RESEARCH ARTICLE

Managing ideational complexity in public policies: the case of public research funding

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Abstract

This article examines how ideational complexity, i.e. the lasting presence of alternative policy frames in a policy domain, can be managed without leading to overt conflicts. By leveraging insights from the organisational literature, we suggest that, in most cases, alternative frames are kept apart within distinct policy instruments, while hybrid instruments are established only when required by the nature of the problem. We provide illustrative examples of how these strategies are employed in the case of public grant schemes for research funding. Our findings suggest that a) composite instrument mixes are an important resource to deal with ideational complexity, and b) the design of the instruments' delivery package, and specifically its procedural and organisational dimensions, plays a central role in avoiding conflicts between policy frames. Accordingly, our analysis advances the unexplored issue of how the coexistence of alternative policy frames impacts policy implementation.

Introduction

The policy design literature emphasises the importance of public policies being based on a coherent set of norms and goals, so that policy interventions are designed based on their efficiency to achieve unambiguous goals (Capano and Lippi 2017) and convey coherent signals to the treated subjects (Howlett 2019).

However, this is more the exception than the rule, as most policy domains are characterised by the lasting presence of competing policy paradigms or frames (Hall and Taylor 1996; Surel 2000; Capano and Howlett 2020). Such *ideational complexity* has been related not only to historical processes of layering (Kern and Howlett 2009; Rayner et al. 2017) but also to the position of policy domains at the crossroads between societal spheres characterised by different institutional logics, such as the state, the economy, and science (Friedland and Alford 1991).

Ideational complexity can have problematic implications for policy implementation. Actors are confronted with different cognitive and normative requirements concerning the goals and principles of policy interventions (LÊgreid 2017; Polzer et al. 2016) and with diverging p concerning the policy instruments to be adopted (Boin and Christensen 2008). Ideational complexity is therefore likely to generate identity problems in civil servants (Noordegraaf 2007; Meyer et al. 2014), lead to inconsistent instrument mixes (Capano et al, 2020), and confront public organisations with contradictory policy interventions (Christensen and Lægreid 2011).

Therefore, the puzzle this article addresses is how public policies can be designed and implemented in a stable way, in a domain characterised by the (lasting) presence of alternative policy frames, which would be expected to translate into instability, conflict, and ineffective implementation.

To this aim, we draw on the literature on organisational hybridity (Skelcher and Smith 2015; van Gestel et al. 2020), which highlights different strategies through which organisations deal with the presence of alternative institutional logics (Smith and Besharov 2019; Lepori and Montauti 2020). That literature suggested that organisations manage conflicts by negotiating compromises around individual practices (McPherson and Sauder 2013), respectively, by adopting procedural or organisational tools to keep logics apart (Smets et al. 2015).

Accordingly, we suggest two approaches to deal with ideational complexity in public policies a) through the adoption of substantive hybrid instruments which embed alternative policy frames (*compromising*) or b) by adopting procedural or organisational instruments (Howlett 2019) to keep policy frames apart, either by *segregating frames* within distinct implementation agencies (Lægreid et al. 2008) or by *segmenting frames* in distinct processes within the same agency. These strategies exploit the complex nature of instrument mixes, which frequently consist of composite sets of ideas and instruments generated by historical processes of layering (Kern and Howlett 2009; Rayner et al. 2017), as well as the multidimensional nature of the instruments' delivery package (Salamon 2002).

In this article, we provide a cross-country illustration of the adoption of these approaches in science policy, specifically in the selection and management of instruments through which the state funds research projects and programmes.

This policy domain is characterised by the lasting presence of competing policy frames (Elzinga 2012) and by a differentiated policy mix (Flanagan et al. 2011; Kern et al. 2019), in which policies are implemented through a complex and multilevel administrative structure (Lepori 2011; Del Rio and Howlett 2013), including ministries, delegated agencies, and research funding organisations (RFOs) (Lepori and Reale 2019). It is, therefore, a suitable setting to investigate the strategies adopted to manage ideational complexity.

We therefore ask:

1. What approaches can be identified in dealing with ideational complexity in the science-policy field?
2. Can we speculate on the advantages and disadvantages of different approaches for policy implementation (Cornforth 2020)?
3. In which circumstances are these employed?

4. Is this choice associated with specific national contexts or with the characteristics of the task?

To address these questions, we first characterise the instrument mix adopted in science policy in a set of European countries in terms of the policy frames they embed, specifically distinguishing between "pure" and "hybrid" substantive policy instruments. Second, we examine whether policy instruments embedding alternative frames have been segmented within or segregated between different agencies. Third, based on this analysis, we characterise how ideational complexity was managed as related to the policy domain's characteristics and national politico-administrative traditions (Painter and Peters 2010; Bleiklie and Michelsen 2013).

Our article contributes to the literature on policy mixes by advancing the understanding of how policymakers manage the presence of competing policy frames through instrument mixes (Howlett 2004; Capano and Howlett 2020) and, specifically, by adopting procedural and organisational tools such as delegation to autonomous agencies (Del Rio and Howlett 2013). Our findings suggest that a) composite instrument mixes are an important resource to deal with ideational complexity, and b) the design of the instruments' delivery package, specifically its procedural and organisational dimensions, plays a central role in avoiding conflicts between policy frames (Salamon 2002).

Theoretical framework
Policy mixes and policy frames
The analysis of public policies highlighted the importance of the instrumental dimension, i.e. the set of tools or techniques for implementing public policies Vedung et al. 1998). Instruments are the places where "things get done" (Salamon 2002), and therefore their analysis is key to understanding policies in practice and their outcomes (Capano and Howlett 2020). In that respect, policy instruments are not simply tools adopted by governments but are institutions in themselves and "carriers" of policy ideas (Lascoumes and Le Galès 2007). Policy instruments comprise multidimensional *delivery packages* (Salamon 2002), including substantive and procedural dimensions (Howlett 2019), such as the type of activity, the way of delivery, and the organisational and procedural setting of delivery.

The literature long abandoned the idea that sets of instruments are consistent (Bressers and O'Toole 2005) and highlighted the composite nature of instrument mixes (Howlett 2004), which reflect different policy beliefs and which developed incrementally over time (Salamon 2002; Kern et al. 2019).

Policy mixes are not only composed of sets of instruments but also involve "ideological or even 'aesthetic' preferences in tool choices and goal articulation" (Howlett and Del Rio 2015), as well as trade-offs and negotiations between actors. Mixes are the outcome of horizontal (between instruments, policies, or governments) and vertical interactions (between levels of instruments, policies, or government).

Policy ideas are core in how actors design policy interventions since they incorporate concepts or theories about how the world should work, how policy problems should be addressed, and how instruments affect behaviour (Braun and Capano

2010). In this respect, selecting policy tools is particularly complex when multiple goals and policies are involved within the same sector and government (Howlett and Del Rio 2015). Yet, the role of policy ideas in the selection and mix of instruments remains poorly understood (Capano and Howlett 2020).

A useful notion representing the ideational dimension is that of *policy frames.* They represent coherent cognitive and normative models for policy design that incorporate basic paradigms (Hall and Taylor 1996), mechanisms of identity formation, principles of actions, prescriptions, and practices (Surel 2000).

Policy frames include principles and goals for designing policies, governance models such as "steering at a distance" (Capano 2011), and preferences for instruments to be adopted (Vedung et al. 1998). Policy frames include general principles for the whole of state intervention but also domain-specific and context-specific norms and values, such as professional governance in higher education and science policy (Capano 2011; Elzinga 2012). They also include "administrative paradigms" of how public intervention should be organised, such as New Public Management (Ferlie et al. 1996).

The literature moved beyond a model of policy change as the paradigmatic shift from one frame to another (Hall and Taylor 1996). While there are indeed common trends, such as the diffusion of managerial templates (Ferlie et al. 1996), variation across countries and layering have been observed where new policy ideas still coexist with older ones (Polzer et al. 2016; Kern et al. 2019).

In policy domains such as healthcare, higher education, and research, ideational complexity is structural because of their position at the crossroads between societal fields, such as the state, the economy, and the science system, each with its own ideas and values (Friedland and Alford 1991). The presence of different actors, policy actors, epistemic communities, and stakeholders, and the uncertainty about the causal linkages between policy actions and outcomes contribute to endorsing different policy frames.

Ideational complexity and instrument mixes

Ideational complexity has far-reaching consequences for policy implementation because it involves "conflicting frameworks that struggle for dominance" (Braun and Capano 2010, 18).

In the presence of ideational complexity, policy actors are confronted with conflicts about goals and norms, generating struggles in selecting policy instruments and how instruments should be implemented in practice. Further, uncertainty about the norms and goals underpinning policy interventions might favour non-compliance or avoidance strategies by targets of policies (Oliver 1991), thereby jeopardising expected policy outcomes.

To advance our understanding of how policy actors might deal with ideational complexity and its adverse consequences for policy implementation, we borrow insights from the literature on how organisations manage institutional complexity, i.e. the simultaneous presence of alternative institutional logics in organisational fields (Greenwood et al. 2011). That literature has shown that, in some instances, complexity led to intractable conflicts destroying the organisation (Tracey et al. 2011), while other organisations were able to manage it (Smets et al. 2015).

Table 1. Approaches to deal with ideational complexity

Approach	Variants	Advantages	Disadvantages
Compromising. Combining policy frames in the substantive dimension of policy instruments		Achieving alternative frames' goals at the same time	Risk of conflicts in the instruments' design and implementation
Keeping frames apart through procedural and organisational dimension of the delivery package	Segregation of frames within distinct agencies	No conflicts; agencies have a clear identity and focus on their core mission	Coordination between agencies might become difficult
	Segmentation of frames within distinct processes or branches	Policy frames do not conflict directly at the instrument level	Agencies' identity might be endangered

Further, organisational structures and procedures played a central role in conflict avoidance (Lepori and Montauti 2020). This suggests that the way policy frames are put into relationships in policy implementation matters when it comes to whether ideational complexity will be a problem or a resource.

Specifically, building on the typology of strategies to manage organisational hybridity developed by Skelcher and Smith (2015), we suggest two approaches to deal with ideational complexity in public policies (Table 1). We also suggest that each approach has different pre-conditions, as well as advantages and risks (Cornforth 2020).

(a) The first approach, labelled as *compromising*, implies combining alternative policy frames directly within the *substantive dimension* of the policy instruments' delivery package (Christiansen and Lounsbury 2013; Polzer et al. 2016), such as setting up an incentive scheme that aims to achieve at the same time market efficiency and social sustainability.

   Compromising might allow achieving different goals simultaneously and developing innovative solutions by combining frames (Smets et al. 2015). However, it requires potentially conflicting work to search for compromises (McPherson and Sauder 2013) and might lead to ambiguous policy interventions not providing clear signals to the treated subjects.

(b) The second approach foresees *keeping alternative frames apart* by leveraging the procedural and/or organisational dimensions of policy instruments (Howlett 2019) to manage separately (substantive) policy instruments embedding alternative frames so that the jurisdictions of each frame are distinguished and, accordingly, conflicts are avoided (Smith and Besharov 2019).

   This approach, therefore, exploits the fact that, in most countries and policy domains, the instrument mix is managed through a differentiated set of administrative and organisational structures such as governmental units, delegated agencies, and public organisations involved in the delivery of services (Verhoest et al. 2009; Howlett and Del Rio 2015).

   More specifically, we define *segmentation* as delivering instruments associated with different policy frames within the same implementation agency but through different processes or branches. S*egregation*, on the other hand,

is establishing distinct agencies for delivering instruments associated with alternative frames (Skelcher and Smith 2015).

Segmentation avoids direct confrontation between frames; however, when frames are incompatible, it might generate identity issues in the managing agency (Cornforth 2020), such as whether an agency is delegated from the state or controlled by professionals (Gulbrandsen 2005). Conversely, segregation allows agencies to focus on their core tasks but entails coordination costs associated with the proliferation of agencies obeying different policy frames (Braun 2008).

The former discussion suggests that the procedural and organisational dimension of the policy instruments' delivery package, which has received less attention in the policy mix literature as compared with substantive content (Capano and Howlett 2020), plays a central role in managing ideational complexity. Yet, the public administration literature also shows that there is variation between countries in how the government is organised (Painter and Peters 2010; Bleiklie and Michelsen 2013) – regarding the set-up of delegated agencies (Verhoest et al. 2009) and the balance between horizontal and vertical coordination (Christensen and Lægreid 2007). Such differences in administrative traditions are also expected to generate variation in how ideational complexity is managed across countries.

Science policy and research funding instruments

Our focal domain, i.e. science policy, deals with the steering, coordination, and financial support to research, mainly in the public sector (Braun 2003). While sharing ideas and instruments with higher education policy (Capano 2011), it has emerged since the Second World War as an autonomous policy domain, characterised by specific goals, processes, and instruments (Larédo and Mustar 2001).

The literature consistently depicted science policy as situated at the crossroads between the state and the scientific community (Guston 2000) and characterised by a balance between control from the state and the wish of scholars to protect their autonomy (Braun 2003). Since the 1970s, science policy is also increasingly aimed at addressing societal needs through scientific discoveries and contributing to economic growth (Geuna et al. 2003). While shifts over time in the rationales for state support can be observed, these rationales largely coexist in today's science policy generating ideational complexity (Elzinga 2012).

More specifically, the literature suggested three broad frames in the science-policy domain (Aleman-Diaz 2023). We label the first as a *curiosity frame*, which is characterised by freedom of science, self-government of the scholarly community, and the delegation from the state (Stephan 2013). The second policy frame is labelled as a *mission frame*, which assumes the professionalisation of policy and the state setting goals and priorities for R&D funding that are translated into policy instruments (Elzinga 2012). This frame emphasises the contribution to economic wealth and addressing societal problems, as well as the users' participation in the implementation of the policy instruments (Mazzucato 2018). The third frame is a *market frame*, where science policy should primarily achieve economic innovation

and growth, fostering competition, public–private collaboration, and the creation of quasi-markets (Geuna et al. 2003).

In terms of substantive policy instruments, science policy is primarily implemented through incentive or capacity instruments (Vedung et al. 1998) that distribute public funding to orient research towards policy goals (Braun 2003). The mix of funding instruments has become increasingly differentiated (Flanagan et al. 2011), as an outcome of layering processes (Aagaard 2017) but also of emerging societal demands for mission-oriented research (Simon et al. 2019).

In our analysis, we focus on a subset of instruments, i.e. grant schemes supporting projects implemented by researchers or research groups, that the literature labelled as "project funding" (Lepori et al. 2007). These instruments cover between one-quarter and one-half of the science budget in European countries (Lepori et al. 2018). Grants are awarded through an open procedure involving a call for proposals, submission, evaluation, and funding of the best-ranked proposals. Within this framework, there is variation in the policy goals behind the programmes, the composition of the selection committees, and the evaluation criteria (Cocos and Lepori 2020).

Specific organisational tools have been established to deliver these instruments, select beneficiaries, and administer subsidies, which we generically label as RFO (Lepori and Reale 2019), either in the form of departmental units within the public administration or, frequently, as semi-autonomous agencies (Verhoest et al. 2009). This administrative structure is expected to allow for different strategies to deal with ideational complexity.

Data and methods

Our empirical strategy builds on the idea that policy frames can be best observed as embedded within policy instruments on two grounds: first, looking at instruments reveals how policy frames come into play in the actual policy implementation; second, instruments allow for a fine-grained analysis of the practices in which frames are embedded, avoiding the "risk of staying in a 'night in which all cows are black'" (Capano and Pritoni 2019, 15).

Data and sample

Data derive from a study of public research funding supported by the European Commission (PREF), which has analysed public investment in research in Europe (Lepori et al. 2018). The study perimeter included all instruments intended to fund research and development in the countries covered and therefore is representative of the instrument mix in this domain (Flanagan et al. 2011). Examples include baseline funding for universities (Jongbloed and Lepori 2015), as well as project funding from research councils and innovation agencies (Lepori and Reale 2019). For this study, we focused on project funding, while we discarded instruments providing funding to whole research organisations, as their setting is very different.

The study involved characterisation of policy instruments through descriptors such as the policy intention behind the instrument, the delivery mode, the intended

policy target, and the composition of the evaluation committee. Moreover, instruments were associated with organisational tools, i.e. the RFOs managing them, which were characterised in terms of identity, organisational structure, and position within the policy domain. An important characteristic of these instruments is that they publish a call document providing potential bidders extensive information on the underlying policy goals, the organisational setting, and the evaluation and award procedure; this information allows for a fine-grained characterisation of the instruments' delivery package.

The selection and categorisation of instruments were made by national experts, relying on a common codebook, and then cross-checked for consistency by the project team. Finally, data on the yearly amount of funding were collected as indicators of the relevance of instruments in policy implementation.

In the analysis, we focused on a sample of eight countries to provide enough variability in some core characteristics of public policies: first, the country's welfare and political regime (Esping-Andersen 1990), as it has been shown to profoundly influence the way marketisation has been introduced in science policy (Bégin-Caouette et al. 2016; Schulze-Cleven and Olson 2017); second, the country politico-administrative tradition (Pollitt and Bouckaert 2017) as it affects the organisational infrastructure available to implement policies (Bleiklie and Michelsen 2013). Specifically, our sample includes one country in the liberal regime and the Anglo-American tradition (the UK), two countries in the Social-Democratic regime and Scandinavian tradition (Norway and Sweden), and countries in the two administrative traditions of the conservative regime, i.e. Napoleonic (France and Italy) and Germanic (Austria, The Netherlands, and Switzerland).

While the article focuses on identifying general strategies to deal with ideational complexity rather than on a systematic comparison between countries, we mobilise this classification case by case when observing country-specific deviations from the general patterns.

Given the goal of the article, we adopted a cross-sectional design using data for the years 2013–2015 (depending on the country) while mobilising longitudinal information from documentary sources to interpret the results.

The final database included 97 funding instruments and 42 RFOs.

Characterising policy instruments

To identify the frames embedded in policy instruments and characterise their organisational context, we focused on three dimensions suggested by the literature (Flanagan et al. 2011; Cocos and Lepori 2020).

(a) First, the *policy goal*, as stated in the decision to establish the instrument. The literature suggested a three-fold categorisation: (1) promoting the general advancement of knowledge through the production of scholarly outputs; (2) addressing policy problems within a specific domain; and (3) promoting economic innovation and development (Lepori et al. 2007). The categorisation was performed through an analysis of the sections of the call document describing the policy goals of the instrument. The category "mixed" was used when statements related to more than one goal could be identified.

(b) Second, the *type of RFO* managing the instrument since the organisational context and the RFO identity is expected to matter in how the instrument is implemented and how frames are enacted in practice (Pache and Santos 2013). By relying on the literature (Braun 1998; Lepori and Reale 2019), we distinguished between (1) research councils essentially managed by the scientific community and oriented towards academic science, (2) innovation agencies funding applied research, as well as economic ministries, (3) mission-oriented agencies oriented to funding research on specific topics, (4) governmental entities within the public administration, and (5) other agencies (without a clear characterisation in terms of their mandate).

(c) Third, the *composition of the decision-making committee* since the literature demonstrated that groups of actors, such as professionals and civil servants, tend to be identified with alternative frames (Pache and Santos 2013; Noordegraaf 2016). Referring to the main professional groups involved in science policy, we distinguish between committees mostly composed (1) of academics; (2) of experts from the economy and civil society; and (3) of policymakers and civil servants. The category "mixed" was used if no group was prevalent.

Analysis

As a first step, we have coded the instruments in our dataset using this set of indicators. To this aim, the original characterisation made within PREF was independently checked by the authors and cases of disagreement were discussed collectively to ensure consistency.

As a second step, we have grouped the instruments displaying similar combinations of characteristics (Schneider and Wagemann 2012). Most frequent combinations were identified and interpreted in terms of the underlying policy frame as suggested by the science-policy literature. This inductive approach avoids a priori assumptions on the main policy frames and their content since these might vary depending on the context and the historical period. Besides identifying the policy frames embedded in the set of instruments, this step allowed distinguishing between "pure" and "hybrid" instruments, which combine multiple frames in their substantive content.

As a third step, we have analysed procedural and organisational tools, specifically the characteristics of the RFOs managing the instruments. Our focus was on identifying cases where instruments embedding alternative frames were segregated within different RFOs or segmented in branches of the same RFO. Information on the RFOs' identity and organisation was then mobilised to interpret the results and provide evidence on each strategy's advantages and disadvantages.

As a final step, we resorted to the amount of funding per instrument to analyse the importance of each strategy and to provide a comparison between countries.

Results

Identifying frames in policy instruments

Table 2 shows that three combinations of instruments' characteristics account for two-thirds of the instruments in our dataset and 85% of the funding volume.

Table 2. Instrument characteristics and policy frames

No.	Policy goals	Managing RFO	Composition of decision-making committee	Policy frame	No. of instruments	Funding volume (%)
1a	General adv. of knowledge	Research council	Academic OR mixed	Curiosity	38	44
1b	General adv. of knowledge	Other agency OR governmental entity	Academic or mixed	Curiosity	4	2
2a	Economic innovation	Innovation agency	Mixed or experts	Market	13	15
2b	Economic innovation	Other agency OR governmental entity OR research council	Mixed or experts	Market	6	3
3	Policy	Governmental entities or mission-oriented agency	Experts or policy or mixed	Mission	16	28
4a	Policy or mixed	Research council	Academic or policy	Mission-curiosity	6	3
4b	Mixed (policy/knowledge)	Governmental entities or mission-oriented agency or other agencies	Mixed or experts	Mission-curiosity	14	5

The first set of instruments (1 in Table 2) aims at developing new scientific knowledge (independently of practical outcomes). It is managed by research councils, while the grant selection is made by committees composed of academics, with scientific quality and academic reputation being the main selection criteria. For example, research grants from the UK Economic and Social Research Council (ESRC) are directed to "established members of an approved research organisation", can be submitted on any topics of the ESRC's domain, and will be assessed from the ESRC peer review college based on originality and potential contribution to knowledge, research design, and methods, value for money, outputs, dissemination, and impact.[1]

These characteristics are consistent with a *curiosity frame* (Aleman-Diaz 2023), i.e. a policy frame where the rationale for funding research is the quest for new knowledge on scientific problems identified by professionals (Elzinga 2012). Accordingly, evaluation might consider the potential for economic and social impact but only as a long-term outcome of curiosity-driven research (Stephan 2013). In terms of actors and processes, this frame foresees that academics select research topics based on their curiosity and, accordingly, manage funding instruments through research councils, which has been labelled as professional self-governance (Capano 2011).

In two countries, funding instruments oriented to the general advancement of knowledge are managed by other agencies since there is no national research council (case 1a in Table 2). In Italy, the Basic Research Funding Programme is aimed at supporting basic science; however, it is managed by the Ministry of Education and

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[1] https://www.ukri.org/opportunity/esrc-research-grant/, last retrieved August 8th, 2021.

Research since the country does not have a science-based funding agency.[2] Similarly, in Norway, the so-called Researchers' Projects are managed by the Research Council of Norway, which is a multi-purpose implementation agency. In both cases, however, evaluation is the remit of committees composed of academics.

The second group of instruments (case 2) targets the generation of economic wealth and is managed by RFOs whose mission is to foster economic innovation; the selection is made by committees composed of representatives of the economy and, possibly, society.

We associate this set of characteristics with a *market-oriented frame* (Aleman-Diaz 2023), which is rooted in the notion that science should be directly oriented towards fostering economic growth and national policies should be proactive in addressing this goal, for example, by establishing programmes on emerging technologies (Geuna et al. 2003). This rationale also implies the direct involvement of economic actors in the management of public funding, as they know better which discoveries are most promising.

An example is represented by the General Programme of the Austrian Research Funding Agency (FFG)[3]: these grants are aimed at enhancing the competitiveness of Austrian companies in alignment with the mission of "Strengthening Austria as a location for research and innovation". While these programmes frequently involve public–private partnerships, the direct participation of companies is usually required. Projects are analysed in terms of technical criteria ("the degree of innovation and the technical challenge of the planned project") and economic assessment, which "focuses on the commercialisation potential and the applicant's economic performance". We observe similar variation in organisational forms for curiosity-oriented instruments – in Italy, there is no national innovation agency, while the Research Council of Norway also manages these instruments (case 2a in Table 2).

The third group of instruments (case 3) is intended to address societal challenges, such as environment, health, or climate change (Mazzucato 2018). These instruments are oriented to specific research topics while contributing to the solution of policy problems is the prime criterion for selection. They are managed by governmental departments or agencies specifically oriented to policy missions. An example is the R&D programmes by the French Agency for ecological transition (ADEME),[4] whose "main objective is to encourage research to accompany the energy and ecological transitions" by fostering research on topics such as "sustainable cities", "renewable energy", and "health and environmental impacts". Decision-making committees mostly comprise civil servants or experts from society and/or the economy.

These instruments can be associated with a *mission-oriented policy frame* (Aleman-Diaz 2023). Its historical roots date back to the critique of academic

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[2]https://www.mur.gov.it/it/aree-tematiche/ricerca/programmi-di-finanziamento/ricerca-di-base, last retrieved August 8th, 2021.

[3]https://www.ffg.at/en/programme/general-programme, last retrieved August 8th, 2021.

[4]https://www.ademe.fr/en/research-development-and-innovation-at-ademe, last retrieved August 8th, 2021.

Table 3. Share of funding by type of instruments and country

	Curiosity (%)	Market (%)	Mission (%)	Hybrid (%)
AT	21	50	29	0
CH	68	13	16	4
FR	42	17	29	13
IT	16	39	28	16
NL	57	17	26	0
NO	9	15	30	46
SE	53	22	11	14
UK	55	13	31	1
Grand total	46	19	27	9

science in the early 1970s as not addressing the problems of modern society (Elzinga 2012) but has been revived and broadened by the debate on grand societal challenges (Simon et al. 2019). This frame translated into a quest for more direct intervention by the state to address shortcomings of academic governance and market forces and for the involvement of societal actors in defining research funding directions (Mazzucato 2018).

Therefore, most observed combinations of instruments' characteristics can be associated with the main frames in science policy. Further, the largest share of policy instruments (77 out of 97 instruments accounting for 92% of the funding volume) embeds a single frame, while combining frames in a single instrument is less frequent.

Data also display that instruments associated with the three policy frames are present in all considered countries (Table 3), confirming that ideational complexity is a structural characteristic of the science-policy domain across diverse national systems. Country differences should not be over-interpreted given the small sample and data limitations: however, we still remark that the curiosity frame is more important in the UK, conforming to the clear separation between state tasks and private economy in the liberal regime, and in German countries, with their focus on public values, while Scandinavian and Napoleonic countries (FR, IT) display a stronger focus on mission and market frames, sharing a more interventionistic role of the State.

Compromising

Our analysis identified a group of '"hybrid" policy instruments, which are characterised by combining characteristics of a mission-oriented frame and a curiosity-driven frame in terms of policy goals, the composition of the evaluation committee, and managing RFO. These instruments account for less than 10% of the funding volume except in Norway (46%) – this country's pattern might be associated with the broad definition of the state's role in society in the Scandinavian tradition.

More specifically, we have identified two ways in which hybridity has been enacted.

First, we found instruments in which the state defines *ex-ante* the programme topic and strategic orientation, while the implementation is delegated to research

councils (case 4a). An example is the Swiss National Research Programs (NRP),[5] which "embrace research projects that contribute to solving the key problems of today" on topics proposed by federal offices, research institutes, research groups or individual persons, and, eventually, selected by the government. Their implementation is delegated to the national research council, while selection criteria include policy relevance *and* scientific quality. Proposals are assessed by committees including academics, practitioners, and representatives from the public administration.

Second, we identified instruments oriented towards policy or economic goals and implemented by governmental entities or innovation or mission-oriented agencies. Developing some (general-purpose) knowledge is one of the main goals, and academics are represented in the selection committee (case 4b). An example is project grants from the Swedish health agency FORTE[6]: while FORTE's vision "to contribute, through research, to a society that provides good health, a sustainable working life and high social welfare" is policy oriented, grants should support research of the highest scientific quality and applications are assessed by scientific review panels.

These instruments exemplify the challenges raised by strategic research (Rip 2004), i.e. research driven by emerging societal challenges, which cannot be addressed through existing knowledge, but require new, sometimes fundamental, scientific discoveries. It has been argued that such grand challenges require fundamentally different forms of knowledge production based on the interaction between academics and users and fostering interdisciplinarity (Gibbons et al. 1994). Compromising in funding instruments is therefore driven by the nature of the policy problem and was enabled by the multidimensional nature of instruments, in which goals, actors, and means do not necessarily enact the same frame (Flanagan et al. 2011). It is, however, instantiated in different forms depending on the (country-specific) organisational architecture.

This analysis shows that, even in the presence of ideational complexity, compromising at the instrument level was adopted only when the type of problem to be addressed required combining two frames. From a policy design perspective, this might be expected: funding instruments support research projects with limited scope, and, accordingly, it would be good practice to provide unambiguous signals to researchers. Moreover, anecdotal evidence suggests that, in hybrid instruments, struggles between policy frames tend to surface in the proposal selection process where the relative importance of the relevance and scientific quality criterion is at stake – translating into potential conflicts and uncertainty.

The organisational architecture: Segregating and segmenting frames

The previous discussion confirmed our expectation that science policy is structurally characterised by the presence of instruments embedding different frames. Accordingly, segregation and segmentation strategies are expected to play a central role in managing ideational complexity. To this aim, Table 4 provides an overview

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[5]https://www.snf.ch/en/ELxP53n5RBBa08a2/funding/programmes/national-research-programmes-nrp, last retrieved August 8th, 2021.

[6]https://forte.se/en/about-forte/our-mission/vision-and-strategies/, last retrieved August 8th, 2021.

Table 4. RFOs managing research funding instruments by policy frame

Country	Curiosity	Mission-curiosity	Mission	Market
AT	Austrian Science Fund		Climate and Energy Fund; national government	Austrian Research Promotion Agency
CH	Swiss National Science Foundation		Central and national government	Swiss Innovation Agency
FR	National Agency for Research		French Environment and Energy Management Agency; French agency for food, environmental and occupational health safety; national government	BPIFrance
IT	Ministry of education and research	Agricultural Research Council; Italian Space Agency; Ministry of Economy and Finance; Ministry of Education and Research; National Research Council	Ministry of education and research	Ministry of Education and Research
NL	Netherlands Organisation for Scientific Research	Netherlands Organisation for Health Research and Development		Ministry of Economic Affairs
NO	The Research Council of Norway		National government	Innovation Norway; The Research Council of Norway
SE	The Swedish Research Council	Swedish Research Council for Health, Welfare and Working Life; The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning	Swedish Energy Agency	VINNOVA
UK	Six disciplinary research councils; British Academy; Royal Academy of Engineering; The Royal Society	Scottish Funding Council; The Engineering and Physical Sciences Research Council; UK Space Agency	Defence Science and Technology Laboratory	Innovate UK; Scottish Funding Council

by country of the organisational structures (i.e. RFOs) managing research funding instruments associated with policy frames.

Data show that *segregating* policy frames within distinct RFOs is the dominant pattern. This is apparent for curiosity and market instruments: in six out of eight countries, curiosity instruments are managed by specialised agencies self-governed by the academic community (research councils), while in seven out of eight

countries, market-oriented instruments are managed by specialised agencies, either autonomous innovation agency or departments within the economics ministry. These agencies have an identity associated with a policy frame. For example, the Austrian Science Fund has the mission to "support the ongoing development of Austrian science and basic research at a high international level", emphasising excellence in all scientific disciplines; its president has a longstanding academic career, and the board in charge of funding decision is composed by university professors.[7]

On the contrary, the Swedish Innovation Agency VINNOVA aims to "build Sweden's innovation capacity, contributing to sustainable growth", providing support to give "companies and organizations the opportunity to experiment and test new ideas before they become profitable", while the agency's board is composed by people holding responsibilities in companies and transfer agencies.[8]

Segregating instruments within specialised agencies bears advantages in terms of policy implementation since the agencies have a clear identity aligned with the instruments' goals, conforming to the New Public Management approach of creating specialised agencies endorsed with clear tasks (Lægreid et al. 2008). However, this also generates coordination problems between agencies, as the same research topic might be funded by different agencies (using different criteria), creating opportunities for researchers to play strategically and weakening the ability to steer research. To at least partially address this issue, Austria took (in 2004) the path of consolidating the three market-oriented agencies into the Austrian Research Promotion Agency (Stampfer et al. 2010).

As for mission-oriented instruments and the "hybrid" mission-curiosity instruments, most of them are managed directly either by sectoral ministries or by autonomous agencies in specific policy domains. As an example, the French Agency for Ecological Transition (ADEME) is a public agency under the joint authority of the Ministry for the Ecological Transition and the Ministry for Higher Education, Research and Innovation. ADEME support of research, development, and innovation "falls under the objectives of the public policies that promote energy and the environment and especially those relating to energy transition"; its scientific council includes members from the scientific community and industry, while the management board is composed mainly by representatives of the government.[9] The consolidation of agencies managing mission-oriented instruments turns out to be more difficult since these are in policy domains associated with different departments, such as the energy or the healthcare ministry. Accordingly, stronger organisational fragmentation is observed.

In our data, *segmentation*, i.e. having instruments embedding different frames managed by the same agency, was rarely observed and, specifically, only for hybrid (mission-curiosity) instruments being managed by science-oriented agencies. This applies to the National Research Programmes managed by the Swiss National Science Foundation and to the Future Investments Programme managed by the French Research Agency. Both programmes include a "curiosity" component and, therefore, can be linked with the agency's identity. Moreover, both agencies

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[7]https://www.fwf.ac.at/en/about-the-fwf/corporate-policy last retrieved September 24th, 2021.
[8]https://www.vinnova.se/en/about-us/ last retrieved September 24th, 2021.
[9]https://www.ademe.fr/en/research-and-innovation last retrieved September 24th, 2021.

are careful in distinguishing tasks implemented "on behalf of the state" from their core academic identity; hybrid instruments are segmented within a separated division and constitute less than one-fifth of the funding volume. Segmentation, therefore, allows the state to rely on established agencies to implement policy-oriented programmes in a context in which strategic research represents a small share of funding.

Our data highlight two exceptions to this pattern. In Italy, there is little tradition of project funding agencies as, traditionally, research was directly managed within the public sector, conforming to the centralised state structure in the Napoleonic tradition. Accordingly, the country has a very low share of project funding (Lepori et al. 2018), while the Ministry of Education and Research managed the few existing instruments by involving the relevant stakeholders within specialised committees. The lack of institutional differentiation, therefore, reflects the low saliency of funding projects in the national science policy. Notably, the other country in our sample with the same politico-administrative tradition, i.e. France, converged to the model of most other European countries by establishing, in 2004, a national research council and increasing the importance of project funding instruments in public research funding (Thèves et al. 2007).

The second outlier in terms of organisational architecture is Norway. While the country has a longstanding tradition of agencification, the debate between autonomy and control has been core to the design of public policies (Christensen and Lægreid 2007), given the decentralised and cooperative structure of the state in the Scandinavian tradition (Bleiklie and Michelsen 2013). As of science policy, in 1993, the five pre-existing agencies were merged into the Norwegian Research Council (RCN). This process was motivated by the wish for better coordination and reduction of administrative costs, as well as by establishing stronger public control of the new agency (Skoie 2000). RCN is now firmly established as an executive agency linked to the government, while its mission is defined as "to promote a society where research is created, used and shared, and thus contributes to restructuring and enhanced sustainability", which encompasses all three policy frames.[10] Within RCN, activities are managed by so-called portfolio boards responsible for funding in different areas: their composition ranges from mostly academic members (e.g. in "social sciences and humanities") to mostly representatives from the economy (e.g. in "industry and services"). In our framework, RCN, therefore, represents an extreme case of segmentation, where instruments incorporating different frames and previously managed by different agencies were merged but, to a large extent, maintained their specificity. However, the reform created a complex RFO, in which tensions have emerged and departments still largely work in different manners and have different relationships with ministries (Slipersæter et al. 2007).

In summary, the segregation of policy frames within distinct agencies has been the most frequent approach despite coordination problems; since project funding is a core task of RFOs, segmenting instruments enacting different frames in one agency is likely to generate identity problems, as exemplified by the Norwegian case. Specific country trajectories are observed when an organisational structure is

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[10]https://www.forskningsradet.no/en/about-the-research-council/what-we-do/what-does-the-research-council-do/, last retrieved October 1st, 2021.

missing (Italy), or mission-oriented research plays a limited role, thereby enabling segmentation (Switzerland), or when the push for horizontal coordination and state control is particularly strong (Norway). We suggested these trajectories might be partly related to different politico-administrative traditions.

Discussion and conclusions

The goal of this article was to analyse the approaches adopted in dealing with ideational complexity in the implementation of public policies. By leveraging the literature on organisational hybridity, we have proposed different strategies, i.e. compromising at the level of the substantive content of policy instruments and segregating or segmenting policy frames within distinct organisational settings. Besides identifying these strategies in the case of science policy, we also aimed at understanding the circumstances in which these are employed. The main findings are as follows.

First, one major pattern observed is that compromising at the level of substantive policy instruments is not widespread. This was expected, based on the organisational literature, as compromising implies a complex setting where multiple actors are involved in an implementation process and conflicting norms and values must be combined, generating ambiguous decision-making criteria (Cornforth 2020). Such hybrid instruments would not conform to recipes for effective policy implementation promoted by New Public Management, which foresees policy instruments characterised by clear goals and coherent implementation (Christensen and Lægreid 2007).

Yet, in one specific case, the nature of the problem to be addressed, i.e. the big societal challenges such as managing climate change, required developing new scientific insights (*curiosity frame*) that are also relevant to address societal challenges (*mission frame*). In this case, combining policy frames was core to achieving policy goals and, accordingly, the resulting costs and ambiguities could be justified by the ability to get "the best of the two worlds" (Smets et al. 2015). However, such hybrid instruments accounted for less than 10% of the total funding volume.

Second, our data showed that the main strategy adopted to deal with ideational complexity consisted of creating mixes of instruments embedding a single policy frame, however, managed within distinct organisational settings. This conforms to the insights from the organisational literature that avoiding conflicts by keeping logics apart is a more effective strategy (Smith and Besharov 2019; Lepori and Montauti 2020).

Among the strategies for keeping frames apart, segregating frames into specialised agencies was the prevalent pattern. On the one hand, this conforms to New Public Management recipes to endow agencies with clear and specialised tasks (Christensen and Lægreid 2007); on the other hand, this reflects the fact that managing funding instruments is a core task of such agencies and, accordingly, alignment between instruments and agency identity is expected.

While this pattern was common to most observed countries, we also observed variation related to two factors: first, how different national policy systems strike a balance between agency autonomy and control (Christensen and Lægreid

2007) since science-managed agencies have an intrinsic tendency to escape from public control and, accordingly, the state might decide to merge them to broader public agencies as in Norway; second, the saliency of a set of policy interventions, as the limited importance of project funding instruments in Italy implied that no differentiated agency structure was created over time. Yet, the Norwegian case displays how reliance on segmentation also generated internal tensions within the agency. We have identified more moderate instances of segmentation in France and Switzerland, two countries in which only "proximate" instruments have been integrated within the same agency.

All in all, our data provide evidence that the proposed approaches to deal with ideational complexity were adopted in public policies and, despite the diversity of the national contexts, some general patterns emerged, such as the prevalence of segregation, that could be associated with the specific characteristics of the domain at hand. We also have provided preliminary evidence that country variation might be related to the country's welfare and political regime (Esping-Andersen 1990) with respect to the prevalence of policy frames and to the country's politico-administrative tradition (Pollitt and Bouckaert 2017) as for the organisational structures adopted.

In a broader perspective, our analysis moves beyond a policy design tradition, which emphasised the design of a coherent set of policy interventions as the norm (Howlett and Mukherjee 2014), and considers incoherent instrument mixes as an accident of history. Instead, we are suggesting that, when policymakers are structurally confronted with potentially incompatible principles and requests, the differentiation of policy instruments might be a viable strategy to avoid intractable conflicts, while "hybrid" policy instruments might be the only way to achieve certain tasks.

Further, our analysis exposes the core role of administrative structures to this aim and, therefore, suggests that moving beyond a focus on substantive policy instruments to take into account also the organisational and procedural dimensions of the instruments' delivery package (Salamon 2002) is relevant in a context of ideational complexity (Howlett 2019). Our analysis, therefore, provides some advances on the unexplored issue of how the coexistence of multiple policy frames impacts policy implementation (Capano and Howlett 2020).

Yet, we acknowledge several limitations in our analysis, which in turn opens avenues for further research. First, we have purposefully focused on how ideational complexity is managed in policy implementation; accordingly, we disregarded that conflicting frames can also be combined and hybridised in the ideational content of policies (Polzer et al. 2016), respectively, within the organisations targeted by policies (van Gestel et al. 2020). Therefore, the respective roles and interactions between these multiple levels in managing ideational complexity remain to be understood.

Second, data limitations allowed only providing some exemplary evidence of the observed strategies. Managing complexity is a dynamic process that unfolds over time: therefore, fine-grained evidence of how these processes worked out in practice, how conflicts were managed by actors and how they unfolded over time would be needed, also to understand the implications for policy outcomes of each strategy (Capano and Pritoni 2019). Conversely, longitudinal data on a larger sample of countries could provide robust empirical evidence on the source of country

variation in complexity and its management and their association with welfare regimes and politico-administrative traditions.

Third, we have analysed a highly specific policy domain characterised by low ideological conflict and the prevalence of incentive instruments (Braun 2003). This setting might also explain the strong use of segregating and segmenting strategies since allocating public subsidies, such as grants, through instruments adopting different criteria is less problematic for the policy target than, for example, introducing conflicting regulations. Accordingly, we cannot claim generality in the patterns observed, as the balance of strategies adopted in managing complexity might depend on the characteristics of the policy domain. Hence, future broader studies will have to compare strategies across domains.

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