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# Understanding Conceptual Impact of Scientific Knowledge on Policy: the Role of Policy-making Conditions

Jakob Edler[1,2], Maria Karaulova[1,2], Katharine Barker[2]

Karlsruhe, Fraunhofer ISI

[1] Fraunhofer Institute for Systems and Innovation Research, Breslauer Str. 48, 76139 Karlsruhe, Germany
[2] Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester, Booth St West Manchester United Kingdom M15 6PB

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# Abstract

This paper presents a framework to understand the impact of scientific knowledge on the policy-making process, focusing on the conceptual impact. We note the continuing dissatisfaction with the quality and effects of science-policy interactions in both theory and practice. We critique the current literature's emphasis on the role and the activities of scientists to generate policy impact, neglecting the conditions and roles of 'user' policy-making organisations. The framework offered in the paper addresses these critiques by developing an argument about the essential role of institutional 'user side' conditions for scientific knowledge to achieve impact. The framework is informed by the reflexive institutionalist and the neo-institutionalist theoretical approaches. The main contribution of the framework is that it unpicks the institutional conditions within policy-making organisations that influence the uptake of scientific knowledge and provides an operationalisation to analyse them. The wider relevance of the paper is in moving the focus from the activities of scientists and the incentive structure in scientific organisations to the policy user side.


# 1 Introduction

How can science have an impact on policy-making? This question has been with us since the beginning of institutionalised public funding of research. The discussion around this question has been extremely broad, with a variety of perspectives and approaches to conceptualise and measure impact of science (Matt et al. 2017; Bozeman and Sarewitz 2011; Caplan 1979; Weiss 1982; Borgenschneider and Corbett 2010). We would like to add to this debate by shifting the perspective and developing a concept that focuses on the conditions on the side of the scientific knowledge user.

Our motivation emerges from four observations regarding the impact of science[1] on policy-making.

First, despite a long history of looking at science – policy relationships and the use of scientific expertise and evidence for policy-making, there still seems to be dissatisfaction with the way scientists and scientific results actually inform policy-making, especially scientists from academia (Almeida and Báscolo 2006; Kenny et al., 2017).

Second, science, technology and innovation policies are increasingly formulated to address global challenges or societal missions (Mazzucato 2018; European

[1] When we talk of scientists we include – in the continental European tradition – social scientists as well if not otherwise indicated.

Commission 2018). Funding systems are being re-shaped to support scientific knowledge production to tackle challenges (Weber and Rohracher 2012). Science since the Second World War has always had an element of mission orientation. The last decade, at least in Europe, has seen a broadening of this approach in science funding, often framed in the language of crisis, response urgency and severity of the challenges (Boon and Edler 2018; Kuhlmann and Rip 2018; Kuhlmann and Rip 2014). In consequence, the impact of science on policy or society more broadly, as one critical dimension in challenge orientation, has come to the fore again as a major justification of scientific activity.

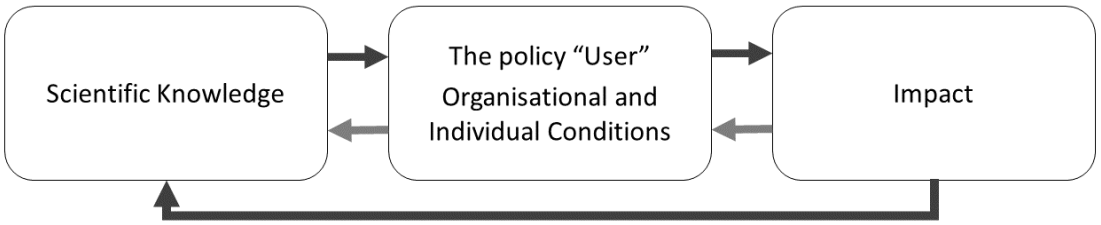
Third, and as a consequence of this trend, there is an increasing demand for scientists to produce knowledge that has impact (Kessler and Glasgow 2011; Brownson et al. 2006). Many research councils, such as the UK Research and Innovation Council, the US National Science Foundation, or the European Framework Programmes, now ask for explicit impact pathways and engagement strategies in funding applications. In performance-based funding systems, such as the UK Research Excellence Framework, the explicit demonstration of impact is becoming increasingly important for the assessment of organisations (Hicks 2012), and for the scientists working within them (Wilkinson 2017). This puts the onus of generating impact on the scientists: to choose topics and create engagement strategies that increase the likelihood of impact.

Lastly, in the policy-making space, there is a persistence of the idea that objective evidence can be produced on the basis of rigorous approaches, translated into layman language, and used by the policy-making system co-determining decisions on policy (Parsons 2002; Sanderson 2009; Van Nes 2011; Mthiyane and Breckon 2020). In this reasoning, the more convincing the evidence, and the more convincing the translation, the more likely the scientific evidence will have effect on the policy-making process. In this perspective, the nature of the evidence determines its impact on policy-making.

Against this background, there is a need for a change of perspective, to balance our understanding of the ways in which science generates policy impact. To this end, our paper develops a new conceptual framework that allows us to shift the perspective towards the users of science in the policy-making arena (Figure 1). This framework stipulates that the way policy ‘user’ organisations set up the search for scientific knowledge, its uptake and use co-determines the impact of this knowledge as much as the circumstances and the context in which it was produced, and the efforts scientists made to ensure its impact. In particular, the framework conceptualises the conditions that drive and otherwise influence the ability and willingness of policy users to access and use scientific research. This process is very rarely linear. It typically involves co-development and alignment between knowledge users and producers through formal

and informal networks, funding and accountability tools and learning from previous successful examples of impactful research (Donovan 2011; Spaapen and van Drooge 2011; Penfield et al. 2013).

Figure 1: Policy user conditions for the impact of science - Simplified framework




Source: own compilation

In this paper, we focus on the relationship between scientific knowledge and a particular kind of impact: *conceptual impact*. We can speak of conceptual impact if we observe a change in the normative and cognitive understanding of policy problems, of causalities underlying those problems and of possible solutions to those problems in the minds of policy makers and politicians (Amara et al. 2004). This focus is deliberate; we do not seek to present yet another policy change framework that explains the outcome of power and interest driven policy-making processes and the relative role scientific evidence can play. This final step towards actual substantive policy change is regularly reviewed in political science and STS contributions (Sabatier 1988; Bennett and Howlett 1992; Smith 2013a; Jäger and Ferguson 1991). The framework presented in this paper is a tool that allows to zoom in on one critical and largely overlooked element of the policy-making process: the conditions and processes for cognitive and normative changes within policy-making organisations. It offers tools to explain how scientific evidence contributes to those changes.

Scientific knowledge, encompassing scientific evidence and (scientific) ideas, is the primary subject of interest of the framework. Science is a specific knowledge production enterprise associated with particular goals and norms (Merton 1973): the scientific research process, its certification and publication conventions, scientific institutions and organisations. The term 'scientific evidence' is different from, for example, 'research evidence', which is a related, but broader concept. The term 'evidence' is broader still and signifies any facts or information used to make decisions (Nutley et al. 2003). In this article, we note that various terms, e.g. 'knowledge translation', are meant to signify the range of data and sources that are broader than scientific research (Dobrow et al. 2004), but are typically used to analyse the delivery of scientific research results

from academia to policy. In the remainder of the paper, 'scientific knowledge' will be our preferred concept.

We mobilise and combine political science and sociological neo-institutional approaches to develop the conceptual framework. More concretely, we utilise reflexive (Edler 2003) or discursive (Schmidt 2002; 2008; 2010; 2012) institutionalism. These conceptualise policy change as primarily ideational change, a result of actors deliberating about, and reflecting on, their ideas about issue framing, policy problems and policy options. This is not to say that this approach neglects the importance of power, politics, or polity. However, its epistemological and ontological stance enables a focus on knowledge-driven cognitive and normative dynamics. We combine this with a broad organisational institutionalist approach (Scott 2014) that allows us to operationalise the conditions in organisations that influence the ideational processing.

The relationship between science and policy is an established topic that is well researched in multiple disciplines. Our specific framework is grounded in a particular institutional approach, but also draws on many complementary insights. Therefore in Section 2 we offer a targeted overview of the key strands in the literature about the impact (and use) of science in policy-making. Section 3 then reviews the reflexive (discursive) institutional theory and lays the foundation of the framework. Section 4 reintroduces the framework and its components. Section 5 discusses the merits of the framework and concludes the paper.

# 2 Previous research and its assumptions

Interest in the relationship between science and policy goes back several decades (Caplan 1979; Weiss; 1977; 1979; 1980) and predates the surge of attention on the societal impact of scientific research brought about by the considerations of evidence-based policy. To understand our specific conceptual take on the issue, it is valuable to briefly characterise the key approaches and their assumptions. We review five key bodies of literature in this section: evidence-based policy, research utilization, two communities, literature on policy development, and research impact assessment. Not all of these are coherent research strands, and some of the domains (e.g. policy development or research impact assessment) are very broad and have been subject of dedicated reviews (Bornmann 2013; Smith 2013a). In the following, we mostly note distinctive sets of assumptions within each domain. We do so by using two structuring devices: common theoretical roots and the logic used to frame the issue (see Table 1). The review demonstrates the emphases on the various parts of impact processes across the bodies of literature, and also indicates overlapping findings with complementary

insights. Taking a note of these findings allows us to position the novel framework presented in Section 4.

In Table 1, logics represent specific ways in which challenges are understood and solutions are offered in the different approaches. Studies that employ a *functional logic* are primarily concerned with whether science is used in the policy-making process, how it is used (e.g. instrumentally, conceptually, symbolically), and which factors affect the type of use. Impact follows naturally from use. Studies that employ *interactional logic* instead prioritise different forms of exchanges on science-policy interfaces. Here, some authors leave the end use or impact of science outside their scope altogether, while others argue that due to the limitations in identifying and measuring impact, scholarly attention should instead focus on efforts scientists make to engage with policymakers (Kogan et al. 2006; de Goede et al. 2012).

Table 1: Major academic conceptualisations of the relationship between science and policy

| Approach | Logic | Assumptions | Representative Studies |
|---|---|---|---|
| **Evidence-based policy** | Functional | Scientific research can help address political questions and issues. Clear instructions, mechanisms of collection and analysis lead to better policy-making. Promotes experimental, quantifiable data for policy collected and aggregated using a number of particular techniques (e.g. RCTs, systematic reviews). Mixed academic-consultancy-government contributions to the knowledge base. | Nutley et al. (2007)<br>Haynes et al. (2012)<br>Head (2008)<br>Cairney (2016) |
| **Research ctilization** | Functional | Scientific research can help address political questions and issues. Seeks to understand the processes and circumstances of research use by policy officials, usually focusing on bureaucracies and the 'middle level' of policy-making (e.g. agencies), paying most attention to factors, enablers and barriers, routine activities of policy officials. Knowledge base heavily relies on utilisation surveys. | Landry et al. (2003)<br>Amara et al. (2004)<br>Hanney et al. (2003)<br>Elliott and Popay (2000) |
| **Two Communities** | Interactional | Scientific research can help address political questions and issues. Science and policy communities are conceptualised as separate entities and the main problem is seen in bridging the gap between them. Better interaction, awareness of each other's values, practices and priorities, and better information exchange can help improve the use of science. Diverse approaches emphasise networks, sustained linkages, co-creation. | Caplan (1979)<br>Weiss (1979)<br>Glasgow and Emmons (2007)<br>Gagliardi et al. (2016) |
| **Literature on policy development** | Mostly Interactional | Good policies are developed as a result of careful consideration and deliberation of evidence and normative arguments. Scientific research is valuable, but not primary reason for developing new policies. Encompasses many theoretical stances that disagree about the extent to which new information (including research) can influence policy change. | Sabatier (1988; 1993)<br>McRight and Dunlap (2010)<br>Kogut and Macpherson (2011) |
| **Research impact assessment** | Interactional and Functional | Publicly funded scientific research should produce societally relevant and impactful results, including policy impact. Scientists and universities should demonstrate their successes in doing so. Internal debates about attribution. Recommendations for scientists to increase the chances of policy uptake. Communicative approach emphasises networks, productive interactions, sustained linkages, co-creation. | Bornmann (2013)<br>Penfield et al. (2013)<br>D'Este et al. (2018) |

Source: own compilation

The differentiation between the two logics is not strict and relates more to the emphasis they give to certain parts of the impact process. For example, studies that discuss co-creation (and co-production) can be conducted following both logics. Co-creation surfaced in recent years as the important approach to produce research with societally relevant outcomes (Donovan 2011). Studies following the functional logic pay attention to how co-creation generates scientific knowledge that is tailored to policy needs and thus increases the likelihood of being used by policymakers (Lemos and Morehouse, 2005). Studies following interactional logic stress the importance of knowledge exchanges between scientists and policymakers during the co-creation process regardless of whether these interactions result in immediate uses of science in policy settings (Spaapen and van Drooge 2011; Pohl 2008).

A major body of literature, termed here *evidence-based policy*, focuses on the nature of good evidence for policy-making. Conducted mostly within the functional logic, these studies originate from the renewed academic interest in the topic after the UK New Labour's initiative to employ evidence-based policy-making principles in 1997. This has evolved over the years; its latest, more nuanced, iteration, labelled 'evidence-informed policy-making', re-shapes the desired relationship between evidence and policy and clarifies the need for 'research evidence' (Head 2016). Within the academic domain, earlier contributions believed that as long as robust, reliable evidence is available to policymakers at the right time, good policies can be developed (Goldman et al. 2001). They received persistent criticism from later contributions that stress the many ways in which evidence-based policy channels can be influenced by political interests (Strassheim and Kettunen 2014).

The evidence-based policy literature focuses heavily on what constitutes good (research-informed) evidence, how it can be produced and what makes it credible (Grimshaw et al. 2012; Perrier et al. 2011; Green and Glasgow 2006; Brownson and Jones 2009; Sanderson 2002). The popularity of a very limited number of specific methods, such as randomised control trials, is a major point of contention (Haynes et al. 2012). A lot of attention is dedicated to developing ways to aggregate and synthesise evidence (Dobbins et al. 2004; Humphries et al. 2014). Among these, research repositories and databases are the latest solution coming in focus (Lawrence et al. 2017).

*Research utilization* studies also follow the functional logic, but focus more on policymakers' ability to search for, understand and use (research) evidence. This literature often considers the relative value of scientific evidence alongside other types of research evidence, such as that produced by think-tanks and consultancies. It differentiates different types of knowledge, including codified and non-codified outputs, and

types of research use by policymakers, e.g. instrumental, symbolic, conceptual (Amara et al. 2004). Empirically, utilization scholars have focused on middle-level bureaucratic policy organisations and paid some attention to the role of organisational and institutional factors, such as the existence of knowledge brokering roles (Lomas 2007; Crona and Parker 2011), organisational culture (Belkhodja 2014), and routines (Jbilou et al. 2007).

Studies conducted within the interactional logic see the effective solution to ensure the impact of science on policy as setting up appropriate knowledge exchange channels between these *'two communities'*. The metaphor was first suggested by Caplan (1979) who pointed at cultural gaps between scientists and policymakers. It was criticised as inaccurate by many subsequent contributors who showed that boundaries between the 'two communities' are at best blurry, or the separation may not exist at all (e.g. Bartley 1992). However, both the notion of, and the empirical distinction between, 'scientists' and 'policymakers' persist in recent literature (Gagliardi et al. 2016). The current consensus about bridging the research/policy gap stresses the importance of sustained exchanges and interactions (Sarkki 2017; Broström and McKelvey 2017; Weichselgartner and Kasperson 2010; Armstrong et al. 2013). Using networks and linkages, the two communities can develop shared values and understanding, exchange evidence, co-produce knowledge, and facilitate long-term 'knowledge creep' of science-based ideas into political debates (Weiss 1980, Lemos and Morehouse 2005).

There appears to be widespread support in the literature reviewed so far of the technocratic assumption that scientific research is particularly valuable for good policy-making compared to other types of information and therefore the uptake of science in policy should be encouraged and supported. Political scientists do not always agree; they stress divisions among scientists who can feed evidence to different sides of political debates (McCright and Dunlap 2010; van der Sluijs et al. 1998; Smith 2013b). While doing so, some scientists may advocate certain policy instruments and even disregard evidence that contradicts their opinions (Pielke 2004; Pielke 2007).

We group such contributions under the umbrella of *policy development literature*. They analyse various aspects of the political deliberation process, such as the role of different types of arguments backed by different actors (Sabatier 1988), the role of individuals, such as policy entrepreneurs (Edler and James 2015), and the ability/inability of the entire policy system for change (Cerny 1990). Scientific research can play a role in the development of new policies, which is often the empirical interest of this literature, but it is not assumed to be more valuable than other arguments or evidence (Hall 1993; Kingdon 1984; Beland 2005). Within this corpus of literature, the ideational stream forms the basis of the conceptual development of this paper and is reviewed in detail in

Section 3. This approach positions scientific knowledge as one of the sources of ideas that underpin policy decisions. It focuses on the deliberation processes that lead to certain policy outcomes.

The *research impact assessment literature*, as noted in the introduction, analyses conditions, incentives and activities of scientists to generate impact of their research. Although the studies in this stream typically theorise the impact of science generally, some authors advocate more nuance, for example to recognise different types of impact pathways in different disciplines and societal areas, including policy (Douthwaite et al. 2003). This body of literature is rarely included in science-policy reviews. However, as its focus is mainly on scientific knowledge produced in academic settings (as opposed to 'research' or 'evidence') it offers important insights about the knowledge production side of the impact process. Most important in this perspective is the crucial role of incentives and institutional conditions for scientists to engage with society (Perkmann and Walsh 2008).

Functional-based impact assessment research typically proposes frameworks that build causal attribution links between scientific research results and their impact (Reale et al. 2018), while interaction-based studies criticise this excessive focus on discrete research outputs, because they downplay the potential of science to influence society conceptually and over the long term (Molas-Gallart and Tang 2011; Donovan 2011). These are linked to the systemic issue of ignoring the less-observable impacts in some topics and disciplines during research evaluations (Spaapen and van Drooge, 2011; Donovan and Gulbrandsen 2018). As scientists have limited ability to influence the impact of their research, these studies argue, their efforts to establish and maintain linkages with the potential 'users' of their research should be the focus of evaluations, not the evidence of its impacts.

The review so far illustrates an important discrepancy in understandings about how science is used in policy and how it generates impact. Instances of use are discrete and short-term. They are available for empirical investigations, and there are abundant examples from the literatures on policy development, research utilization and evidence-based policy about how various actors use knowledge. Impact, on the other hand, refers to longer-term lasting changes that occur as a result of individual instances of research use over time. As these are harder to study and go beyond individual policy outputs, there is less knowledge about how scientific knowledge can generate lasting impact on policy. Actual impact is harder to demonstrate than use of science.

Additionally, we note a recurring tension in the debates. Some studies emphasise *observable* instances of scientific research use. Others stress that impact is *not always*

*observable* or identifiable. Observable instances of science use can be consistently reliably measured. In many instances, it is possible to build a causal attribution link with long-term impact. Critics of this approach stress that science may influence policy and leave no observable evidence behind (Contandriopoulos et al. 2010; Rudd 2011). The conceptual use of science is at the centre of this tension, because changing one's mind about an issue does not always lead to concrete action. Moreover, conceptual impact of science is often linked to long-term policy change, potentially resulting in changes on a larger scale than individual observable instances of use (Weible et al. 2010; Albaek 1995).

Patterns of science use differ across domains. Health research, for example, has a strong evidence-based practice mandate (Hanney and González-Block 2009), with robust records of instrumental use of scientific results, while the impact of arts and humanities research tends to be mostly conceptual (Hazelkorn et al. 2016; Hicks and Holbrook 2020). Research utilization studies have paid some attention to organisational characteristics, but only within a narrow understanding of science use. We add to this perspective by focusing on the institutional conditions that make the uptake of scientific knowledge in policy organisations more or less likely.

We argue that in-depth analyses of policy organisations' institutional and organisational conditions allows for a novel and useful conceptualisation of the missing link in our understanding of how scientific knowledge can achieve lasting impact on policy-making. We achieve this by drawing on reflexive institutionalism, an ideational strand of policy development research, combined with organisational institutionalist theory. These two constitute the theoretical foundations of the conceptual framework this paper develops. We review them next. To develop the conceptualisation, we mobilise insights from all five strands of literature discussed so far.

# 3 Theoretical foundations

We now turn to a political science approach that allows us to capture and operationalise the key dimensions influencing the process through which scientific knowledge generates impact on policy-making. The reflexive (Edler 2003) or discursive institutionalist tradition (Schmidt 2002; 2008; 2010; 2012) offers an analytical lens to understand why and how new cognitive and sometimes normative elements (ideas embedded in scientific research) influence thinking and acting in policy systems.

## 3.1 Reflexive/discursive institutionalism

In traditional neo-institutional analysis, change is thought to be brought about through rational calculation in given incentive structures and fixed preferences (rational choice institutionalism), changes of contextual settings over time in within historical paths (historical institutionalism) or through evolutionary change in all-encompassing social norms (sociological institutionalism). Those three institutionalist approaches build upon specific ontological understandings of what determines change and can be applied to analyse particular empirical cases. However, they all neglect a major underlying property of decision making, which is the individual and organisational sense-making. This refers to the gathering of credible information and data and theoretical concepts to make sense of that data and information.

A fourth strand of neo-institutionalism has its starting point here. It asserts that what actors define as problems, what they consider to be possible solutions and what they define as their interests is open to change. Thus, change comes about as a result of cognitive processes based on reflection on cognitive (or causal) and normative ideas (Cox and Béland 2013). Ideas can change interest perception, alter existing institutional paths and overcome boundaries set by pervasive social norms. Beliefs in terms of policy-making can "*provide the recipes, guidelines, and maps for political action and serve to justify policies and programs by speaking to their interest-based logic and necessity*" (Schmidt 2008, p. 306).

The ideational approach in political science is situated in a broader movement of ideational approaches in social sciences that has a strong root in a constructivist paradigm (for an overview see Béland and Cox 2010). In political science, there has been a range of scholars focussing on the role of ideas and argumentation for understanding the policy process (Blyth 1997; Fischer and Gottweis 2012; Anderson 2008; Finlayson 2004; Seeleib-Kaiser et al. 2007). Across those approaches, the authors agree that there are different types of ideas and they have different influence on policy-making (Béland 2005). The most prominent and pervasive - and most appropriate one for our purpose - is the distinction in three levels of ideas: ideas on the nature of a problem, ideas on the nature of the solution and ideas that shape the overall ‘public philosophy’ (Heclo 1986) or "Zeitgeist", i.e. the understanding of the public about the very role of government vis-a-vis certain issues (Mehta 2010).

Vivien Schmidt elaborated the ideational institutional approach and coined the term ‘discursive institutionalism’. We mobilise this approach in particular because it emphasises the importance of both the substantive content of ideas (e.g. scientific evidence) and the interactive process (Schmidt 2017, p. 5) for the influence of ideas on policy

change (Schmidt 2008, p. 303). In doing so, she enables us to shed light on the ways in which the substance of ideas as well as the interaction with which they are generated and transformed in the deliberation and policy-making process make an impact upon the policy-making organisations and individuals.

Important for our context is Schmidt`s distinction between *coordinative* and *communicative discourse*. Both provide different venues for scientific ideas to be transported, transformed and absorbed (Schmidt 2008). The coordinative discourse unfolds within the policy-making system to develop policy solutions in the policy space in order to establish a necessary level of policy consensus. Participants in that discourse are all those actors that are involved in the creation, elaboration and justification of policy ideas. This discourse explicitly involves technical experts and is shaped by epistemic communities (Haas 2009) arranged around a shared body of knowledge and techniques and spanning organisational boundaries. As these communities adhere to certain basic epistemological and ontological truths, they influence the likelihood with which new ideas are transmitted and accepted.[2] Epistemic communities are cross-organisational, linking academia, think tanks and policy-making bodies. Yet there may nevertheless be a need for ideational brokerage (Parsons 2002, p.174). Epistemic communities can support 'advocacy coalitions' (Sabatier 1988), which combine, deliberately, material interest and causal and normative beliefs in their attempt to proactively influence policy decisions.

The communicative discourse builds a discursive connection between the political sphere and the general public. It serves to legitimise political decisions or to trigger policy change through public pressure. Here, the formal institutional context, the polity, as well as the political culture, are important intervening factors. The two discourses interact in many ways. The technical discourse fed by scientific arguments connects with the public narrative - and vice versa. The power of the epistemic community within the coordinative discourse may add legitimacy when engaging with the general public (Edler 2003). Conversely, the communicative discourse may exert normative power against which cognitive beliefs in the coordinative discourse cannot persist (see also Schmidt 2002).

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2 As Haas developed this model in the context of international organisations and power politics, he focused strongly on the agency of those epistemic communities and their interest to promote certain kinds of ideas. We can abstract from this qualification here, as the basic proposition, the cross-organisational epistemic community as a transmission belt for (scientific) ideas remains an important element of a framework on the influence of scientific ideas on policy-making

Discursive institutionalism offers an entry point to understand the existing - and changeable - institutional conditions in policy organisations that interact with science, absorb and transform scientific research. This is done by taking into account the ability of actors to make sense of ideational content (in particular in coordinative discourses). Organisational systems of meaning and understanding – labelled background knowledge – act as an ideational filter and an interpretative device. Organisations (and individuals within them) exercise their *background ideational abilities* when they encounter new (scientific) ideas. These background ideational abilities influence the extent to which the ideas can exert conceptual influence within policy-making organisations (Schmidt 2008). Therefore, the systems of meaning collectively maintained by agents significantly influence the conceptual impact of new ideas, including scientific knowledge. This part of discursive institutionalist theorising has not been developed further to interrogate the extent and ways in which the institutional context can act as an intervening variable for the impact of (scientific) ideas on policy.

In sum, for our framework to conceptualise the meaning of scientific knowledge for policy-making, we can conclude that

1. We mobilise the established approaches to understand policy change as a result of ideational processes,
2. Ideas must be distinguished on three levels (broader "Zeitgeist", problem definition, solution space), each with their own specific meaning for policy change,
3. We need to understand the origin of ideas as well as the ways in which they unfold in the discourse in order to understand their conceptual effects in and between policy-making organisations,
4. We can distinguish different kinds of ideational discourses with their own logics,
5. We need to take into consideration the (pre-)existing and co-evolving institutional and ideational conditions in policy-making organisations to understand how external ideas exert influence on them.

We have outlined these principle tenets of ideational, discursive institutionalism to conceptualise the meaning of ideas for policy-making. We now turn to what we see as a major gap even in this approach. The elaboration of the background ideational abilities are far too limited to understand what is in the core of our interest: the institutional conditions within policy-making organisations for participants in the ideational discourse, as recipients of ideas and as instigators of idea creation for their own use. In the following section we turn to a framework for those conditions.

## 3.2 Three elements of institutions

A policy organisation's background ideational abilities can be analytically accessed by distinguishing three elements of institutions: regulative, socio-normative and cognitive, as suggested by Richard Scott (2014). They encompass both structures and processes, which can be explicit or implicit. They emerge as a result of sustained social interactions, are interdependent and interwoven in practice (Edelman 1992). The three elements of institutions can help us to operationalise the organisational dimension of policy actors' engagement with different types of scientific knowledge.

*Regulative* institutional elements are constituted by formalised instructions that influence human behaviour via a system of sanctions and rewards. These can be legal prescriptions or a set of formally set rules. In organisations, regulative elements encompass formal authority structure, incentives, bonuses, promotion, and also penalties and fines. Within the policy-making space, formal and legal processes of policy development rest on the regulative pillar, which in the context of our interest could manifest itself, for example, in instructions to use the best available evidence and disclose the evidence base of a policy to the public.

*Normative* institutional elements reflect shared expectations and social obligations regarding the behaviour in certain circumstances. Encompassing values and roles, normative elements emphasise the processes through which actors interpret social context in order to take an 'appropriate' course of action that leads to achieving their goals (March and Olsen 2011). These common frames of reference allow the actors to navigate social life by anticipating the behaviour of others. In the context of our specific interest, normative processes would dictate the extent to which policymakers expect to draw on scientific research in debates about the issues, and the notions about which research is seen as robust or reliable.

*Cognitive* institutional elements encompass assumptions, meanings attached to social action, symbols, identities, causal connections, and scripts. They are taken for granted, are rarely contested and are sometimes not even rationalised. They all make up the 'natural order' in which the actors operate, and its 'constitutive rules' (Searle 1969), creating shared frames of meaning in social life. Structural isomorphism is one of the key examples of the cognitive institutional processes, as people expect to see elements that are 'normal' when they interact with various organisations (Scott 2014). In the policy-making space, cognitive proximity to certain domains of knowledge enable easier diffusion of scientific research from these domains into policy. For example, the institutional logics of quantification and the economic style of reasoning pervasive in many policy spaces are among the key reasons of why economics research might be

one of the most policy impactful social sciences (Espeland and Stevens 2008; Hirschman and Berman 2014).

We can now integrate the theoretical foundations. Discursive institutionalism offers a conceptualisation of the policy development process as an ideational deliberation between the actors engaged in the coordinative discourse (Schmidt 2008). The mechanisms through which the actors develop and/or change their ideas about the nature of the problem, the solution space and the overall role of governance are explained through the notion of background ideational ability. To this we add that policy actors – both individual and collective – operate in organisational environments and are embedded in various institutional processes. These directly affect actors' background ideational abilities and influence their ability and willingness to engage with new ideas, including ideas embedded in scientific research.

For both Scott and Schmidt, *depth* is an important dimension of institutionalisation because it explains the extent to which ideas are malleable. Schmidt uses Sabatier's (1993) concept of the policy 'deep core' to explain the difference between often unquestioned public philosophies and programmatic, debatable, policy options. More radical ideational scholars represent institutions as persisting, 'sedimented' ideas that are collectively shared and reproduced by the actors inhabiting them (Eleveld 2016). The institutional elements approach can explain how this 'sedimentation' happens in organisations, for example, using the concept of legitimisation (Cashmore and Wejs 2014; Deephouse et al. 2017). Regulative, normative and cognitive legitimacy mechanisms influence the way ideas are observed, filtered and made sense of by the actors embedded in institutionalised organisational processes. Some of these ideas are considered credible, while others do not pass institutional filters as easily.

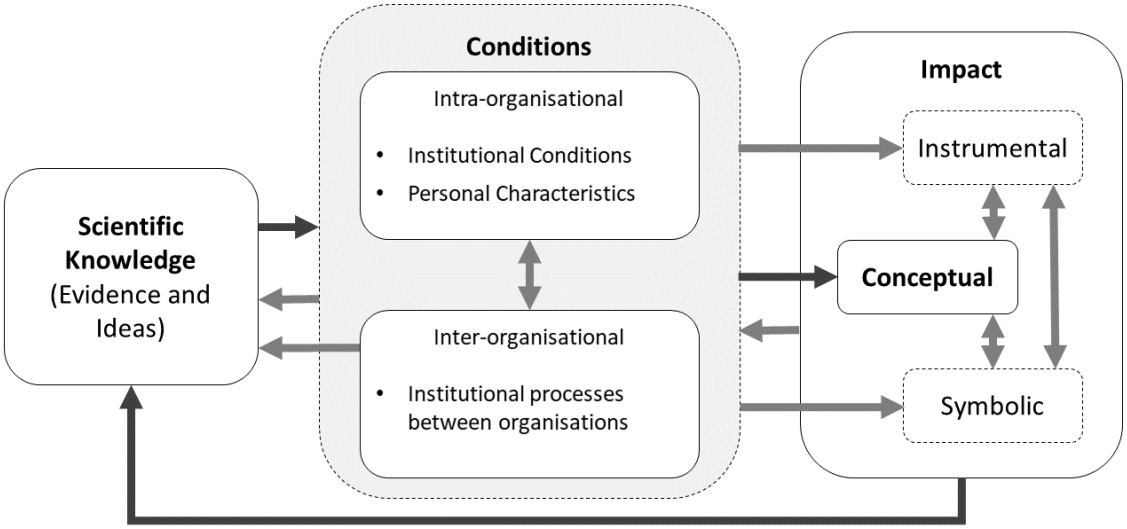
These conceptualisations pave the way for operationalising the process through which policy actors are influenced by ideas embedded in scientific research. For example, scientific knowledge may be carried by one or several institutional elements, e.g. by the regulative pillar requiring the use of evidence in policy-making and by the cognitive pillar in the case where policymakers have academic backgrounds and value science. In that case, the two institutional elements would reinforce each other and influence the policymaker's background ideational ability to interact with scientific research. Such situations generate favourable conditions for the conceptual impact of science. In the following, we return to our conceptual framework to demonstrate how it captures such dynamics in a systematic way.

# 4 Conceptual framework

## 4.1 The basic idea

In this section we propose and explain the conceptual framework of how institutional conditions in policy 'user' organisations influence conceptual dimensions of policy. The framework consists of three major components: the properties of scientific knowledge, the organisational and institutional conditions, and the various types of impact that can be generated. These components mutually influence one another (Figure 2). The framework is informed by the discursive institutionalist research that emphasises the role of ideas in policy-making (Section 3.1) and the organisational institutionalist research that theorises about various institutional elements that affect knowledge transfer, acquisition, and absorption (Section 3.2).

Figure 2: Institutional conditions influencing impact of scientific knowledge on policy - Expanded framework




Source: own compilation

Component one, scientific knowledge, encompasses both research results and underlying scientific ideas, either of which may find use in policy-making. Both the characteristics of scientific knowledge and the pathways through which it reaches policymakers influence its uptake. For example, non-codified knowledge transfer, e.g. via personal communication, was found to be more likely to influence policymakers conceptually (Molas-Gallart and Tang 2011). Other important characteristics of scientific knowledge are the type and reputation of the author and organisation that produced research (Olmos-Peñuela et al. 2014); whether there is contestation or consensus in the scien-

tific community (Shackley and Wynne 1996; Upham and Dendler 2015); and the social context surrounding the research process (Kessler and Glasgow 2011; Stirling 2007). In the following, we will leave these aspects largely outside of this paper's scope, in line with the focus on the user side conditions.

Component three, the impact of science, draws on the established typology that divides impacts of science into those affecting cognition (conceptual), those that aid decision making (instrumental) and those that are selected to support pre-existing opinions (symbolic) (Pelz 1978; in Astley and Zammuto 1992). Conceptual impact of science is most generally understood as the process that enlightens decision makers, sensitises them to issues, helps to identify policy problems (Weiss 1979). Some studies see conceptual impact only as a passive long-term process that indirectly promotes general enlightenment (Beyer 1997; Weible et al. 2010). However, conceptual impact also occurs if policymakers change the way they frame the issue, or their thinking about causalities and solutions pertaining to it (Estabrooks 1999). Although we focus on conceptual impact in this paper, we recognise the complex relationships between the different types. Even if conceptual impact takes place, it may or may not result in the instrumental use of science in policy action. Therefore, we do not focus the attention on the outcomes of policy-making processes, which are influenced by many factors beyond the ones considered in this paper (Hamlett and Cobb 2006; Oliver et al. 2014; Smith 2013a). Instead, we bring together the literature that theorises the conceptual influence of science on policy-making, regardless of the final policy outcomes.

The main contribution of this framework is the focus on the second component, the institutional conditions of policy ‘user’ organisations that influence the process through which scientific knowledge achieves impact on policy. We ascribe importance to both the conditions within policy organisations, termed ‘intra-organisational conditions’, and the broader conditions within the organisational fields they are embedded in, termed ‘inter-organisational conditions’. The latter are essential to understand the flow and co-development of scientific knowledge between organisations. The framework also recognises the characteristics of individuals as ‘thinking’ and sense-making agents capable of reflecting about new ideas and evidence. We assert that individual and institutional conditions influence the background ideational ability of scientific knowledge users to meaningfully interact with and be conceptually influenced by scientific research. The conditions thus determine the likelihood and the type of impact to occur, without the impact pathway being linear. On the next pages, we substantiate and further qualify the organisational components of the framework.

## 4.2 Intra-organisational conditions

*Intra-organisational* conditions encompass institutional structures and processes within policy user organisations. Elements, such as guidelines, values, management structures and practices of knowledge acquisition are important to understand the ways in which various types of scientific knowledge affect policies developed by the organisation. The meaning of these conditions can usefully be characterised along the three institutional elements as follows.

*Regulative* institutional conditions in our framework describe the formal instruction for the use of research in policy-making. They encompass formally defined research units and roles within the policy organisation; formally established research communication channels; accountability for the extent and type of research used in policy development; and the research resources available in the organisation. Setting up a formal instruction to use research (or evidence) reinforced by a monitoring and incentives system is a powerful push to change behaviour of policy organisations (Nutley et al. 2007). The capacity to support engagement with research by allocating resources, setting up infrastructure and creating dedicated staff roles is widely recognised as the foundational condition for effective use of science in policy (Makkar et al. 2016; Wu et al. 2017; Olmos-Peñuela et al. 2014).

Scientific research will be more likely to find use and generate impact on policy if the mechanisms for its use are clearly outlined (Armstrong et al. 2013). Organisations that formally define the roles and units responsible for research utilisation, such as in-house analytical units, knowledge brokers or the position of a Chief Scientific Adviser can work more effectively with research than the ones that do not have such formal set-ups (Topp et al. 2018; Belkhodja 2014). The use of scientific research is further supported if internal teams have access to relevant research repositories. Larger organisations often have repositories or libraries on site symbolising and supporting the importance of scientific research in policy-making (Uzochukwu et al. 2016). These structures and roles help decision makers navigate the abundance of information and opinions about policy issues (Dobrow et al. 2004). Formally established horizontal and vertical communication channels between research and non-research units also significantly influences the uptake of science (Makkar et al. 2016), especially in terms of having opportunities to advise senior policymakers.

Formal units, roles and communication structures can only be effective if they are recognised as needed and appropriate by staff, in other words, if they are acknowledged as necessary, appropriate and legitimate, highlighting the role of *normative* institutional conditions (Weiss et al. 2008). If policymakers at all levels of authority honour the for-

mal prescription for research use and value scientific research as a source of information for decision making, it is more likely for science to be used conceptually and not symbolically (van der Arend 2014). The alignment between the regulative and the normative institutional conditions influences the absorptive capacity of the organisation: its ability to seek out, recognise, import and meaningfully use relevant knowledge to achieve its mission or improve performance (Harvey et al. 2015; Harvey and Kitson 2015).

If policymakers are expected to stay up to date with research in their relevant area of work, or if research expertise yields additional informal authority, they are be more likely to make choices to consult scientific research during policy development, even if it might not be a part of their remit (Oliver et al. 2014). Policy organisations may further emphasise their valuing of science by incorporating commitment to research-informed policy-making in the mission or strategy statements, organising dedicated events (ibid.). In addition to valuing science, organisational culture that is receptive to new ideas and approaches is more likely to open up opportunities for multiple different types of research to generate impact (Hammami et al. 2013). Valuing diversity and exploration of new sources of knowledge as an organisational value (March 1991) is particularly important, because policymakers are known to be drawn to familiar sources of research (van der Arend 2014).

Networks and communities of practice organised around science and technology topics in the organisation facilitate the exchange of information between different functional units and different levels of authority. They serve an important legitimisation function: to recognise the value of research (Currie and Suhomlinova 2006), and also contribute to learning about effective ways to use scientific research that work in that particular organisational setting (Andereggen et al. 2013). Where the intra-organisational networks span the organisational boundaries, the individuals linking to the outside may accrue additional informal roles and become knowledge brokers (Bielak et al. 2008).

The last group of institutional factors is *cognitive*. Taken for granted institutional elements encompass assumptions, meanings attached to social action, symbols, identities, causal connections, and scripts. As Brownson and Jones (2009) have noted, the use of research is to a large extent habitual and is influenced by stereotypes and cultural norms of the decision makers, illustrating the importance of cognitive institutional conditions. They influence the extent to which different kinds of scientific research are likely to be considered seriously by the policymakers. They affect the ‘type’ of evidence science represents for the organisation, the causal ideas about the link between scientific research and good policy (Landry et al. 2003), and, more generally what good ‘science’ or ‘evidence’ is.

Further, policy organisations are established off the back of certain background ideas and rest on the foundations of those ideas. If scientific knowledge does not align with the dominant worldview of those organisations, the worldview can act as a filter for knowledge absorption (Boswell and Hampshire 2017; Rein et al. 1993). This concerns both the content of knowledge and the method used to produce it (which may be perceived as not robust or scientific). Similarly, the prevalence of a certain way of thinking and reasoning in the organisation (Hirschman and Berman 2014) limits the opportunities for science generated within other modes of reasoning to be taken seriously as credible source of evidence. Conversely, in organisations that are not underpinned by one particular public philosophy or dominated by one way of reasoning there are more opportunities for various kinds of knowledge to be impactful.

## 4.3 Inter-organisational conditions

*Inter-organisational conditions* are shaped through the relationship between organisations in the science and the policy domains. Policy organisations connect to other organisations, networks and institutions and in doing so become dependent on other actors during the process of knowledge production and transfer (March and Olsen 1995). This means that alignment between different organisations and the extent to which various institutional logics dominate science-policy links influence the processes through which individual policy organisations handle scientific research. Inter-organisational interactions can match and validate the policy organisation's structures and processes as legal, appropriate or true, or, on the contrary, highlight contradictory institutional arrangements (Seo and Creed 2002).

Much of the literature about science-policy interfaces emphasises the differences in the institutional time frames and cycles of the two domains that create obstacles for meaningful and timely translation of scientific research into policy (Innvaer et al. 2002). Barriers, such as long time scales for research and short-term evidence demands of the policymakers (Brownson et al. 2006; Sarkki 2017), or the abstract nature of scientific research compared to specific, focused demands of policy-relevant evidence (Avey and Desch 2014) are mentioned frequently to emphasise the differences.

The *regulative* aspect of these inter-organisational barriers concerns formal institutional structures for the production and evaluation of knowledge in the two domains, and the formal channels and tools for knowledge transfer between science and policy. For example, formal evaluation mechanisms in academia reward certain types and formats of research. As a result, academic papers are written in a highly specialist language and are published in high impact factor journals, mostly behind the paywall (Weichselgartner and Kasperson 2010). These are not the outputs needed in policy,

and there is a widespread consensus that such academic research has to be further transformed into policy-relevant knowledge.

There are various ways in which research and policy spheres are steered towards closer interaction in order to generate incentives, conditions and opportunities for scientific knowledge to be transferred into policy and used in decision making as research evidence. To facilitate knowledge transfer, instruments ranging from guidelines and dedicated funding tools to intermediary organisations and other types of infrastructure have been tested out in various empirical settings (Bremer and Meisch 2017; Knight and Lyall 2013; Spoth et al. 2013). Mission-oriented projects are one example of regulative steering of scientific research to generate policy-relevant results (Weber and Rohracher 2012).

*Normative* institutional elements concern the norms that influence the informal authority of scientific knowledge, the processes and objects that make it credible for the policymakers and the mechanisms through which this credibility is achieved. Social authority of science is underpinned by the societal expectations and beliefs about the importance of research (Lavis et al. 2004). Van Est (2019) argues that science is not a neutral mechanism that provides truths about the world, but a worldview and a set of values. The authority of science influences the strength of science-based arguments in the political debate, and also the possibility for key scientists to lead the knowledge transfer process, e.g. by speaking directly with elite policymakers (Weiss 1982).

'Usable knowledge' – scientific knowledge that can be used in policy without further translation - is a boundary object shaped by the reflections and expectations of both scientists and policymakers about each other's work. What is regarded as usable knowledge varies across research fields, policy areas, national and sometimes regional contexts. This reflects different processes of negotiation and expectations management between the scientists and policymakers (Wall et al. 2017; Stilgoe et al. 2013). For example, scholars using the framework of knowledge translation especially in the area of health care, argue that systematic reviews rather than individual studies constitute usable knowledge, because they aggregate results from many standardised empirical studies and hence have high external validity (Glasgow and Emmons 2007; Green and Glasgow 2006; Grimshaw et al. 2012). Health policymakers are in turn more aware of systematic reviews than policymakers in other areas (Bedard and Ouimet 2017). However, in areas such as global disease research systematic reviews are not always helpful and are sometimes harmful due to the diverse nature of findings coming from different disciplines that use different methods (Leach and Scoones 2013).

*Cognitive* inter-organisational conditions reflect the importance of the paradigmatic compatibility of background ideas in science-producing and policy-making organisations and the extent of their discursive alignment for successful impact process. This type of condition is much more recognised by the ideational scholars. On the deeper level of political ideation, predominant public philosophies in science and policy organisations determine the way issues are framed, arguments are built and solutions are selected. If the paradigm in which scientific research is produced significantly differs from the public philosophy that dominates the public policy sphere, it is likely that policy officials will simply be unable to use it due to the amount of modification to other existing policy instruments that would require. Such research may not be perceived as valid, or legitimate. In contrast, research produced within the shared public philosophy will be more likely to be useful because it does not challenge policymakers' established ways of thinking about issues (Stevens 2007; McCright and Dunlap 2010). These are the arguments made by Schmidt (2016) to explain the persistence of neoliberal policies in the UK and by Lindvall (2009) to explain the different rates at which Austria, Sweden and Denmark abandoned Keynesian economic policies after the 1970s oil crisis.

Cognitive institutional conditions also include taken for granted elements that evolve into knowledge translation scripts over time (Kuruvilla et al. 2006). Policymakers are more likely to seriously consider the knowledge that is written in a familiar language (Upham and Dendler 2015), presented in a familiar format (e.g. as a policy brief) through a familiar, expected channel (e.g. via news media or a dedicated app). These cognitive differences between what the policymakers are comfortable with and what researchers are able to provide are cited as one of the key barriers to impact (Weichselgartner and Kasperson 2010).

## 4.4 Individuals in organisations

In describing inter- and intra-organisational conditions influencing scientific knowledge impact in the policy-making space, we stress that ideas, strategies and characteristics of individual policymakers[3] are as important to achieve conceptual impact as the organisational conditions. From the discursive institutionalist standpoint, individual reflection and the subsequent collective deliberation are the two key components of policy change. Individual characteristics are therefore the key component in conceptual impact generation. Below, we provide an overview of policymakers' individual characteris-

3 Obviously, the characteristics and attitudes of individual scientists are also important in generating impactful research, for reference see D'Este et al. (2018). In this paper, we deliberately focus on the individuals in policy-making organisations.

tics in two parts: by first reviewing the studies that write about individuals in organisations and then the studies that write about 'science champions'.

The research utilization literature has surveyed individuals in their organisational context by examining, first, their formally defined functional responsibilities and, second, their skills in accessing and understanding research acquired through previous work and training. Generally, the findings indicate that background characteristics, attitudes and strategies of public servants and government officials working on lower functional levels of policy are significant predictors of the type and the scale of organisational research use (Amara et al. 2004; Landry et al. 2007; Landry et al. 2003; van der Arend 2014).

Policy officials with dedicated research-related responsibilities increase exposure of their colleagues to science, which in turn results in greater overall use of research (Belkhodja 2014), and their colleagues with advanced degrees or work experience in research are much more likely to be conceptually influenced by science (Amara et al., 2004). Overall, policymakers who recognise scientific research as the importance source of evidence tend to draw on it more in their everyday work practice (Jbilou et al. 2007).

A separate and somewhat exceptional body of literature theorises the role of scientists who 'championed' science-informed reasoning in addressing complex high-level or controversial issues. Examples frequently found in the literature concern, for example, vaccination (Lynch and Cole 2005), drug policy (Humphreys and Piot 2012), and disaster mitigation (Craig 2018). The studies typically report the involvement of high-level scientists who engage their expertise to argue for a certain policy action – sometimes unsuccessfully – and analyse the reasons of the policy outcome. Credible, competent and famous scientists who bravely speak truth to the highest levels of power are often discussed in these contributions as an effective channel of delivering science to policy. Roger Pielke's (2007) four idealised roles scientists can play in policy has become one of the most popular heuristics used to normatively understand how these science champions should act[4].

4 Pielke's roles are idealised and can be performed by individuals or organisations. In the book, he mostly gives examples of individual scientists playing the roles.

## 4.5 Summary and operationalisation

We have outlined the components of the framework and the various types of conditions that influence the likelihood of scientific knowledge influencing policy-making conceptually. The joint analysis of multiple relevant strands of literature substantiates and further clarifies the nature and types of conditions, highlights complementarities and overlaps in thinking about the relationship between science and policy from these different subject areas.

Taken together with the considerations about particular characteristics of the policy area and the specific national and broader societal contexts, the framework presented above can be operationalised for empirical analysis. Table 2 offers an option for operationalisation of the intra- and inter-organisational conditions in the order they were introduced in Sections 4.2 and 4.3.

With respect to the operationalisation of the individual characteristics, most studies reviewed in Section 4.4 use research utilization surveys. If the research is conducted with the policy organisation's consent, accessing data about staff involved in policy-making will be valuable. Methodologically, this task is more straightforward than operationalising the analysis of institutional conditions. However, individual characteristics are not typically considered alongside the institutional conditions in empirical analyses.

We suggest a case study methodology to employ the framework in empirical settings, although other types of research designs can work well for studies focusing on one type of institutional condition. For example, secondary data, surveys and interviews will be less effective in examining cognitive institutional conditions, which may be implicit in organisations. Understanding these conditions would require either embedded, extensive participant observation, or collecting data in settings, such as knowledge co-production, where underlying assumptions about science and policy become apparent via science-policy interactions.

Table 2: Operationalisation of the institutional conditions for the impact of scientific knowledge on policy-making

| | Intra-organisational conditions | Inter-organisational conditions |
|---|---|---|
| **Regulative** | Examine prescriptions to use research in policy-making; examine formally defined research units and roles (organisation's policies and protocols)<br>Examine formally established and endorsed channels for communication with scientific knowledge suppliers (formal policies, interviews)<br>Examine research resources and infrastructure (offline and online set-up to engage with scientific research, budget for research-related activities ) | Examine the organisation's scope, infrastructure and resources of formal science-policy knowledge transfer (organisation's policies and protocols)<br>Are there intermediary organisations on science-policy interfaces? What are their functional roles? (desk research)<br>What is the public steering of science-policy linkages? Are any incentives offered? (national and regional policy documents) |
| **Normative** | Do employees honour formal prescriptions to engage with research? Does this contribute to informal authority in the organisation? (surveys, policymaker and analyst interviews)<br>Does the organisation commit to valuing research? (mission and strategy documents, interviews)<br>Is the organisational culture welcoming of new conceptual ideas? (survey)<br>How is science-related information exchange organised in networks between different units and levels of authority? (interviews, observation) | What is the social authority of science in the policy area and in the national/regional context? Is there agreement about what constitutes 'usable knowledge' for policy (interviews or surveys with scientists and policymakers)<br>Examine networks and/or communities of practice that span research and policy organisations (secondary data, interviews/surveys) |
| **Cognitive** | What are the taken-for-granted ideas about good evidence, good science and how science is useful for policy? Is there a dominant worldview? (interviews, naturalistic materials, any texts produced by the organisation)<br>Examine the habits, scripts and routines of research use (participation in co-creation, observation) | Is the policy organisation's work underpinned by a particular public philosophy? (interviews within the organisation, observation)<br>What is the range of public philosophies in the policy area? Are the background ideas in the science domain compatible? (naturalistic materials, interviews with policymakers and scientists, participation in co-creation) |

Source: own compilation

# 5 Contributions and implications

In this paper we developed and operationalised a framework that fills a gap in the literature on the impact of science policy-making. It is not a framework for replacing the existing literature on science-policy interfaces, research utilization, impact assessment, policy development and evidence-based policy. However, we believe that our framework allows us to enrich those existing perspectives. It enables what Sarewitz and Pielke (2007) called a proper "demand-side assessment" (p.12): an analysis of the conditions and behaviours on the side of scientific research ‘users’. The novelty of the framework, we believe, is in preparing the micro-foundations for understanding mechanisms and conditions of the use of scientific evidence through a multi-dimensional and inter-linked conceptualisation of the user conditions.

So far, we see a strong emphasis towards, first, the shortcomings of the science system, and the individual scientist, to deliver policy impact and second, towards approaches that explain the use of science in a power- and interest driven perspective as one among many assets to be used by rational actors. The debates within the different streams of literature focus on a limited number of key issues with respect to the science-policy relationship, most importantly, the ones that prioritise the uses of science and the ones that stress the limits of observability and propose focusing on processes, interactions and networks. We identified and operationalised organisational conditions on the side of the policy user as the missing link at the intersection of these studies, and developed the framework to offer a systematic perspective.

If we accept that the way policy makers interpret the world and define solutions is one critical dimension in the process of policy-making, we also must accept the importance of the ideational dimension. Reflexive institutionalism as a theoretical lens allows us to make sense of the way in which ideas exert influence. It helps us to understand when and how scientific ideas and evidence influence perceptions of the nature of problems and possible solutions, i.e. when conceptual impact occurs. Following from that is a recognition that the discourse by which scientific ideas and evidence are transferred and the conditions by which they are processed are critical to the impact of science on policy. The framework combines a discursive institutionalist understanding of the nature and mechanisms of ideational dynamics in policy-making with the organisational institutionalist approaches to capture absorptive conditions within and between organisations. We stress that these two, combined with the individual characteristics of reflexive individual policymakers, are the elements required to understand the nature and extent of conceptual impact.

To our knowledge, this basic perspective, and the finely grained differentiation of the ideational and institutional dimensions we present, is the first attempt to bring *conceptual* impact of science on policy to centre stage. Jointly with others in the field (McNie et al. 2016; Matt et al. 2017), we argue that the impact of science on policy is a multi-stakeholder process and the shortcomings as to how science impacts policy-making cannot be properly explained, and overcome if we continue to blame the scientists or political power games. Focusing on policy-making organisations is a useful setting to explain how institutional conditions co-determine the demand for, co-production and use of scientific knowledge, and thus its impact. This, in the end, will allow us to better understand the actual translation of scientific ideas and evidence into policy outcomes - and thus instrumental impact of scientific knowledge - much better as well (Weiss et al. 2008).

From these contributions, we derive three implications for future research, relating (1) to the inter-dependent nature of the institutional dimensions of the framework, (2) to the need for existing research approaches to acknowledge and confront the gaps in their understanding of the processes of use and impact of science, and (3) to the importance of ideational alignment to accomplish complex policy missions.

Firstly, the framework enables us to recognise the *inter-dependencies* of institutional dimensions. For example, the ability and readiness to understand the nature of scientific knowledge, to interpret its outcome and to assign credibility does not depend on "rigorous" scientific approaches and appropriate dissemination activities only. Rather it also, maybe mostly, depends on the *interplay* of appropriate regulative, cognitive and normative conditions within policy-making organisations and between policy and scientific organisations. The extent of conceptual impact will be limited no matter how strong the scientific evidence and how clearly it is communicated if some of the institutional conditions for impact are not in place. For example, a lack of material resources - such as access to scientific publications or time to seek out research – could inhibit policy-makers' critical engagement with scientific knowledge even if there are strong normative claims to use scientific knowledge in policy. Equally, formal internal resources and incentives to use scientific knowledge only materialise in sense-making and lesson-drawing if certain cognitive and normative conditions are met.

Second, this further means that existing approaches in the literature discussed in this paper must be confronted with their institutional gaps and complemented with an ideational neo-institutionalist perspective. We criticise functional approaches a lot in this paper. They take scientific ideas and evidence as one variable that rational policy-makers and politicians use in intra-organisational and political negotiations. The functional logic also underpins a significant number of science assessment and funding

frameworks in a considerable number of countries (Stampfer 2019). In believing that high quality, robust and relevant evidence will be used by rational (unbiased) policy-makers, and that use will be demonstrable and attributable, these approaches have severe limitations. Interaction-based approaches, which start by acknowledging the various differences and gaps between the policy-making and science producing worlds, fall short of systematically acknowledging how the three institutional dimension interfere with the ability to build meaningful bridges.

The final implication of the framework we discuss here is that it can be used to address research questions that are increasingly pertinent. This brings us back to a key initial observation made in the introduction. The current calls for mission orientation across the OECD implies that science, technology and innovation policy can support the solution of societal problems. However, if societal missions are to be accomplished, it is increasingly recognised, that this can only be meaningful if different areas of policy (transport, energy, health etc.) are strongly aligned. This implies that they have compatible problem framings and are able to develop policies that are underpinned by evidence that can be understood and shared by diverse organisational actors. This is not simply a question of traditional policy coordination. It is, in a very fundamental sense, a question of ideational alignment and co-evolution.

To define a mission that spans multiple policy areas, such as "plastic free oceans", "carbon free cities", or "automated driving" necessarily needs sound scientific underpinning. Applying our framework, it means a "coordinative discourse" for policy-making that takes into consideration the pre-existing historically path-dependent ideational backgrounds of diverse ministries and agencies. Their ideational alignment that enables science to have an impact on the overall mission needs careful consideration. Certain bodies of evidence or even basic scientific ideas for a mission might be in line with that background of one key ministry, while entirely conflicting with another one. Similarly, the acceptance of scientific evidence as a driver for the definition of policy interventions and assessment of policy success, and the readiness to make sense of this evidence, will differ as organisational conditions differ.

To be conscious of the critical dimensions within and between organisations when it comes to mobilise science for missions is therefore imperative, from the framing of the mission down to the identification of problems and imaginations about the solution space. Inter-organisational conflicts in the pursuit of missions may much less be a result of traditional power games. Rather, it may be the result of severe challenges in the ideational alignment of those organisations, who do not recognise why scientific evidence and ideas cannot help them. To accomplish complex missions will not work without scientific support. Policy organisations must inspect their own conditions for the

uptake of scientific ideas and evidence and examine the differences if they want science to play its necessary role effectively. For those academics who seek to understand the impact of science on policy, on mission policy even, it means to open up for ideational approaches.

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