relevance and societal role of R&D&I. If these opportunities are taken advantage of, the socio-economic importance

and appreciation for R&D&I and science in general could rise in Member States and the whole European Union.

7 CONCLUSIONS

This report focuses on how science communication and policy making influence one another and describes the current and emerging trends connected to this relationship. One of the main objectives was to understand how policy-makers – with a focus on broader innovation policy and digitalisation – consume science communication and how their habits and values potentially influence their policy decisions. Starting from the discussion on the specific characteristics of science communication aimed at policy-makers, a number of trends have been highlighted.

Science communication with policy-makers has professionalized since the mid-1990s, when the emerging new ICT technologies resulted in more readily available information which led to a higher need for and uptake of evidence-based policy-making. There is a shift to include scientific evidence in the legislative and regulatory decision-making-process in an institutionalized way. A stronger engagement between experts and decision-makers is built through various institutional mechanisms to ensure more democratic and effective scientific communication with the use of high-quality data. The two-way dialogue models gain more and more ground against one-way information-provision. The introduction of the European Commission's Scientific Advice Mechanism is the culmination of this process at a European level.

A more open, accessible and reliable science communication is needed to make this new participatory model work. The building of trust between scientists and policy-makers is of the utmost importance here. A deeper understanding on how the other stakeholder group operates is essential. Recently, more detailed guidelines or the practice of job-shadowing support this knowledge transfer. Enhanced trust is also facilitated by the ongoing movement towards open science, supported by the European Commission. This gives rise to open scholarly communication addressing not only data access but also science communication outreach and engagement with policy-makers. The COVID-19 pandemic has given further impetus to open science communication trends with new platforms for open scholarly communication and innovative forms of science-policy co-operation, such as the #EUvsCorona Hackathon, or the Hungarian COVIDEA idea and start-up competition.

Better transparency and higher openness should not decrease the reliability and excellence of scientific input used for policy advice. Ensuring data security is crucial to attain this, new measures such as the new Italian evaluation and data processing tool for digital safety can support this process. The diminishing role of traditional intermediaries, such as journalists, challenge data security and reliability. Science communication is getting more digital and visual: experts and political decision-makers use social media for direct messages, which results in a higher share of unchecked scientific information.

The COVID-19 crisis accelerated the spread of such misinformation. The science community and policy-makers took counter-steps to re-affirm evidence-based policy-making, in particular by setting up or upgrading 'fact-checking' websites, such as #EUvsDisinfo, or a new European hub against fake news, the European Digital Media Observatory (EDMO), or national sites such as the Austrian Mimikama. Visual solutions support these efforts, such as the edutainment videos produced by German animation studio Kurzgesagt or the "Only together we get Corona under control" campaign of the Dutch government.

The fight for more reliable science communication also led to a higher appreciation of experts: since the outbreak of COVID-19, policy-makers turned for advice to reputable scientists more likely, sparking more intense science-policy interactions. The science communication trends caused or accelerated by COVID-19 are too novel to be deemed permanent at this moment. Policy-makers nevertheless should ensure the engagement and participation of a wide range of scientific stakeholders, while keeping in mind to ensure that the collection, processing and sharing of personal data serves the public interest and is consistent with societal values.

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ANNEX 1 – INTERVIEW GUIDELINES AND QUESTIONNAIRE

Objective

The aim of the interviews is to assess the nature of influence science communication and policy have on one another. The partners should strive to find out more about the currently ongoing and emerging trends that are the result of the mutually reinforcing relationship between science communication and policy.

Target group

The **target group** of the interview is the following:

- policy-makers and policy-influencers engaged in the broader innovation policy and digitalisation, in particular in areas at the crossroads of SSH and STEM disciplines, such as digital security, automation, skills and jobs of the future, etc.

The interviews focus on **three levels:**

- global
- European Union
- national, where it primarily targets three countries: **Austria, Italy and the Netherlands.**

In addition to the primary country group, the interview process may be extended to other countries with low-level of trust (e.g. Hungary), if needed – this is up to Task Leader ZSI's decision and the approval of the other partners.

Number of interviews

As foreseen in the concept, a minimum number of **around 15 interviews** is deemed necessary to successfully provide relevant findings on the interrelated nature of science communication and policy. However, quality rather than quantity is of particular importance therefore this number may depend on the characteristics of policy-makers

interviewed (e.g. specific area, level of embeddedness in international and national networks, decision-making level, etc.).

The interviews can be done in the following tentative breakdown:

- **Austria:** 5 interviews

- **Netherlands:** 5 interviews

- **Italy:** 5 interviews

- **Hungary:** 5 interviews

- **EU and global level:** 3-5 interviews

Implementation of interviews

If possible, the interviews primarily should be held in **national language** however if the mother tongue of the interviewee and interviewed person is different (e.g. in case of EU-level interviews), the interview can be held in **English language.** The summarization of the interviews should always be prepared in **English** after the interviews.

It is advisable that all partners try to hold these interviews **in person** and ask for permission of audio-recording the interviews. If such permission is not given, then detailed written notes should be taken during the interview (as later proof if needed). The face-to-face communication ensures that the interviewer will have full control over the progress of the interview and could steer the interviewee in the most relevant direction by asking additional questions.

If for time or logistical reasons, the interview cannot be held in person then it can be taken by **phone or other online communication tools.** In this case, permission for audio-recording should be asked too. If such permission is not given, then detailed written notes should be taken during the interview (as later proof if needed).

As proof of each interview and for acceptance of the interviewee, a **signed consent form** in paper or in scanned format is needed. The format of the consent will be elaborated in WP8 before the start of the interview process.

At the end of each interview, the partners **summarize their findings** in English, following the questions in the questionnaire below. The whole interview should not be transcribed but a short and concise summary is drawn up by partners, focusing on the most important issues the interviewee said: 1-2 paragraphs should be added per each question and the whole interview summary shall not **exceed 2-3 pages.** If a partner considers an interview highly valuable to subsequent WPs, then the 3-page limit can be exceeded (please consult Task Leader ZSI before doing so).

Stakeholder interviews are **semi-structured**; meaning there is a set of standardized questions around a pre-determined framework of topics that should be explored, with the possibility of additional questions depending on the responses. If a partner significantly updates the guidelines it should provide the new

The interviews should last around **30 minutes,** depending on the availability and attitude of the interviewee.

TRESCA interview questionnaire

Before engaging in the interview, interviewer introduces him/herself and the TRESCA project and urges the interviewee to ask any clarifying questions before the start of the interview process.
Furthermore, give a short presentation on the project and the related task.

OPTIONAL Show a short video by KURZgesagt to intro conversation, e.g. Can We Trust (https://youtu.be/JtUAAXe_0VI)

1. **General background questions**

Can you tell me a bit about the background of your position and what attracted you in this position in the first place?

Tell me about your working life: how should we imagine a typical day of yours?

How is science and the communication with scientists an integral part of your daily activities?

2. **What are the most relevant science communication data sources used for your work and what is the process of collecting, analyzing and using this data for your work?**

What are the reasons that these specific data sources are used? (e.g. reliability, trustworthiness)

What do you feel are the quality criteria for science communication data sources with regard to policy-making?

Are there formal and informal lists of science communication data sources used in your organisation?

Do you feel these data sources have changed significantly in the previous years? How do you feel this has influenced policy-making processes?

Do you feel that the collection and analysis of these data changed in the previous years, and if yes, how?

3. **What specific science topics are the most interesting for your work?**

What are the ongoing and emerging science topics most relevant for policy-makers in your country?

How is the increased importance of certain topics reflected in policy-making (e.g. new processes, formats, topics)?

4. **What are the most relevant science communication channel(s)* and format(s) used for your work?**

** Examples for science communication channels per country may include scientific news aggregator websites (e.g. APA Science (Austria); Science Business), newspapers, magazines and periodicals specifically aimed at scientists, scientific supplements of well-respected newspapers, etc.*

In which format(s) and through which channel(s) do you prefer to receive relevant science information?

What are the criteria for effective science communication format(s) and channel(s) with regard to policy-making (e.g. timeliness, trustworthiness or easier digestion with visuals, textual elements)?

Have these data formats and channels changed significantly in the previous years, and if yes, how did this influence policy-making process? *(e.g. more interactivity with other policy-makers,*

scientists; faster and/or more targeted dissemination of news or decisions; higher frequency of policies discussed or adopted, etc.)

Are you familiar with national or EU-level scientific news aggregator websites, such as ScienceBusiness?

5. **From your perspective how do you most effectively engage different stakeholders?**

In which ways are scientists / journalists (influencers) / citizens involved in the policy-making and how did this change in the previous years (if any)?

Have these practices changed significantly in the previous years, and if yes, how did this influence policy-making process? *(e.g. agenda-setting, discussion formats and platforms, different formats of policy decisions)*

6. **Which strategies and approaches do you apply to communicate policy decisions to journalist and the science community?**

How does the praxis look like?

How relevant are journalists (and other influencers) in the communication of policy decisions to scientists / interested stakeholders? If relevant, how can these influencers be identified?

Have top-down communication practices changed in previous years due to new science communication practices and formats?

Can you share some examples of good practices?

7. Sharing your praxis: How relevant are open and RRI principles in the context of science communication?

Have you been involved or did you participate in open science projects?

Do you know any recommendations by the EC or other organizations in this context of open science or RRI and if yes, which?

Can you share some examples of good practice from your praxis?

ANNEX 2 – LIST OF GOOD PRACTICES

Good practice of science communication – Scientific Advice Mechanism

Short title**:** Scientific Advice Mechanism

Short description of the practice: The European Commission (EC) has relied on science for its various policies for decades. The JRC serves as its official in-house science management service and it utilises the support of scientific committees, ad-hoc and permanent expert groups and agencies. However, science communication was not truly embedded within the EC's political structure until the adoption of the Scientific Advice Mechanism (SAM) in 2015. Based on the lessons learnt from all the different science groups, and in particular the Chief Scientific Advisor (CSA) position, the SAM represents a true partnership in the science-policy interface at the European level.

SAM is composed of seven independent scientists – the so-called Group of Chief Scientific Advisors – from various scientific fields, Member States (considering also gender balance). They are selected by an Identification Committee composed of independent experts, through a transparent evaluation process based on clear criteria concerning research excellence. Members elected for max. 5 years act in their personal capacity, independent of institutional or political interests.

The advisors can act proactively, setting their own agenda or prepare proposals for policy or legislation at the request of relevant DGs or other EC stakeholders.

SAM is physically located at the DG Research and Innovation, thus ensuring a continuous communication between experts and decision-makers – this is also guaranteed by the direct reporting to EC. It has a structured relationship with national academies – that formed a consortium under project Science Advice for Policy by European Academies – and other relevant scientific bodies, e.g. EU Agencies Network on Scientific Advice (EU-ANSA), the European Science Advisers Forum (ESAF) to draw on the broadest scientific knowledge base available.

The SAM structure corrects many previous mistakes of the CSA position, namely it does not concentrate too much influence in a single person; it is better integrated within the EC formal structure and has more financial and human resources; it is better connected with other

scientific advisory bodies, which enhances synergies; it has a mandate to act independently to identify policy issues where expert advice is needed, without duplicating existing advice, including an assessment of the robustness and limitation of available evidence.

Scope: European Union

Policy areas affected: The scientific advisors select the policy areas with which they intend to deal next based on its scientific and political relevance (agenda-setting for policy advice). From TRESCA perspective it is of utmost importance that they give scientific advice on cyber-security in September 2017, based on which the relevant EU approach was substantiated.

Main stakeholders: Seven high-level scientific experts, the national academies, European Commission – the science communication is done within the official EC structures

Duration: It was established in 2015 and was evaluated in 2019 – its activities continued under the von der Leyen Commission as of 2020 (therefore it will most likely continue at least until 2024).

Methodology: in the review of scientific evidence and drafting of its evidence review reports, SAM experts conduct a broad consultation of the scientific community, drawing on the resources of the other scientific bodies, especially national academies. This process can be done in various formats, e.g. science communication of EC policy issues might happen through online or offline meetings, workshops, stakeholder meetings or through written documents. The final output of the evidence review report is disseminated to stakeholders and experts through the official channels of the European Commission.

Impact: The introduction of SAM has a profound effect on the European science-policy (communication) interface since it ensures that the most relevant scientific issues (deemed so by independent experts) are discussed, reviewed and analysed before decision-making. The EC is officially informed of the expert position through SAM before its relevant meetings. Scientific advice is thus always available to inform EC's proposals for policy or legislation (evidence-informed policy-making).

Important links: https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/scientific-support-eu-policies/group-chief-scientific-advisors_en

Good practice of science communication – Digital Earth Lab

Short title: Joint Research Centre's Digital Earth Lab

Short description of the practice: the interdisciplinary team of researchers and developers of the Joint Research Centre (JRC) aims to facilitate the understanding of citizens' possible roles and relationships towards policy-makers that are emerging due to the ongoing digital transformation of society.

Data is collected from various sources, such as sensors, civil society, and the commercial sector. It identifies the challenges concerning the heterogeneity of such data collected and provides solutions for integrating data from these data sources, made possible by the increasingly relevant open data policies.

The Digital Earth Lab helps to advance the understanding of peoples' intentional engagement in authentic scientific investigations (citizen science) and demonstrates its values and possible uses for European policy-making at the intersection of better regulation and open science agendas. In order to do so, a citizen science information platform was developed which supports the underlying processes. Furthermore, related partnerships with organizations and working groups were set up in the fields of citizen science and big data.

The aim is to provide methodologies on how to integrate citizen science into the policy cycle by reflecting on the changing role of the public in European policy-making and new forms of contributions to the provision of scientific evidence.

The ultimate goal is to develop a citizen science information platform comprising an archive of resources, showcase the potential policy relevance of particular aspects of citizen science, as well as provide a means to evaluate the feasibility of Pan-European operations.

The current work areas are as follows: citizen science data and services; citizen science and EU policy-making; knowledge extraction from new data sources; innovative use of global earth observation data.

Scope: European Union

Policy areas affected: digital transformation, citizen science

Main stakeholders: Joint Research Centre (at the interface of science and policy), (citizen) scientists

Duration: started in 2014, it is ongoing under the current Commission (no definite end date indicated)

Methodology: data from (citizen) scientists is collected in various ways utilizing the novel collaborative methods made possible by digital transformation, such as data crowdsourcing. The end results are communicated through the web platform to interested scientists, as well as the official JRC communication channels towards experts are used.

Impact: The Digital Earth Lab combines the advantages of two recent science communication trends, i.e. open data and citizen science. It engages scientists (from and beyond the JRC) and citizens within the Commission's formal policy structure to collect and analyse data via novel digital methods with the aim of checking their feasibility and usability for policy-making. The opinion of (citizen) scientists is thus more prominent towards policy-makers.

Important links: https://digitalearthlab.jrc.ec.europa.eu/

Good practice of science communication – #EUvsCorona Hackathon & Matchathon

Short title: #EUvsCorona

Short description of the practice: The EUvsVirus Programme was a hackathon and matchathon and EIC COVID Platform initiative organized by the European Commission, led by the European Innovation Council with the patronage of Commissioner Mariya Gabriel: #EUvsVirus was a highly efficient mission-driven initiative to fight against corona pandemic. It showed innovative ways of working between public administrations (European Commission and 27 Member States), purpose-driven innovators, entrepreneurs and the civil society actors based on the principles of decentralised collaboration and empowerment. #EUvsVirus has functioned as a lean start-up: a mission-driven team of 600 volunteers and Commission officers from seven departments of the Commission were involved.

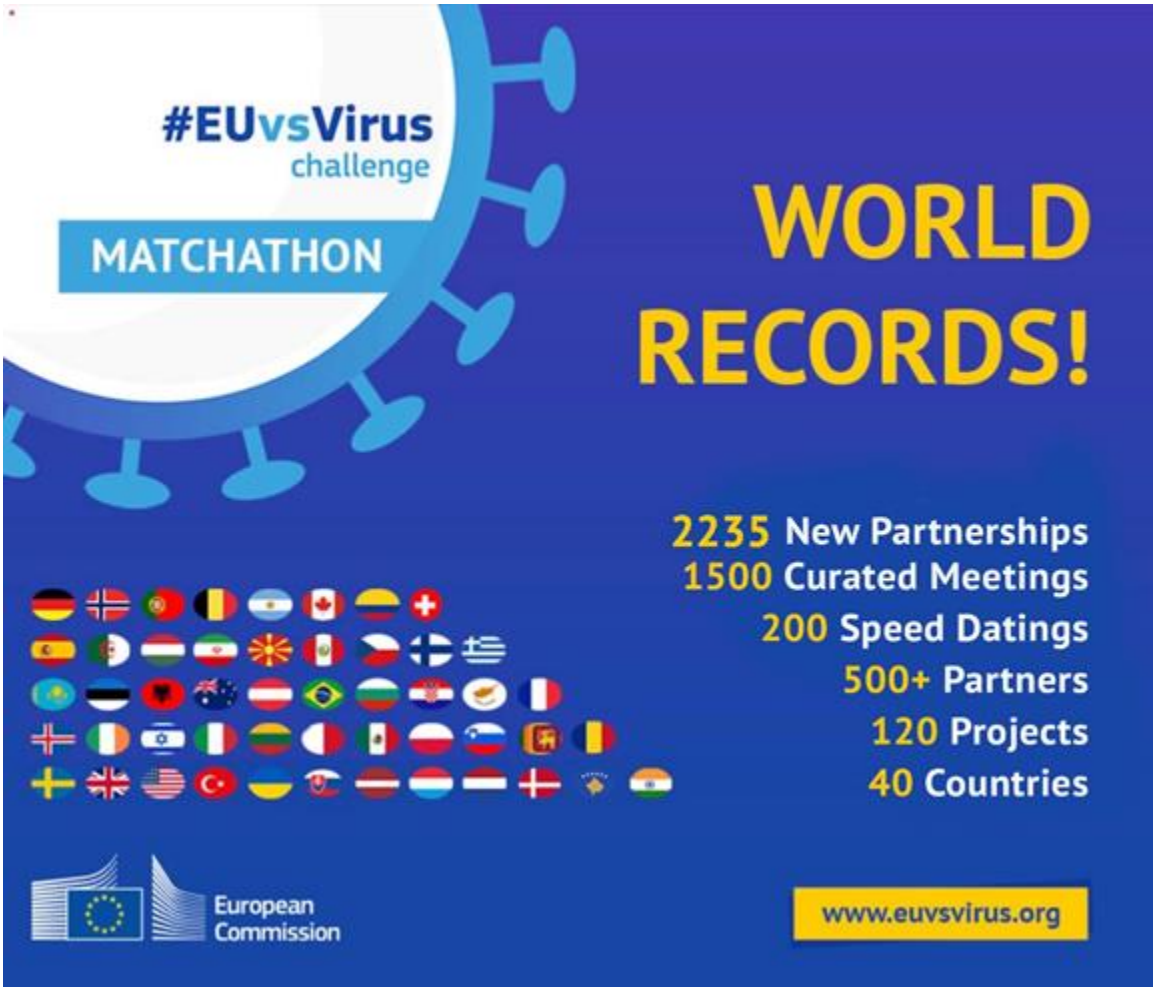


Figure 5 Review on #EUvsCorona source: euvirus.org

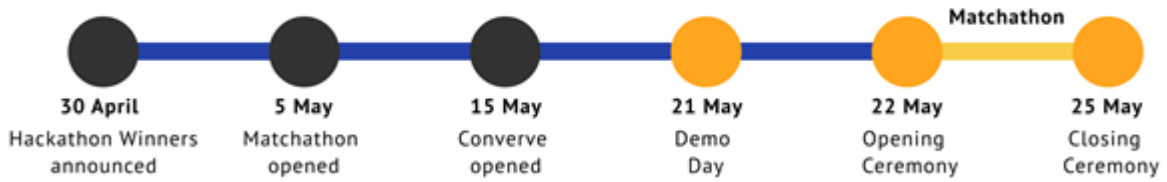
Over 20,900 people from across the EU and beyond took part, with 2,150 solutions submitted in areas including health and life (898), business continuity (381), remote working and education (270), social and political cohesion (452), digital finance (75) and other challenges (83).

Scope: Europe and beyond

Policy areas affected: #EUvsCorona programme was built on open innovation principles in the context of digitalisation. At the intersection of science communication and open innovation the programme introduced a more collaborative and participatory approach to public engagement and the dissemination and communication of science, research and innovation. The programme can be highlighted as good practice example generating new

forms of public-private-partnerships for innovation taking up a potential future of work to reality.

Main stakeholders: Innovators from all sectors were matched successfully with the business/industry sector – supported by the public administration at European and national level – and became the main drivers of the programme.



Duration: The programme was kicked off within a few days at the end of April, results were presented at the end of May.

Figure 6 Timeline of the #EUvsCovid Source: euvsvirus.org

Methodology: #EUvsVirus was based on the concept of an online hackathon, which is a design sprint-like event (often developing software projects with an open community); furthermore, it took a further step by implementing an online Matchathon, which connected the needs of innovators with the opportunities made available by investors, corporates, public authorities (including hospitals and other contracting authorities), academia and research institutions. Throughout the 7-day Matchathon, teams were able to pitch their solutions before 'partners' (investors, corporates and other public and private entities) in order to secure funding and other forms of support. The foremost objective was to enable the scale up and commercialisation of innovative solutions tackling COVID-19 related challenges and contributing to the European and global recovery in the aftermath of the pandemic.

The programme provided a robust co-creation and matchmaking concept to generate cross-innovation and to speed up processes beyond national and disciplinary borders.

Impact: #EUvsVirus created 2,164 multi-disciplinary, multi-nationality teams with innovative solutions throughout April, then sparked the development of 2,235 new Cross-European partnerships by matching the best 120 teams with 458 supportive partners from the public and private sectors throughout May. The former were the results of the world record Hackathon with more than 21 thousand participants in 3,500 teams. The latter were the results of the Matchathon that became the biggest matchmaking exercise ever organised in the world with 1,500 curated meetings to generate 2,235 new partnerships.

#EUvsVirus demonstrated how open innovation strategies can transform public administration, and at the same time, support value creation and service delivery by collaborating with external parties to accelerate the creation and exploitation of innovation.

Important links:

https://www.euvsvirus.org
https://www.euvsvirus.org/partnershipshttps://www.facebook.com/EUvsVirus/

Good practice of science communication – scientific advice to policy-makers on a global level

Short title: Working and Living in Times of Coronavirus of the WageIndicator Foundation

Short description of the practice: The Global Labor Organisation (GLO) and WageIndicator collaborate to promote the collection of data in as many countries as possible and provide access to this data. WageIndicator is a non-profit foundation, which aims to share and compare wages and labour law on a global scale through its national websites in 140 countries with millions of web visitors. Through WageIndicator the GLO provides access to databases on wages, income and prices, as well as on labour law and collective agreements.

In response to the outbreak of the COVID-19 virus, WageIndicator started to survey people around the world to discover what makes the coronavirus lockdown easier (or tougher), and what is the COVID-19 effect on their jobs, lives and mood on 23 March, 2020. The survey reaches out to all people in working age, contracted, self-employed and unemployed alike.

WageIndicator Foundation organizes this global research effort together with a co-creation process along the relevant stakeholders, such as associated researchers, web masters and

translators through its network. All contributions to make this survey possible, to operate it and to disseminate results through its many websites are for free, thus contributing to open science and open access to research results. These results are shown in maps and graphs for 134 countries, updated on a daily basis.

One outcome of the research process will be policy advice provided to interested decision-makers around the globe, thus ensuring the practical use of data collected and analysed in a uniform manner. The first such policy paper was compiled by researchers from the Netherlands, Slovakia and Spain concluding that their findings are relevant for policy-makers who design paths to recovery from the COVID-19 pandemic. They endorse the pursued maintenance of employment for as many people as possible: 'protecting jobs implies the protection of citizen's well-being'.

Scope: Wageindicator reaches out to 134 countries in all continents and has a global scope.

Policy areas affected: labour market

Main stakeholders: both, from policy and communication fields

Duration: The survey started on 23 March 2020 and it is still possible to fill it out. Until the end of May, more than 5,000 respondents have shared their opinion and data.

Methodology: The online web survey is used for collecting data, and the scientific results are communicated through various means in each country, based on local requirements and circumstances. One policy paper summarizing the findings for Netherlands, Slovakia and Spain has already been published and disseminated to relevant policy-makers.

Impact: Wageindicator Foundation is unique in its global reach and uniform scientific methods in the field of labour market policies. Through its network the organisation is able to communicate its scientific results to various policy-makers involved through GLO.

Important links:

GLO Wageindicator Platform: https://glabor.org/platform/wageindicator/ Survey – https://wageindicator.org/salary/living-and-working-in-times-of-the-coronavirusSurvey maps and graphs – https://wageindicator.org/Wageindicatorfoundation/projects/living-and-working-in-coronavirus-times Policy brief –

https://wageindicator.org/documents/publicationslist/publications-2020/2000-wp_muni_econ_2020-03.pdf

Good practice of science communication – Coronavirus video

Short title: Coronavirus video produced by Kurzgesagt

Short description of the practice: Kurzgesagt (in English: in a nutshell) is a German animation studio producing videos on its dedicated Youtube channel mainly for educational purposes. Its typically short and concise videos discuss scientific, technological, political, philosophical and psychological subjects.

In March 2020, during the COVID-19 pandemic, Kurzgesagt uploaded a video about how the human body reacts after contracting COVID-19. The video has over 25 million views, making it the most viewed video on the channel.

The unprecedented success of this video can be attributed to its good timing and sensitive topic, but also to the interactive, highly entertaining way how it explains complicated scientific facts to lay persons.

The success of this video showcases the strengthening trend of visual solutions in science communication with the general public and also with the specific target group of policy-makers. The video was promoted by regional and global policy-makers as a readily digestible way of raising awareness on a crucial health issue contextualised in various social environments.

The video was co-produced with Our World in Data, which enabled the video to be produced in a much faster time than usual. This was needed due to the time-sensitive topic of COVID-19. As stated on the website of Our World in Data, virologists and epidemiologists were very responsive in their feedback, indicating a high interest in the video from the scientific side.

This partnership also showcases the intertwined nature of two relevant recent science communication trends, i.e. the proliferation of visual solutions, as well as the reliance on big data. Without more readily available, novel and trustworthy (big) data, the video of Kurzgesagt could not have been produced in such a short time (3.5 days) – or its scientific data could not have been so accurate.

Scope: global – dependent upon the languages to which the video was translated (or the available sub-titles)

Policy areas affected: environ-mental health

Main stakeholders: Kurzgesagt is the provider of this scientific 'infotainment' video, which was checked for scientific accuracy by interested scientists and can be freely taken up by any policy-makers for awareness-raising or dissemination purposes

Duration: Kurzgesagt provides videos since – the English channel is financed through donations, while the original German channel is supported by funk, the online presence of German public broadcasting therefore the lasting operation of the company is ensured

Methodology: video format, using the so-called flat design style

Impact: the 'infotainment' videos are produced for further uptake by general citizens or other stakeholders, such as policy-makers. At the time of drafting the report, we were notified of two such dissemination and promotion by policy-makers: (1) a tweet from the government of the German State of Baden-Württemberg and (2) a Facebook post by UNICEF Maroc.

Important links:
https://www.youtube.com/watch?v=NU31mw90re0https://ourworldindata.org/kurzgesagt-coronavirus-video

Good practice of science communication – Debunking Handbook

Short title: Debunking Handbook

Short description of the practice: The Debunking Handbook is an open-access guide to debunking misinformation, written by an Australian cognitive scientist and climate communication scientist. Although there is a great deal of psychological research on misinformation, this Handbook is the first to offer practical guidelines on the most effective ways of reducing the influence of myths. The Debunking Handbook boils the research down into a short, simple summary, intended as a guide for communicators in all areas who encounter misinformation.

The Handbook lays down the ways how to effectively debunk misinformation, for which three main factors are detailed. First, the refutation must focus on core facts rather than the myth to avoid the misinformation becoming more familiar. Second, any mention of misinformation should be preceded by explicit warnings to notify the reader that the upcoming data or information is false. Third, the refutation should include an alternative explanation that accounts for important qualities in the original misinformation.

Even though the Handbook offers practical examples from the area of climate change, it can be more generally utilised in a wider range of scientific fields.

Scope: International: The Handbook has been translated to 13 languages.

Policy areas affected: Basically any policy area dealing with misinformation. The ongoing COVID-19 pandemic makes debunking the most relevant in environ-mental health areas (as regards the core topics of TRESCA).

Main stakeholders: Policy-makers in any setting should take use of the advice and recommendations provided by the scientific writers (cognitive and communication experts) of the Debunking Handbook.

Duration: The Handbook was first published in 2011 and is updated from time to time, as well as translated to other languages so its durability and transferability is ensured at the current moment.

Methodology: The Debunking Handbook is freely downloadable and usable via the website of Sceptical Science, a climate science blog and information resource website. It was written by two psychological experts, making sure that its recommendations can be used for a wide range of scientific areas.

Impact: The open access publication, easily digestible language, concise format and logical reasoning of the book makes it possible for uptake by any interested policy-makers. This is also facilitated by its translation to 13 languages, as well as the broad network guaranteed by Sceptical Science where the book is located.

Important links: https://sks.to/debunk

Good case practice of science communication – Open Data Österreich & the pilot project COVID-19 Dashboard - Austria, example 1

Short title: data.gv.at

Short description of the practice: data.gv.at offers a compilation of administrative, non-personal data published in Austria in machine-readable form for further use by citizens as well as by business and research. Open government is used as a collective term for different concepts and visions, which deal with certain facets of an opening of state and administration. Open government data (OGD) are those non-personal and non-infrastructure-critical databases that are freely accessible for public use without any restriction for free use, distribution and re-use.

Corresponding to the idea to make government data more visible and transparent, the project data.gv.at was initiated by the Cooperation Open Government Data (an alliance of federal and regional public administration organisation, universities and research institutes) and to be a central metadata catalogue for Austria, which should record and keep the metadata of the decentralized data catalogues of the Austrian public administration.

Currently, it provides more than 28.000 data sets, more than 550 applications and is connected to nearly 1300 organisations in Austria.

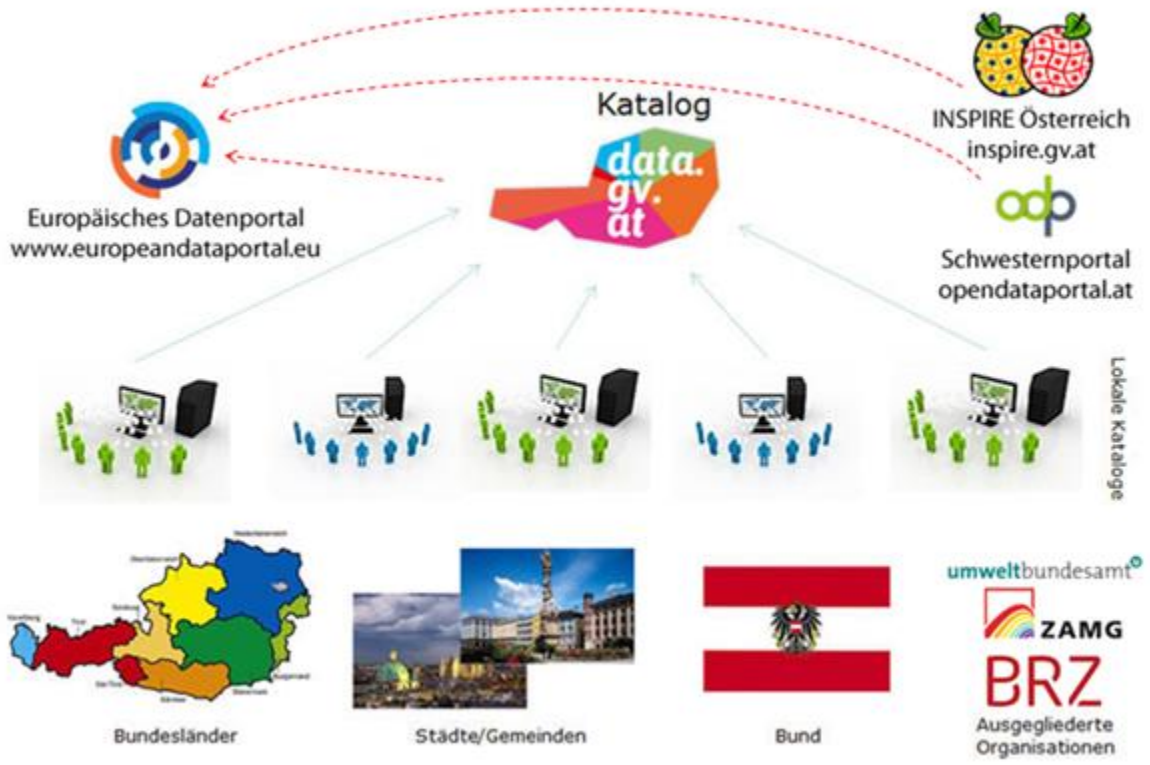


Figure 12 structure of data.gv.at portal source: ibid.

Furthermore, data.gv.at is the "single point of contact" to the European Data Portal (this portal has run until the end of June 2020 also a dedicated section for COVID-19).

The sub portal data.gv.at/COVID-19 ("COVID-19 dashboard") was set up in the beginning of April by the Federal Ministry Austria of Social Affairs, Health, Care and Consumer Protection (BMSGPK) with the purpose of providing a better understanding of the pandemic emergency in Austria. The dashboard aims to empower citizens (and experts) by presenting relevant datasets and data-related initiatives on the topic.

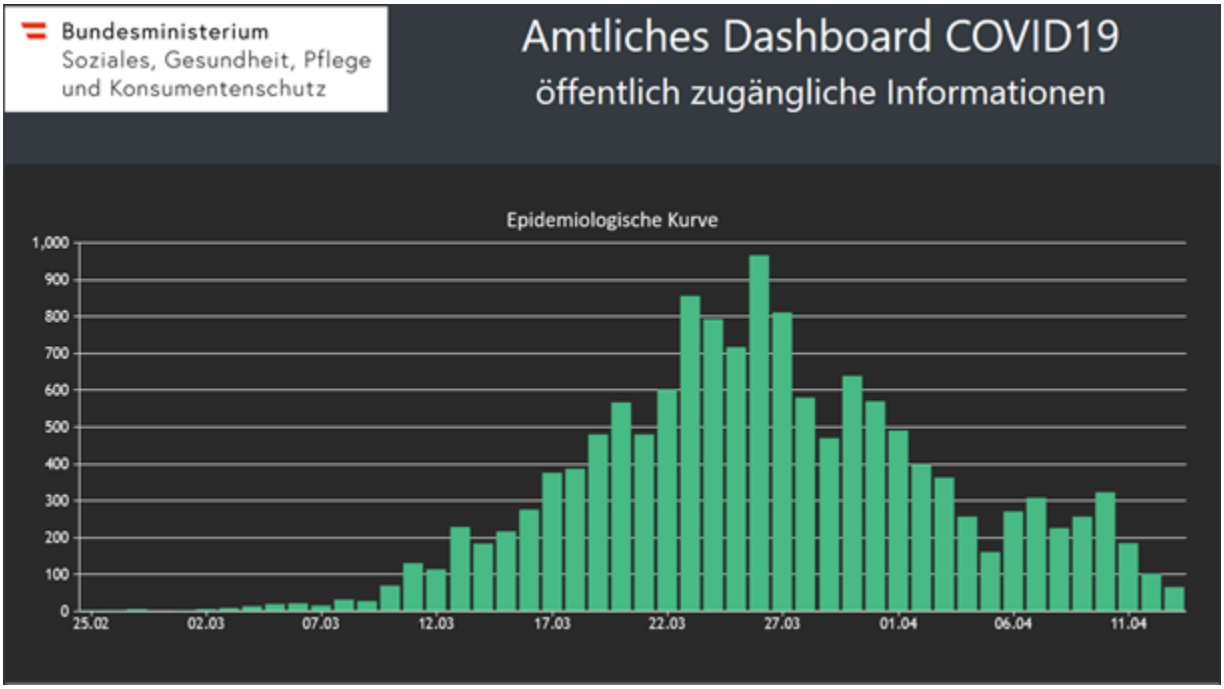


Figure 13 COVID-19 Dashboard - on the epidemiological curve in Austria provided by BMSGPK, retrieved on May 5, 2020 source: data.gv.at/covid-19/

Scope: Austria

Policy areas affected: Open Data Österreich emerged in the context of the national strategy to further advance digitalisation and digital transformation in Austria. Open Government Data is seen as an adequate tool to increase the transparency of administrative dealings, to facilitate better cooperation between politics, administration, business, research, citizens and to strengthen democracy, although there has been a strong criticism regarding the data quality and presentation on the COVID-19 dashboard (COVID-19 sub portal) by the community and media and press.

Main stakeholders: The platform provides open governance data and is open to all interested stakeholders including media partners and journalists.

Duration: Open Data Austria launched in 2014 and relaunched in the beginning of 2019; the COVID-19 dashboard was established in 2020 during the pandemic crisis in Austria.

Methodology: It is possible for participating organisations (currently about 1300) to enter metadata themselves and also to save administration data on the platform. The platform is

the central point of reference for the European Data Portal, that regularly takes over all data and automatically translates into some languages.

The Open Data Portal Austria (ODP) is the equivalent to the above featured data.gv.at for the "open" non-government data of Austria. It offers the chance for business, science, culture and NGOs and civilian society to provide all users with non-personal data.

Impact: Open Data Austria won the "United Nation Public Service Award" in 2014 and has since its kick-off of an effect on the Austrian science-policy (communication) interface by opening the governance data landscape to a wider range of stakeholders and open data communities. Furthermore, the platform provides videos, a netiquette comprehensive e-learning modules and invites stakeholders to feedback and co-develop. Yet, the "COVID-19 Dashboard" showed a range of weaknesses and was criticized by the Open Data community as well as Austrian media and press (especially Twitter @datagvat became the venue for public discussion recently).

Important links:
https://www.data.gv.at/
https://www.data.gv.at/covid-19/
https://www.opendataportal.at/

Other:
https://www.europeandataportal.eu/en;
https://www.bmdw.gv.at/en/Topics/Digitalisation/In-administration/Open-Government-Data.htm
https://www.bmi.gv.at/magazinfiles/2014/11_12/FILES/datenverbund.pdf

Good case practice of science communication – Austria, example 2

Short title: "**Das Corona Virus einfach erklärt"** (translation: "The Corona virus simply explained")

"Oma und Opa geht es gut" (translation: "Grandma and Grandpa are doing fine")

Short description of the practice: A simple but entertaining video released by the City of Vienna, explains the measures that are necessary for developing a sense of responsibility for one's fellow human beings in the context of COVID-19-pandemic. The video is addressed to children and their parents. Among the questions that the video answers are (a) What is

Corona anyway and why can't you see it? (b) What does the virus do? (c) Why is there no contact with grandma and grandpa and why is hand washing so important? (d) What can I do? I Why am I not allowed to reach my face and why am I not allowed to give a hand anymore? (f) What is quarantine? The video was provided in the beginning of March 2020 soon after the COVID-19 pandemic crisis hit Austria.
A second video with title "Oma und Opa geht es gut" followed in the end of March tackling restrictions to meet grandparents during the pandemic crisis. This video was addressed to families and members of the age-related risk groups.

Scope: The video was provided by the City of Vienna but was intended to reach out for the young population (and families) in Austria and beyond.

Main stakeholders: The video was published by the city government and co-developed in with the Child and Youth Welfare Service and the Press and Information Service of the City of Vienna; there is no information publicly available on the collaboration of experts in the field of science communication, storytelling or science education with a focus on public health.

Duration: The first video was released on the 15 March 2020. The second video followed on 28 March. Both videos are still accessible.

Methodology: Both comic-based videos (first video with a length of 2 min. 10 sec., second with 1 min. 59 sec.) were disseminated via the website of the City of Vienna as well as YouTube. Videos were made viral with the help of a push communication strategy using Facebook, and then further spread by users via WhatsApp. Furthermore, the department of education provides an overview on a set of activities and service information provided by the municipality.

Impact: First video was accessed on YouTube 1.216.573 times, second video 46.961 times (per 5 May 2020). Notably, the first video gained positive feedback beyond the Austrian borders: German magazine Stern listed the video in its online version; furthermore, the video gained interest from German schools in Hamburg, Flensburg and Erlangen and was listed on the school homepages; the city of Budapest and Romania requested an approval by the City of Vienna to spread video.

Important links:
https://www.wien.gv.at/video/2706/Das-Coronavirus-Kindern-einfach-erklaert
https://www.youtube.com/watch?v=XNOt8X5i9Pc

https://www.facebook.com/wien.at/
https://www.wien.gv.at/presse/2020/03/15/corona-fuer-kinder-leicht-erklaert-neues-video-der-stadt-wien-online
https://www.bildung-wien.gv.at/service/gesundheit-und-sport/Infos-f-r-Kin—r--ber-Corona-von-der-Stadt-Wien---Hinweis-auf-Untertitel-bei-Youtube.html
https://www.stern.de/gesundheit/coronavirus-fuer-kinder-leicht-erklaert---stadt-wien-mit-erklaervi—o--9187908.html
https://wien.orf.at/stories/3040276/

Other (optional): Video stills of both videos giving information on the visualisation strategy

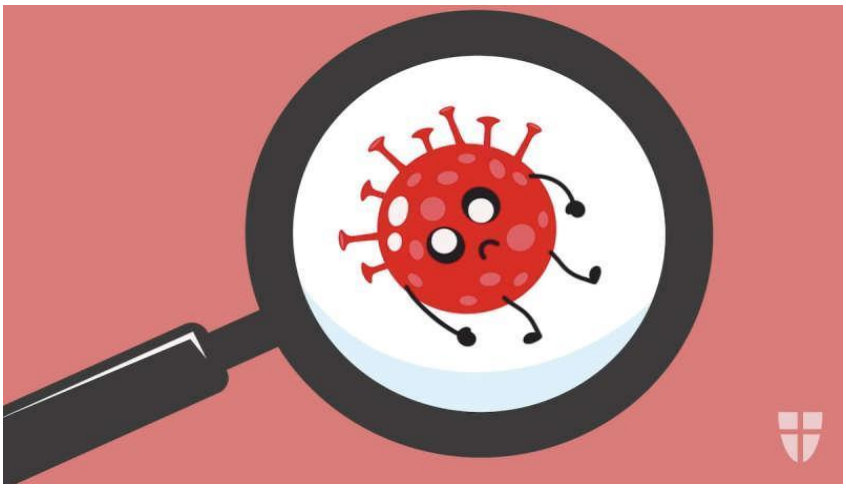


Figure 14 Video still “Der Corona Virus einfach erklärt”

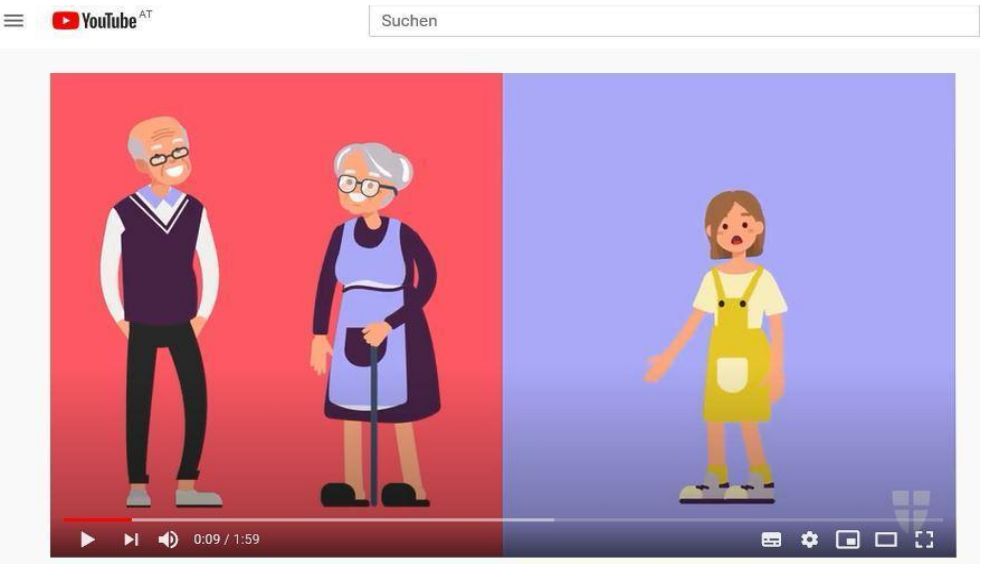


Figure 15 Video still “Oma und Opa geht es gut”