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Navigating complexity: looking at the potential contribution of a boundary organisation in Portugal to evidence-informed policy

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Governments deal increasingly with multidimensional problems involving high levels of complexity. These so-called wicked problems, such as climate change, demand coordinated and coherent government action, as well as multi-stakeholder approaches. Boundary Organisations (BO), working at the knowledge-interface of the science–policy–society nexus may contribute substantially to both ends. This paper considers the potential contribution of the recently created Competence Centre for Planning, Policy, and Foresight of the Public Administration (PlanAPP), a Portuguese BO at the centre of government, to evidence-informed policy. To this goal, we focus on two streams of literature, Policy Coordination and Coherence (PCC) and Knowledge Governance (KG). An analytical framework with two dimensions is proposed: the first dimension considers if and how PlanAPP engages in boundary work; the second dimension looks at the activities that PlanAPP implements and their potential for PCC and KG. Our results support the idea that PlanAPP is promoting work on the knowledge-interface for public policy, with the potential to become a main player in supporting governments to address policy issues, including wicked problems, whilst potentially triggering a shift to knowledge governance in Portugal's public administration. Nevertheless, PlanAPP could further intensify boundary activities, especially by increasing civil society participation and producing shared outputs that all actors involved recognise as legitimate, increasing trust in policy and institutions. This study's methodology may be replicated to improve understanding of BOs and their contribution to policymaking in other contexts.

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Background

In the current VUCA (volatility, uncertainty, complexity, ambiguity) world, governments face increasingly complex problems, also known as *wicked problems* (Rittel and Webber, 1973). Wicked problems are nonlinear multidimensional problems, inherently characterised by ill-definition, and thus difficult (or impossible) to solve definitively. Wicked problem's inherent "insolvability" emphasises the importance of trust in public policy and institutions in their governance. They do not fit neatly in specific government departments or policy areas (Christensen and Serrano Velarde, 2019; Peters, 2018) and frequently require expert knowledge production and interpretation (OECD, 2020b). The multidimensionality inherent to wicked problems, such as climate change and migration, poses governance challenges: coordinated and coherent decision-making processes are required, as well as multifaceted forms of knowledge input and analysis (Feagan et al., 2019; Tengö et al., 2014).

Fragmentation and specialisation of public organisations intensified during New Public Management (NPM) reforms. Nevertheless, that hegemonic paradigm has recently been counteracted by more "holistic approaches" (Lapuente and Van de Walle, 2020). Post-NPM trends attempt to counter the specialisation, fragmentation, and marketization characteristic of NPM by strengthening the coordination and collaboration between public sector organisations, which, in turn, may contribute to policy coordination and coherence (Lapuente and Van de Walle, 2020; Trein and Maggetti, 2019). Despite such trends, the sectorial and functional structure of public administrations may hamper policymaking processes and policy design as they are frequently misaligned with the growing need for different knowledge input and for policy coordination and coherence, required to face increasing complexity and uncertainty.

With this background in mind, this paper looks at two streams of literature: literature on *policy coordination and coherence* (PCC) and on *knowledge governance* (KG). These streams of literature were chosen as they complement each other: the first stream, PCC, concerns the institutional architecture and agency in policymaking; the second stream, KG, analyses the knowledge-sharing processes involved.

PCC concerns the process of integrated decision-making, and the implementation efforts to achieve consistent and coherent government action (Cejudo and Michel, 2017; Peters, 1998). Several institutional arrangements pursue better policy coordination, characterised by a horizontal coordination dimension (between units) and/or a vertical coordination dimension (between municipal, regional, central, and international levels) (Bouckaert et al., 2010). Lack of coordination and coherence may be mitigated by having decision-makers tackle complex problems together, jointly setting the goals and strategies required to address them. Coordination solutions may appear at any stage of public policy—design, implementation, evaluation—but that requires engagement by different government sectors and at different levels of public governance, including citizen participation (OECD, 2020b; Cejudo and Michel, 2017). PCC is central to better functioning public services, increasing citizen trust and satisfaction by ensuring coherence and reducing redundancy, gaps, and contradictions among public policies (Bouckaert et al., 2010).

Line Ministries and related public administrative departments produce and retain much of the knowledge and data in their given areas. However, they do not have all the analytical skills and expertise to address the social, environmental, and economic dimensions of challenges. External, independent institutions that collect and analyse policy data and outcomes, such as research units, universities, private consultants, and think tanks, retain expertise that may be used to support public policy design,

monitoring, and evaluation processes (OECD, 2020b). Such epistemic communities may vary depending on the policy issue (for a discussion of epistemic community formation, see Haas, 1992). In addition to these knowledge producers, policymakers also require information about how citizen values, perceptions, needs and expectations evolve (Pereira and Völker, 2020). Access to knowledge about the nature of the problems at hand will lead to greater consensus on how to improve policy outcomes (Newman and Head, 2017). Policy developed with sufficient evidence (organised data and statistics, contextualised information) and knowledge (organised evidence) is likely to be more successful. Using evidence in a structured way in the entire policy process can help distinguish values and power dynamics from facts in complex governance systems and reduce costly regulatory or investment mistakes (Sienkiewicz and Mair, 2020).

The second stream of literature considered here highlights the need to create knowledge deemed actionable for policy decision-making through an iterative and dynamic process of co-creation (Fazey et al., 2020; West et al., 2019). Research points to the urgency of implementing a *knowledge governance* (KG) approach to inform timely and wise decisions (Cummings et al., 2019; Oliver et al., 2021). Van Kerkhoff (2014) presents KG as related to the "institutional layer", a scale above knowledge management better suited for multilevel, complex challenges. KG goes beyond discussing knowledge questions and sharing knowledge in workshops and is about "engaging actors in innovative ways of solving societal issues" (Gerritsen et al., 2013, p. 605). KG is based on networks of actors and processes that enable these actors to draw on various forms of knowledge and connect them (Wyborn et al., 2016). It connects different epistemic perspectives and backgrounds—"knowledge systems"—and offers a conceptual basis from which to critically think about their interweaving as ways of valuing, sharing and combining multi-player knowledge enriching inclusive decision-making processes (Rathwell et al., 2015; Tengö et al., 2014). These processes aim to produce more robust, accountable and usable knowledge: "knowledge that 'serves locally' at a given time; knowledge that has been de- and reassembled" (Meyer, 2010, p. 123).

Based on a survey by the Finnish Innovation Fund SITRA that collected responses from professionals at the interface of knowledge and decision-making, Hellström and Ikäheimo (2017) recognise two approaches for using knowledge in decision-making. The *linear approach* ensures that information is produced for specific questions. The *dynamic approach* sees knowledge production as an interactive process where experts and decision-makers contribute to formulate questions and make sense of the information from the start. To be productive, these interactions require specific skills and training (Topp et al., 2018; Schwendinger et al., 2022), as well as modes of organisation. Both accepting the information used and perceiving the process of using knowledge as legitimate affect decision-making: shared knowledge, that is, knowledge that results from a joint question formulation, research development and interpretation process, increases the impact of knowledge on decision-making (Hellström and Ikäheimo, 2017). The SITRA survey results suggest that most participants feel that the responsibility for taking the initiative to interact is shared by all actors at the knowledge/decision-making interface (Hellström and Ikäheimo, 2017).

Combining policy coordination and coherence and knowledge governance. The two literature streams on PCC and KG point to common central ingredients. In this section, we combine and summarise these insights into three key propositions for improved policymaking for complex problems.

Internal cross-sectoral networking. Internal networking implies a cross-government approach, including the articulation within Public Administration departments and services, which is of paramount importance to improve PCC. Complexity and inter-disciplinarity require PCC approaches where the same level of hierarchy (e.g., ministries) can come together to discuss comprehensive and cross-cutting policy solutions (Peters, 2018). This way of functioning involves collaborative work and shared leadership among services and departments within Public Administration (Bouckaert et al., 2010). Rather than minimising tension among conflicting interests (Peters, 2018), policy coordination relates to how it can build coherence and achieve a more overall government performance (Bouckaert et al., 2010). These features are essential, for example, to better align sectoral plans with national cross-cutting legal documents. In this sense, networking must entail some form of collaboration yielding a co-created output or joint agenda setting, joint working groups or joint projects to be meaningful.

Internal networking also facilitates a shift to a system´s mindset, which may further contribute to three transitions: (1) from "command and control" governance towards a high degree of unloosing and flexibility; (2) from a strong focus on incontrovertible planning for concrete results towards a higher degree of emergence and serendipity; and (3) from strictly imposed planning towards creating a space for learning and reflection (Nevens et al., 2013).

External networking and participation. The whole-of-government approach to public sector management highlights the need to work across Public Administration boundaries and beyond, mitigating traditional boundaries (Trein and Ansell, 2020; Bianchi and Peters, 2018). This whole-of-government approach includes handling the flow of knowledge and information ("knowledge governance"): it is necessary to promote participation and stakeholder engagement, including relevant participants who bring important insights and knowledge to the policy-making process (Bouckaert et al., 2010). Cooke et al. (2021) highlight the importance of reflecting on the knowledge co-production process and assessing whether its partnerships are truly respectful and inclusive. Cooke and Kothari (2001) criticise participatory discourse and its legitimisation of hegemonic perspectives and knowledge systems instead of challenging them. They highlight the danger of obscuring the "politics of participation" and the risk of it becoming an instrument of control. External networking encompasses a policy–science–society engagement, which implies articulating policymakers, citizen participation, and formal knowledge producers and institutions such as academia, think tanks, companies and trade unions, among others (Šucha and Dewar, 2020). In healthy science for policy ecosystems, external networks are spaces for mutual learning (Pedersen, 2023). Increasing stakeholder involvement in governance implies that new modes of jointly creating and exchanging knowledge may need to be taken into account (van der Molen et al., 2016). Successful external networking needs to step up its ambitions in relation to participatory approaches and provide opportunities for active and meaningful participation by all actors of public policy (policymakers, citizens, stakeholders, scientists, etc.), thereby introducing public values and enhancing higher levels of trust in decision- making (Beierle and Konisky, 2000).

Knowledge sharing. Resources and expertise available across Public Administration and its partners are of great value to co-creative processes and individual and collective skills empowerment and training (Topp et al., 2020). Cross-sectoral work creates opportunities to develop skills because governments often do not have all the resources, knowledge, and expertise to address wicked problems (OECD, 2017). Skills acquisition and training based on mutual learning and knowledge sharing are important to keep pace with new governance systems and tools (OECD, 2017). The reconceptualization of knowledge as a global public good instead of a private asset (Van Kerkhoff, 2014) has gained some traction in the literature. Looking at knowledge as "commons" means developing arrangements for overcoming the various dilemmas associated with sharing and producing information, innovation and creative works (Hess and Ostrom, 2005). It also implies the re-politicisation of wicked problems, such as climate change, to include more democratic debate and argument based on a wider discussion of values, norms and experiences (Rice et al., 2015). Without explicit knowledge sharing, complex issues may be de-politized, running the risk of creating crises of legitimacy (Clarke et al., 2013). The aim, thus, includes work to strengthen citizen participation, compelling more responsiveness and accountability (Landemore, 2020).

Boundary organisations. The three key insights gained from the state-of-the-art on PCC and KG highlight the relevance that boundary organisations (BOs) may assume in dealing with complex problems through multi-stakeholder approaches to coordinated and coherent policy action. So what characteristics should BOs have to facilitate this role?

Despite earlier discussions (for example, see Friend, 1987), the concept of BO was introduced by Guston (1999, 2001) to describe organisations that meet three criteria: (1) they exist at the frontier of policy and science, with distinct lines of accountability to each [e.g., through appointment by elected government officials (politics) and through contracts (science)]; (2) they involve the participation of actors from both sides of the boundary (as well as professionals with a mediating role); (3) they provide the opportunity and incentives for the creation and use of boundary objects (e.g., models, technical reports) or standardised packages (e.g., formal agreements), recognised as legitimate by both sides. A paradigmatic example of a BO is the European Commission's Joint Research Centre.

But, BOs are not necessarily limited to the policy–science interface. They are an effective approach to public policy salience, legitimacy, and credibility (Cash et al., 2003). To fulfil this role, BOs manage multiple interactions (Cash et al., 2003), bridging gaps between policymakers and academics and between practitioners and stakeholders (Šucha and Dewar, 2020). BOs may foster transdisciplinary relationships and catalyse the exchange of ideas, enhance trust, and contribute to the consideration of scientific evidence at any stage of public policy (Honeck et al., 2021). In their systematic review, Gustafsson and Lidskog (2018) found that most applications of the concept of BO occur within the environment (/climate) field, the paradigmatic "wicked" policy area, and that the concept has been applied to a variety of institutional arrangements and organisational objectives. Some were established with the purpose of governing expertise or to facilitate policymaking; but most with the main objective of facilitating interaction among stakeholders (Hoppe and Wesselink, 2014).

In terms of their functions, BOs may thus be understood as performing three main activities. First, *the production of boundary objects* (van Enst et al., 2016). Boundary objects sit between different worlds, such as science and policy, and can be used by each for specific purposes without losing their identity (Star and Griesemer, 1989). Boundary objects include, among others, patents (Guston, 2001), policy briefs, models, and reports (Cash et al., 2006). These outputs foster a sufficiently shared understanding to gain legitimacy in each world by enabling

negotiation to resolve mismatches in overlapping areas (Kirchhoff et al., 2013; Star and Griesemer, 1989) by serving as a focal point over which disparate perspectives can argue and agree (Kirchhoff et al., 2013; Star and Griesemer, 1989).

A second characteristic of BOs is ensuring alignment between the needs of the policy community and the evidence provided through *knowledge brokerage*. Knowledge brokerage ensures that any evidence synthesis is robust, transdisciplinary, and with appropriate expert inputs (Gluckman et al., 2021). Efficient brokerage uses language and delivery formats that facilitate usability by policymakers: knowledge brokerage requires a domain of the cultures and languages of both the policy community and the science community in order to link them bidirectionally (Gluckman et al., 2021). Good knowledge brokerage provides advice in the form of options rather than specific recommendations, recognises its own limitations and biases, and does not attempt to take a decision role in the policy process (Gluckman et al., 2021). Brokers play a privileged role in addressing knowledge asymmetries, clarifying policy options and helping policymakers assess what evidence is reliable (Gluckman et al., 2021). Access to knowledge brokers may increase a policymaker's knowledge and skills in finding, appraising and using evidence, leading to increased engagement in evidence-informed policymaking (OECD, 2020a).

The institutionalisation of knowledge brokerage also contributes to the third characteristic of BOs, that of *boundary management*. Boundary management is an active mediation between actors, including the management of trade-offs (Cash et al., 2003). This is an ongoing process of negotiation and managing tensions between specific stakeholders, which may change over time (Parker and Crona, 2012). BOs provide spaces for open deliberation and learning, allowing for numerous and different types of stakeholders to play a role in the governance of wicked problems (Hoppe et al., 2013). BOs perform this function by proactively interacting with users and producers and by promoting informal meetings between stakeholders (Parker and Crona, 2012; van Enst et al., 2016). The structured participation of many actors allows trust to build over time between different groups and enables the production of credible and salient outputs (Cash et al., 2006).

This paper's object. Keeping in mind the insights gained from the combined reading of literature on PCC and KG to improve policymaking addressing complex challenges, we will now discuss how to apply them to a specific potential BO: Portugal's Competence Centre for Planning, Policy, and Foresight of the Public Administration (PlanAPP).

Recent reforms of the Portuguese Public Administration have underestimated its advisory function, which is presently characterised by fragmented and decoupled responses (Feio, 2021). In addition to this, Simoes's (2022) report "Science for policy in Portugal" describes the science-for-policy ecosystem not as one, but as a set of multiple "ecosystems" that function as uncoordinated, independent units.

PlanAPP was established as a policy advisory body with a wide-ranging mandate in public policy, including to support competencies in foresight and public policy planning, monitoring, and evaluation, to contribute to developing capacity for the use of evidence in decision-making and to coordinate the inter-ministerial collaborative network RePLAN.

To determine PlanAPP's potential contribution as a boundary organisation to evidence-informed policy we have characterised it in terms of boundary activities by looking into its projects database and seeking potential boundary-crossing projects. We then describe if and how PlanAPP and RePLAN encompass the key ingredients for successful PCC and KG: internal networking; external networking; and knowledge sharing. Finally, we discuss possible ways forward for PlanAPP–RePLAN as they seek to strengthen their contribution to evidence-informed policymaking addressing complex problems.

Methods

Taking stock of the literature review on PCC and KG and its key ingredients, this paper uses a qualitative approach to explore the potential of PlanAPP (the Portuguese Competence Centre for Planning, Policy, and Foresight in Public Administration) and RePLAN (Planning and Foresight Services Network in Public Administration) to improve policymaking for complex challenges. Both PlanAPP and RePLAN were recently created (Decree-Law 21/2021). In their broad, cross-cutting nature and their placement under the tutelage of the Minister President of the Council of Ministers, PlanAPP and RePLAN are unique bodies in the policy advisory system in Portugal. They provide opportunities to develop thought and practice in the policy-making for wicked problems but may viewed, to that goal, as "prototypes". In that respect, they may be considered "paradigmatic case studies" (Flyvbjerg, 2011).

PlanAPP and RePLAN's institutional and legal setting. PlanAPP was created by Decree-Law 21/2021 as a public body with administrative autonomy within the Presidency of the Council of Ministers (Diário da República, 2021). Its wide-ranging legal mandate includes: to support strategic national policy planning by setting goals and targets; to evaluate the implementation of public policies; to contribute and develop competence capacity within policy departments across the government for the use of evidence through the coordination of collaborative networks. It is also tasked to develop and promote good practices in strategic planning, foresight, policy design, policy monitoring and policy evaluation, and to set-up and to preside over the inter-ministerial strategic planning network, RePLAN—Portugal's Public Administration Foresight and Planning Services Network (Diário da República, 2021). This set of assignments makes PlanAPP a unique and innovative entity in the Portuguese Administration.

RePLAN was conceived as a collaborative network between policy-making departments of all government ministries to foster cross-sectoral cooperation in matters of planning and foresight, the dissemination of knowledge and good practices, and competence-building initiatives (Diário da República, 2021). PlanAPP's role in the scope of RePLAN is that of a "coordinator", or facilitator, a position that allows a mediation role between public administration policy making entities under the tutelage of the various ministries, a consensus-seeking role, and an active promoter of collaboration across government areas (see Fig. 1).

PlanAPP-RePLAN may pursue these goals through the establishment of "multisectoral teams", which bring together policymakers from different policy sectors (Diário da República, 2021) to promote multi-sectoral working groups that address cross-cutting issues.

PlanAPP itself has five multidisciplinary teams, as well as a strategy advisory group to the Board of Directors, part of its Board Support. Within the group of Strategy Advisors and Special Projects, coordinators are a Partnerships and Innovation group and the Futures' Thinking Lab 2050 special project group. PlanAPP's multidisciplinary teams are the Foresight and Planning Unit, the Monitoring and Evaluation Unit, the Strategic Communication Unit, the Project Management and International Relations Unit, and the Information Systems Management Unit (PlanAPP, 2022b). PlanAPP has 68 workers with different backgrounds ranging from social and natural sciences to
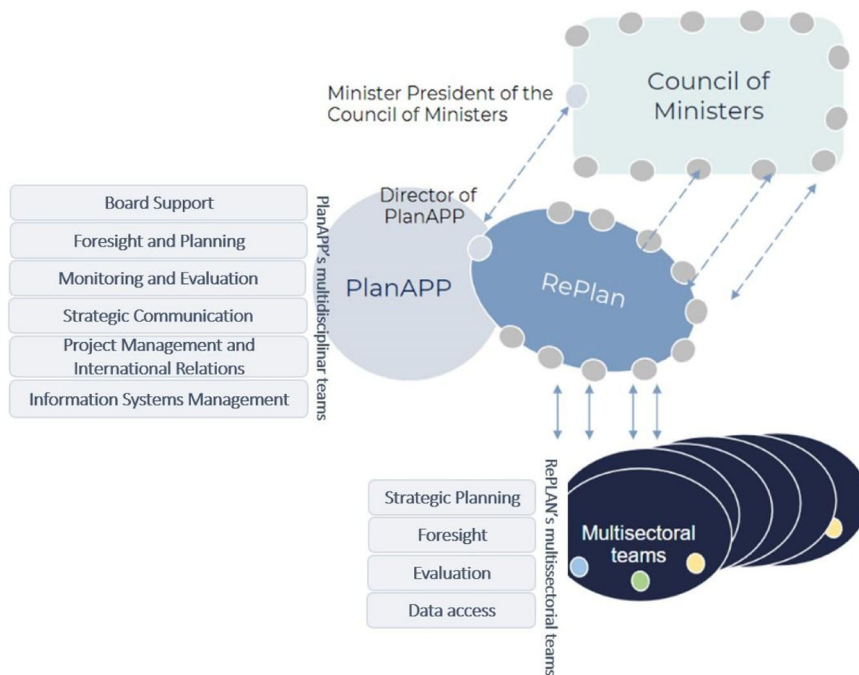
Fig. 1 Relationship between the political and administrative level: members of the network RePLAN represent the different areas of the Council of Ministers. RePLAN appoints multisectoral teams to address specific issues. The Director of PlanAPP presides over RePLAN and responds to the Minister-President of the Council of Ministers. Source: Authors elaboration (in July 2023) based on Decreto-Lei no. 21/2021 (Diário da República, 2021), PlanAPP's site (PlanAPP, 2023a) and RePLAN's *Action Plan* ("Plano de Ação 2023–2024": PlanAPP, 2023d).

engineering, education and tourism. 34% of PlanAPP's workers hold a university degree, 51% hold a Master's degree and 13% a PhD degree (PlanAPP, 2022a).

RePLAN held its first meeting on November 23, 2022, and the network has met twice since then and July 2023. RePLAN's 25 members represent Public Administration entities from 19 ministries (PlanAPP, 2023c). RePLAN initiated its activities almost a year after PlanAPP, once all its members had been appointed by their Minister. RePLAN's approved *Work Plan* appointed four Multi-sectoral working groups: Strategic Planning; Foresight; Evaluation of Public Policies; and (Public Administration) Access to Data (PlanAPP, 2023d).

Analytical framework. Our analytical framework is two-fold and considers (see Fig. 2): PlanAPP's boundary work; and activities carried out by PlanAPP–RePLAN through the combined lenses of KG and PCC and their three central ingredients as discussed above. (Results are presented in reverse order from the literature review for clarity.) Components of our analytical framework were pre-tested and discussed in three previous papers (Barbosa et al., 2022; Cabete et al., 2022; de Wit et al., 2022).

The first dimension of our analytical framework looks at if and how PlanAPP engages in boundary work. To answer this question, two sources were used: PlanAPP's "Mapa de Projetos" (PlanAPP, 2023b), an administrative project database that describes PlanAPP's activities (including objectives, deliverables, and implementation periods, as well as the projects' coordinator and participating units or teams); and PlanAPP' official webpage (PlanAPP, 2023a). These sources were used to identify ongoing projects that potentially bridge boundaries between science, society, and policymaking. To qualify as boundary "bridges", projects should involve one or more of the three main activities of BOs, as identified in the literature reviewed above (see the section "Boundary organisations"). They should (i) involve the coproduction of a variety of outputs, such as policy briefs, reports, and

studies, but also training programmes, seminars, and workshops (*boundary objects*); (ii) and/or facilitate interactions, in the context of meetings and working groups, between sector policymakers and scientists and citizens or other stakeholders in policy planning and coordination processes (*knowledge brokerage*); and/or (iii) involve partnerships (formally or informally defined) with other entities (*boundary management*). To be included, a project must also clearly state expected outputs.

Through qualitative data analysis, we conclude that PlanAPP is currently (July 2023) engaged in 19 activities that qualify as projects that satisfy at least one of the three criteria above. These 19 projects are listed, describing their BO activities, partner entities and expected outputs.

The second dimension of our analytical framework looks at the activities carried out by PlanAPP and RePLAN through the combined lenses of KG and PCC and their three central ingredients (as discussed in the section "Combining policy coordination and coherence and knowledge governance"): Internal cross-sectoral networking; External networking and participation; and Knowledge sharing.

Content analyses based on PlanAPP´s Activities Programme for 2023 (PlanAPP, 2022b) and on the Decree-Law 21/2021, which created PlanAPP (Diário da República, 2021), were performed regarding mechanisms for PCC and KG. Thus, we looked for activities related to the following aspects: Knowledge production, sharing and dissemination; efforts to engage external actors (citizens, stakeholders, scientists, academia, etc.); internal network building and strategies for meaningful collaborative work.

Results

In this section, we look at boundary activities at PlanAPP to enquire how well the Centre realises (or may potentially realise) a role in policymaking for wicked problems (see the section "Does PlanAPP engage in boundary activities?" below). Then, we assess
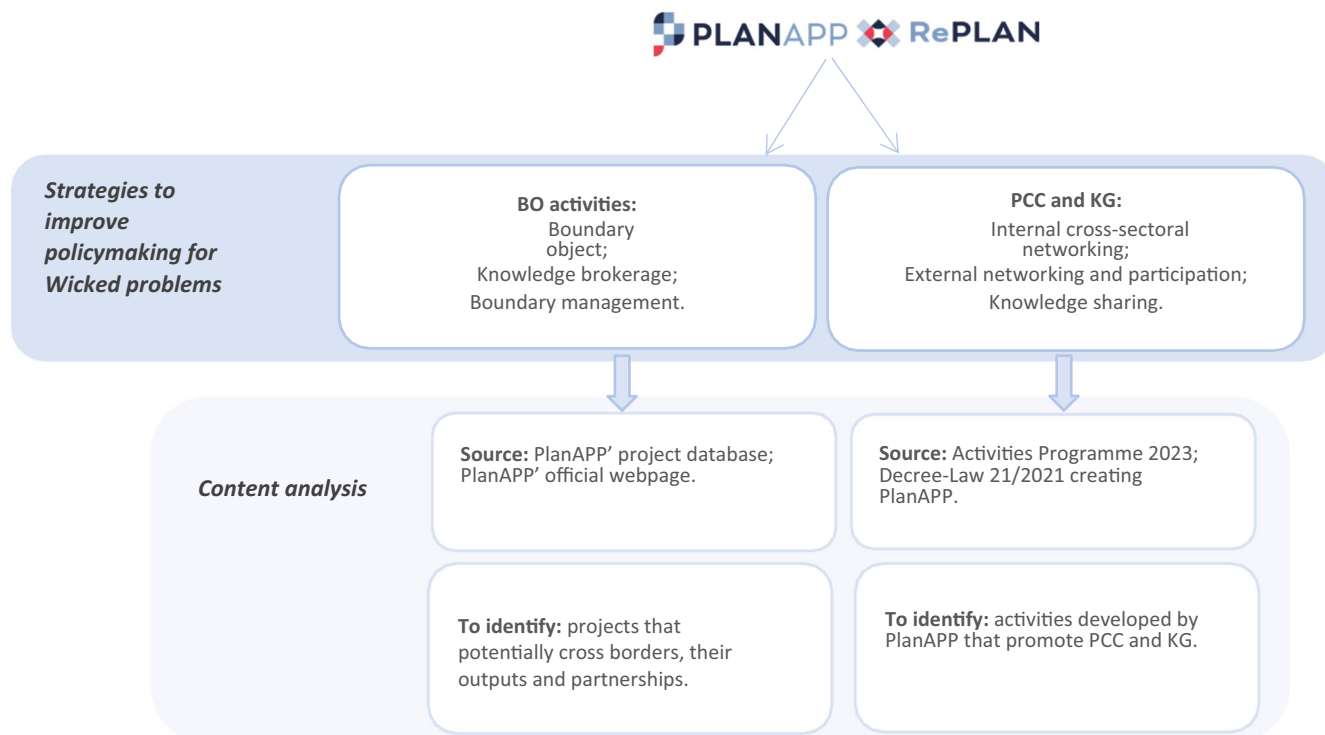
Fig. 2 The two dimensions of the analytical framework used to answer the question "Are PlanAPP and RePLAN deploying strategies to improve policy-making addressing wicked problems?". The elements considered in each dimension were identified based on two streams of literature: on Boundary Organisations (BO) and on Policy Coordination and Coherence (PCC) and Knowledge Governance (KG). From each of these streams of literature, key features were identified, which were then used to perform content analysis on different sources of documents. Source: Authors' elaboration (in July 2023).

how strongly PlanAPP and RePLAN embrace the characteristics identified as essential for PCC and KG, necessary to address complex challenges (see the section "How well do PlanAPP and RePLAN encompass the characteristics identified as essential for PCC and KG?", below).

Does PlanAPP engage in boundary activities? Considering the functions/attributes of boundary organisations identified above (see the section "Boundary organisations"), we distributed PlanAPP's 19 projects according to three groups (see Table 1).

The first group of projects concerns the production of boundary objects which includes the design of projects to solve specific policy problems by mobilising external expertise. Examples in this group include the creation of an economic impact at regional scale analysis tool (PlanAPP, 2023b); the prototype of an Artificial Intelligence for better regulation (PlanAPP, 2023a); and the prototype for Statistical Information Standardisation for Better Regulation project (PlanAPP, 2023a). These boundary objects are being produced by involving science and public policy actors.

The second group of projects corresponds to boundary management. Activities in this section are those of facilitation between actors, including potential active mediation of trade-offs. Four teams at PlanAPP conduct boundary management projects of this kind: the Partnerships and Innovation group, PI; the Monitoring Unit, MU; the Lab2050 group; and the Planning and Foresight Team (PFT).

PI's projects include: the "Science and Policy: How to build bridges?" Workshops, which seek to promote a culture of science for policy by reaching out to the Portuguese scientific community (PlanAPP, 2023a); and the "Roundtable Sessions", which are another group of activities contributing to institutionalise a

culture of Science for Policy in Portugal by defining and testing participatory methodologies that may be applied to different policy issues – one project (PlanAPP, 2023b) brings together researchers and academics and policymakers around specific policy issues to discuss how to improve communication and data and knowledge sharing between the two communities; another project, "Soil and Water 2030: Anticipating Strategies for Climate Change Mitigation and Adaptation project" (PlanAPP, 2023b) will involve researchers policymakers and stakeholders from civil society, to produce two policy briefs (on water governance objectives for 2027, and on soil climate change adaptation and mitigation targets for 2030). PlanAPP's MU is implementing "Portugal's Sustainable Developing Goals Monitoring Scheme", which includes collaborative work with public administration entities and with relevant civil society actors. PlanAPP's Lab2050 team is implementing a futures' visioning exercise, collecting visions that emerge from citizen-assembly-like meetings (PlanAPP, 2023a). The MU is also developing a Living Lab to co-construct a roadmap for the participation of people living in poverty in the monitoring of Portugal's Poverty Strategy. Finally, PlanAPP's PFT participates in the European project "Open Strategic Autonomy" (PlanAPP, 2023a), a project centred on policymaking that also involves citizen engagement activities.

Finally, the third group of activities is related to knowledge brokerage. Knowledge brokerage ensures alignment between the needs of the public policy community and the evidence that is produced and provided, and which may be gathered from multiple sources. Most projects in this section arise to answer specific requests by policymakers and ministries—such as modelling studies and evaluation reports. Examples in this category include a pilot study for the implementation of the 4-day week in Public Administration (PlanAPP, 2023b), which is

Table 1 PlanAPP's projects 2023.

	Activity	Actors	Project	Partner entities	Expected output
1	Boundary object	Science	Economic impact at regional scale analysis tool	Faculty of Economics—University of Coimbra (FEUC)	Software Prototype
2	Boundary object	Science	Artificial Intelligence for Better Regulation in the European Union	NOVA IMS Information Management School	AI Prototype
3	Boundary object	Public policy	SIBER - Standardise Statistical Information for Better Regulation project	Organisation for Economic Co-operation Development (OECD) and National Institute of Statistics (INE)	Prototype
4	Boundary object/ Boundary management	Science & public policy	Elaboration of economic growth and demographic projections articulated scenarios	Regional Coordination and Development Commission—Centre (CCDR-C) and University of Aveiro	Prototype
5	Boundary object/ Boundary management	Science & public policy	Technical Support for the Implementation of the National Strategy to Fight Poverty	National Strategy to Fight Poverty Coordination, Strategy and Planning Office (GEP - Ministry of Labour, Solidarity and Social Security) and Institute of Social Sciences—University of Lisbon	Action Plan 2022-2025
6	Boundary object/ Boundary management	Public policy & society	2030 Agenda Roadmap (SDGs)	General Secretariat of the Presidency of the Council of Ministers (SGPCM), Directorate General for Foreign Policy (DGPE) and Statistics Portugal (INE)	Voluntary National Review—SDGs report
7	Boundary management	Society	PlanAPP's Futures' visioning Project "Lab2050"	Local municipalities; Primary and secondary schools; Dona Maria II National Theatre; Portuguese Association of Writers (APE); University of Porto; World Youth Day; University of Manchester; Citizens Forum; Contacto—Science Fiction and Fantasy Literary Festival	Reports on the visions emerging from the meetings
8	Boundary management	Science	Science and Policy: How to build bridges? Workshops	Joint Research Centre—European Commission	Science for policy multidisciplinary community of practice
9	Boundary management	Science, public policy & society	Soil and Water 2030: Anticipating Integrative Strategies for Mitigation and Adaptation to Climate Change for the resources water and soil	Associated Laboratory CHANGE	2 policy briefs (one for each resource)
10	Boundary management	Science & public policy	Roundtables Session for the Institutionalisation of a Culture of Science for Policy in Portugal	Organisation for Economic Co-operation and Development (OECD)	Policy brief
11	Boundary management	Public policy	Open Strategic Autonomy (European project)	Strategy and Studies Office (GEE—Ministry of Economy), Strategy and Planning Office (GEP—Ministry of Labour, Solidarity and Social Security), Directorate General for European Affairs (DGAE) and National Laboratory of Energy and Geology (LNEG).	Recommendation report for the Spanish Presidency of the Council of the European Union
12	Boundary management/ Knowledge brokerage	Public policy	Lease contracts prior to the urban lease regime - quantification and characterisation study (article 228 of the 2022 state budget law)	Housing and Urban Rehabilitation Institute (IHRU), Tax Administration (AT) and National Institute of Statistics (INE).	Policy brief/Analysis of alternative policy possibilities and recommendation report
13	Knowledge brokerage	Science & public policy	PlanAPP's Annual Competitive Science4Policy Call for Projects	Foundation for Science and Technology (FCT) Research units	22 S4P projects financed, each of which will produce a police brief
14	Knowledge brokerage	Public policy	Ex-post evaluation of "Cooperativa na Hora"	Institute of Registries and Notary Public (IRN)	Evaluation report

Table 1 (continued)

	Activity	Actors	Project	Partner entities	Expected output
15	Knowledge brokerage	Public policy	Evaluation of the incentive to cinematographic and audiovisual production "Cash Rebate"	Office of Cultural Strategy, Planning and Evaluation (GEPAC - Ministry of Culture) and Strategy and Studies Office (GEE—Ministry of Economy)	Evaluation report
16	Knowledge brokerage	Public policy	Study on the organisation of working time and pilot study of the 4-day week in PA	Directorate-general for Administration and Public Employment (DGAEP)	Literature review/Analysis of alternative policy possibilities and recommendation report
17	Knowledge brokerage	Public policy	Ex-post evaluation of quotas in administration	Commission for Citizenship and Gender Equality (CIG)	Evaluation report
18	Knowledge brokerage	Public Policy	Evaluation of the Youth Participatory Budgeting Portugal (OPJP)	Portuguese Institute for Sport and Youth (IPDJ)	Evaluation report
19	Knowledge brokerage	Public policy	Ex-ante evaluation of the diplomas in simplification with Simplex licensing	Office of the Secretary of State for Administrative Modernisation	Evaluation report

Source: Authors elaboration (in July 2023) based on PlanAPP's website (PlanAPP, 2023a), PlanAPP's *Project Database* ("Mapa de Projetos": PlanAPP, 2023b), and PlanAPP's *Activities Programme* 2023 ("Programa de Atividades" PlanAPP, 2022b).

being coordinated by a senior strategy advisor at PlanAPP; and evaluation studies of public policies conducted by PlanAPP's Evaluation Unit (EU) and Regulatory Impact Assessment Unit (RIEU), which include, for example, "Cooperativa na Hora" (PlanAPP, 2023b), as well as the incentive to cinematographic and audiovisual production scheme "Cash Rebate" (PlanAPP, 2023b). PlanAPP's Annual "Science for Policy" Call for Projects (PlanAPP, 2023b) is being developed by the PI group through a partnership with Portugal's Foundation for Science and Technology (FCT). This activity seeks to intensify PlanAPP's role in support of knowledge brokerage by financing 12–18 month projects on issues put forward by policymakers and ministries from at least two different governmental areas in a scheme inspired by Finland's TEA working group (TEA is the government's working group for the coordination of research, foresight and assessment activities). TEA includes representatives of all ministries, and the group plays a key role in the selection of the research topics that are included in the government's annual research plan (Finnish Government, 2021).

It is thus clear that PlanAPP engages intensely in BO activities, taking full advantage of the opportunity provided by its institutional mandate.

How well do PlanAPP and RePLAN encompass the characteristics identified as essential for PCC and KG? PlanAPP and RePLAN's mandates encompass mechanisms of internal networking. RePLAN is composed of representatives from each government area with expertise in planning, policy, and foresight. The network may potentially be mobilised to produce whole-of-government strategies, which require horizontal coordination, and bring coherence and alignment between sectoral plans and cross-cutting strategic national documents, such as the Portugal 2030 Strategy, Portugal's Recovery and Resilience Plan, Portugal's National Reform Plan and Major Planning Options (Diário da República, 2021). The latter two are already coordinated by PlanAPP. This involved the creation of "informal" internal networks/working groups within the Administration to elaborate cross-sectoral documents and coordinate proposals and contributions from several departments.

External actor's engagement is ongoing at PlanAPP. This is explicit in PlanAPP's institutional setting through partnerships (see Table 2). The establishment of institutional partnerships with research units from the National Science, Technology and Higher Education System and other relevant entities, from public administration and civil society is a primary means through which PlanAPP may promote contact between its internal network of partners with external actors. The formalisation of collaboration agreements with stakeholders, which set clear roles and responsibilities for both parties and include provisions of intellectual property and confidentiality, allows for the establishment of long-lasting institutional relationships with a variety of policy-relevant knowledge producers located across society. These agreements may cover matters of technical and scientific cooperation, namely, to produce policy-relevant research, but also provide the opportunity for capacity-building initiatives, such as the development of training workshops for policymakers. These relationships, enforced through specific projects relevant to PlanAPP's mission, are based on terms agreed upon between the parties.

There are explicit mechanisms included in PlanAPP's mandate for knowledge production and sharing, which are closely linked to networking and collaborative work. These mechanisms are resulting in: (1) skill development and training sustained through partnerships, namely with Portuguese academia and research centres; (2) the creation of multidisciplinary and multisectoral

Table 2 Policy coordination and coherence and knowledge governance potential of PlanAPP and RePLAN.	
Characteristics	**Activities**
Internal networking	RePLAN (composed of representatives of Public Administration entities under different ministries)
	PlanAPP (Coordination of cross-cutting strategic national documents such as the National Reform Plan and Major Planning Options)
External networking	Partnerships with academia and entities from Portugal's national science system
	Citizen engagement mechanisms (for example, PlanAPP's Foresight Project "Lab2050")
Knowledge sharing	Partnerships with academia and entities from Portugal's national science system
	Multidisciplinary teams within PlanAPP Multisectoral teams within RePLAN

Source: Author's elaboration (in July 2023) based on PlanAPP's website (PlanAPP, 2023a) and PlanAPP's *Project Database* ("Mapa de Projetos": PlanAPP, 2023b).

(even if informal) teams with other entities from the Public Administration for specific projects which promote knowledge among participants; (3) PlanAPP's presiding to RePLAN and the creation of multisectoral teams, which are envisaged to contribute to break discipline and government sector silos.

Planned activities for 2023 by PlanAPP's technical teams include the production of content for manuals, support tools and implementation/action guides for the public policy cycle, as well as of content to promote literacy in public policies (on sectoral and technical topics) through interviews and podcasts with relevant actors (PlanAPP, 2022b), further contributing to share knowledge and best practices.

To promote capacity building, PlanAPP and RePLAN will survey Public Administration entities regarding technical skills and training needs in the areas of planning foresight, monitoring, and evaluation to create a "Skills Incubator for Public Policy". The Incubator aims to develop specialised training for civil servants, produce and disseminate knowledge and develop a sector studies agenda (PlanAPP, 2023d). The studies agenda encompasses an agenda for studies within the scope of Portugal's Major Planning Options (a government document produced annually), and studies and analyses by research centres and researchers, contributing to a repository of scientific evidence to support policymaking (PlanAPP, 2023d).

Discussion and conclusions

Holistic approaches that counteract the fragmentation and specialisation characteristic of New Public Management are on the rise, but they may be insufficient to address the knowledge input and increased policy coordination and coherence required to manage present levels of complexity and uncertainty. This paper evaluates the potential of a newly created public administration competence centre in Portugal to contribute as a boundary organisation to policymaking in times of complexity.

A literature review identified strategies to improve policy-making for complex challenges from the combined perspective of Policy Coordination and Coherence (PCC) and Knowledge Governance (KG) (section "Combining policy coordination and coherence and knowledge governance"). The review points to three central ingredients: internal networking, external networking, and knowledge sharing. These elements combined are required for PCC and may potentiate a transition to institutional settings that increasingly embed KG.

The key insights from the state-of-the-art on PCC and KG also revealed the potential relevance that boundary organisations (BOs) may assume in better public policy to face wicked issues (see the section "Boundary organisations"). BOs may be public administration entities that promote work on the knowledge-citizen-policy interface. These arrangements are inherently transdisciplinary, multi-level and multi-actor. Public policy BOs are recognisable as entities associated with the production of

boundary objects: policy briefs or prototypes that are the product of participatory processes involving the three groups of actors of public policy (policymakers, citizens, scientists). BOs contribute to manage boundaries (tensions and trade-offs) and act as knowledge brokers, entities that adjust evidence delivery to policy-making demands. By their nature BOs may thus increasingly fulfil their role as potentially vital players to support effective governance in complex and crisis-driven times (Gustafsson and Lidskog, 2018; Hoppe and Wesselink, 2014).

In Public Administration, BOs may, therefore, assume a central role in PCC, and also, by their very nature, drive the shift in public administration from Knowledge Management towards Knowledge Governance. PlanAPP's strategic setting is that of a BO (see the section "PlanAPP and RePLAN's institutional and legal setting") and PlanAPP engages in boundary activities—including boundary management, knowledge brokerage and boundary object production (see the section "Does PlanAPP engage in boundary activities?")—taking full advantage of the opportunity provided by its institutional mandate.

The setting of PlanAPP as a potential BO is in itself a break-through. Previous attempts to install a BO for Technology Assessment at the Portuguese Parliament (see Almeida, 2015; Böhle and Moniz, 2015) were abandoned, perhaps indicating a difficulty with institutional innovation. Furthermore, PlanAPP and its link to RePLAN provide an opportunity to follow-up on Simões (2021), who highlighted the need to connect a scattered science-for-policy ecosystem.

Nevertheless, there is room to intensify the production of boundary objects using participatory methodologies for the production of shared outputs. In particular, there is plenty of room to intensify citizen involvement in PlanAPP's boundary activities. Indeed, increased citizen participation in governance may foster trust in public institutions through recognised policy legitimacy (OECD, 2023). Citizen participation may contribute to balancing the role of scientific advisers, as cautioned by Jasanoff (1990). Moreover, citizen participation contributes to empower communities by addressing matters of collective concern. Finally, opening up to citizens in policymaking strengthens participatory rights, deliberation, the majoritarian principle, democratic representation, and transparency (Landemore, 2020).

Knowledge broker activity at PlanAPP may be enriched by promoting boundary management activities—as actors make decisions collaboratively, negotiate how to address the multiple dimensions of a problem, and identify what may be learned for future related situations (Michaels, 2009; Tengo et al., 2014). Indeed, PlanAPP and RePLAN's multisectoral teams could work as "engagement hubs" between academia and scientific research centres, government bodies and civil society, and as "creative hubs" for mutual knowledge sharing and policy co-creation processes. Multisectoral teams would then play a role both in internal network collaboration and in external networking, bringing together policy-makers and different actors from science

and society to address specific policy issues collaboratively, strengthening stakeholder engagement in the policy-making process. Functioning as learning incubators, multisectoral teams would then also encourage the development of co-creation skills among participants. Knowledge gained in these teams would then propagate through internal networks by pollination into public administration entities.

There is presently no specific mandate to enhance citizen or scientific researcher engagement and participatory mechanisms through RePLAN, but this could be accommodated through its multisectoral teams in the future. Such multi-actor collaborative groups could be structured around policy topics (such as housing, demography, water, and crisis management) rather than policy stages (such as planning, foresight, evaluation, etc.) intensifying evidence-informed policymaking.

Internal networks (including those that RePLAN has already created) could also provide the space (and time) needed to recognise, by experience, the benefits that a reconceptualization of knowledge as a "common good" would bring. Looking at knowledge as a "common good" means developing arrangements for overcoming tensions associated with information production, information sharing, innovation, and creative work within Public Administration. The knowledge required to handle complex problems successfully may require more debate among public policy actors, which will also likely defy crystalized assumptions about "expertise" that usually encode power relations.

PlanAPP and RePLAN may promote engagement activities that go beyond the national consultation mechanisms that already exist in Portugal but commonly take place at the end of the policy-making process (implemented through three web platforms www.consultalex.gov.pt, www.participa.gov.pt, www.participa.pt; see OECD, 2022, p. 52). Increased stakeholder participation in governance and the production of shared objects (boundary objects), which all actors recognise as legitimate, can enhance trust (OECD, 2023). Multi-actor projects, such as the project "Soil and Water 2030" (see the section "Does PlanAPP engage in boundary activities?"), may be used to test this idea. Aligning with Cooke et al. (2021), the project "Soil and Water 2030" aims to develop a participatory approach to improve water governance in Portugal, as well as to identify the country's climate change mitigation and adaptation objectives for soil. The project also aims to deliver a methodology for co-participatory policy design that mobilises the three actors of public policy and is reproducible in other complex or cross-cutting issues. Projects of such nature may also contribute to strengthen PlanAPP's role as a BO at the Centre of Government, enabling policy innovation and capacity building in policy-making. Measuring the impact of such initiatives on their participants, and thereby evaluate the impact of boundary activity on policy, would be a welcome addition to this framework and a necessary step to identify needs and gaps that require mending.

We have focused on PlanAPP's potential contribution to PCC and KG and its potential role as BO. Nevertheless, PlanAPP has other roles. For example, we have not addressed the interface between complex problems and PlanAPP's routine tasks (such as developing annual government action plans). PlanAPP's actual or potential contribution to wider government responsibilities will also matter as they define evidence requirements—a central knowledge brokerage function—which, in turn, require resource allocation and prioritisation.

The methodology we have described does not serve as an assessment framework for BOs or for their projects but rather as an analytical framework on the boundary potential of a given entity. Indeed, it may work as a starting point for reflection and learning on dealing with policy for complex problems, supporting governance in crisis-driven times and the required strategies for

knowledge and evidence mobilisation to inform policy and decision-making. Nevertheless, the methodology we have defined is, in principle, reproducible in other contexts, where it may similarly be used as a starting point to study other organisations.

Our study's results must also be considered within the limitation of the sources used (legal documents, PlanAPP's website and project database, and PlanAPP's and RePLAN's Annual Activity Plan) and the fact that the authors are part of the organisation, which could lead to researcher bias. In future analyses, other sources of information could be used, such as, surveying project leaders to detail information and explore their focus on outcomes, as well as interviewing project leaders from other BOs for their experiences and perspectives as a source of comparison. These additional steps may deepen our understanding of PlanAPP's potential weaknesses and strengths.

Further research on the institutional setting of BOs will improve our understanding of their role in enhancing successful PCC and in KG, to address complex problems. This paper's conclusions and analytical framework should be viewed as a starting point for future studies, including further analysis of PlanAPP and RePLAN and their contribution to evidence-informed policy-making, including managing wicked problems.

Data availability

No data were generated. Documents and project databases not publicly available (PlanAPP (2022a) *PlanAPP—Presente e Futuro*; PlanAPP (2023b) *Mapa de projetos PlanAPP*; PlanAPP (2023d) *RePLAN—Plano de Ação* 2023–2024) will be supplied on request (please note they are available only in Portuguese).

References

Almeida M (2015) Parliamentary TA in Portugal: a comparative analysis of two models. TATuP 24(3):102–108. https://doi.org/10.14512/tatup.24.3.102

Barbosa A, Carrilho R, Cabete D, Sobral S, Vala F (2022) Bridging the gap between science and policy in Portugal: using PlanAPP as a case study for the role of boundary organizations. Paper presented at the European Group for Public Administration (EGPA) Conference, Lisbon, 6–9 September 2022

Beierle TC, Konisky DM (2000) Values, conflict, and trust in participatory environmental planning. J Policy Anal Manag 19(4):587–602. https://doi.org/10.1002/1520-6688(200023)19:4%3C587::AID-PAM4%3E3.0.CO;2-Q

Bianchi C, Peters BG (2018) Measuring coordination and coherence: assessing performance across the public sector. In: Borgonovi E, Anessi-Pessina E, Bianchi C (eds) Outcome-based performance management in the public sector, vol. 2. Springer, Cham, pp. 143–159

Böhle K, Moniz A (2015) No countries for old technology assessment? Sketching the efforts and opportunities to establish parliamentary TA in Spain and Portugal. TATuP 24(1):29–44. https://doi.org/10.14512/tatup.24.1.29

Bouckaert G, Peters BG, Verhoest, K (2010) Coordination of public sector organizations. Palgrave Macmillan, London

Cabete D, Sobral S, Carrilho R, Barbosa A, Vala F (2022) Improving interministerial cooperation within the scope of RePLAN: European experiences on Policy Coordination. Paper presented at the European Group for Public Administration (EGPA) Conference, Lisbon, 6–9 September 2022

Cash D, Clark WC, Alcock F, Dickson NM, Eckley N, Jäger, J (2003) Salience, credibility, legitimacy and boundaries: linking research, assessment and decision making. KSG Working Papers Series, Harvard, pp. 1–24

Cash DW, Borck JC, Patt AG (2006) Countering the loading-dock approach to linking science and decision making: comparative analysis of El Niño/Southern Oscillation (ENSO) forecasting systems. Sci Technol Hum Values 31(4):465–494. https://doi.org/10.1177/0162243906287547

Cejudo GM, Michel CL (2017) Addressing fragmented government action: Coordination, coherence, and integration. Policy Sci 50:745–767. https://doi.org/10.1007/s11077-017-9281-5

Christensen J, Serrano Velarde K (2019) The role of advisory bodies in the emergence of cross-cutting policy issues: comparing innovation policy in

Norway and Germany. Eur Politics Soc 20(1):49–65. https://doi.org/10.1080/23745118.2018.1515864

Clarke B, Stocker L, Coffey B, Leith P, Harvey N, Baldwin C, Baxter T, Bruekers G, Galano CD, Good M (2013) Enhancing the knowledge–governance interface: Coasts, climate and collaboration. Ocean Coast Manag 86:88–99. https://doi.org/10.1016/j.ocecoaman.2013.02.009

Cooke B, Kothari U (2001) Participation: the new tyranny? Zed Books, New York

Cooke SJ, Nguyen VM, Chapman JM, Reid AJ, Landsman SJ, Young N, Hinch SG, Schott S, Mandrak NE, Semeniuk CA (2021) Knowledge co-production: a pathway to effective fisheries management, conservation, and governance. Fisheries 46(2):89-97. https://doi.org/10.1002/fsh.10512

Cummings S, Kiwanuka S, Gillman H, Regeer B (2019) The future of knowledge brokering: perspectives from a generational framework of knowledge management for international development. Inf Dev 35(5):781–794. https://doi.org/10.1177/0266666918800174

de Wit F, Lourenço A, Moreira H, Vala F (2022) Towards knowledge governance in public administration. In: Cerchione R, Centobelli P (eds) Proceedings of the 23rd European conference on knowledge management, Naples, Academic Conferences International, 2022

Diário da República (2021) Decreto Lei no. 21/2021 da Presidência do Conselho de Ministros. https://diariodarepublica.pt/dr/detalhe/decreto-lei/21-2021-159432384. Accessed 11 Jul 2023

Fazey I, Schäpke N, Caniglia G et al. (2020) Transforming knowledge systems for life on Earth: visions of future systems and how to get there. Energy Res Soc Sci 70(101724):1–18. https://doi.org/10.1016/j.erss.2020.101724

Feagan M, Matsler M, Meerow S, Muñoz-Erickson TA, Hobbins R, Gim C, Miller CA (2019) Redesigning knowledge systems for urban resilience. Environ Sci Policy 101:358–363

Feio P (2021) Sistemas de Apoio à Reflexão Estratégica e à Decisão Política: que papel para a Administração Pública? Contributos para um debate necessário. Rev Adm Emprego Público 6:83–107

Finnish Government (2021) Government plan for analysis, assessment and research in support of decision-making 2022. Finnish Government. Government+plan+for+analysis,+assessment+and+research+in+sup-port+of+decision-making+2022.pdf (tietokayttoon.fi). Accessed 27 Jun 2023

Flyvbjerg B (2011) Case study. In: Denzin NK, Lincoln, YS (eds) The Sage handbook of qualitative research. Sage, Thousand Oaks, CA

Friend JK (1987) Planning under pressure: the strategic choice approach. Pergamon Press, Oxford

Gerritsen AL, Stuiver M, Termeer CJ (2013) Knowledge governance: An exploration of principles, impact, and barriers. Sci Public Policy 40(5):604–615. https://doi.org/10.1093/scipol/sct012

Gluckman PD, Bardsley A, Kaiser M (2021) Brokerage at the science–policy interface: from conceptual framework to practical guidance. Humanit Soc Sci Commun 8(1):1–10. https://doi.org/10.1057/s41599-021-00756-3

Gustafsson KM, Lidskog R (2018) Boundary organizations and environmental governance: performance, institutional design, and conceptual development. Clim Risk Manag 19:1–11. https://doi.org/10.1016/j.crm.2017.11.001

Guston DH (1999) Stabilizing the boundary between US politics and science: the role of the Office of Technology Transfer as a boundary organization. Soc Stud Sci 29(1):87–111. https://doi.org/10.1177/030631299029001004

Guston DH (2001) Boundary organizations in environmental policy and science: an introduction. Sci Technol Hum Values 26(4):399–408. https://doi.org/10.1177/016224390102600401

Haas P (1992) Introduction: epistemic communities and International Policy Coordination. Int. Organ. 46(1):1–35

Hellström E, Ikäheimo H (2017) Knowledge in decision-making in Finland. Sitra. https://www.sitra.fi/en/publications/knowledge-decision-making-finland-towards-greater-dialogue/ Accessed 22 Jun 2023

Hess C, Ostrom E (2005) A framework for analyzing the knowledge commons: a chapter from understanding knowledge as a commons: from theory to practice. MIT Press, Cambridge, MA

Honeck E, Gallagher L, von Arx B, Lehmann A, Wyler N, Villarrubia O, Guinaudeau B, Schlaepfer MA(2021) Integrating ecosystem services into policymaking—a case study on the use of boundary organizations Ecosyst Serv 49(10):101286. https://doi.org/10.1016/j.ecoser.2021.101286

Hoppe R, Wesselink A (2014) Comparing the role of boundary organizations in the governance of climate change in three EU member states. Environ Sci Policy 44:73–85. https://doi.org/10.1016/j.envsci.2014.07.002

Hoppe R, Wesselink A, Cairns R (2013) Lost in the problem: the role of boundary organisations in the governance of climate change. WIREs Clim Change 4(4):283–300. https://doi.org/10.1002/wcc.225

Jasanoff S (1990) The fifth branch: science advisers as policymakers. Harvard University Press, Cambridge, MA

Kirchhoff CJ, Carmen Lemos M, Dessai S (2013) Actionable knowledge for environmental decision making: broadening the usability of climate science. Annu Rev Environ Resour 38:393–414

Landemore H (2020) Open democracy: reinventing popular rule for the twenty-first century. Princeton University Press, Princeton, NJ

Lapuente V, Van de Walle S (2020) The effects of new public management on the quality of public services. Governance 33(3):461–475. https://doi.org/10.1111/gove.12502

Meyer M (2010) The rise of the knowledge broker. Sci Commun 32(11):118–127. https://doi.org/10.1177/1075547009359797

Michaels S (2009) Matching knowledge brokering strategies to environmental policy problems and settings. Environ Sci Policy 12(7):994–1011. https://doi.org/10.1016/j.envsci.2009.05.002

Nevens F, Frantzeskaki N, Gorissen L, Loorbach D (2013) Urban Transition Labs: co-creating transformative action for sustainable cities. J Clean Prod 50:111–122. https://doi.org/10.1016/j.jclepro.2012.12.001

Newman J, Head BW (2017) Wicked tendencies in policy problems: rethinking the distinction between social and technical problems. Policy Soc 36(3):414–429. https://doi.org/10.1080/14494035.2017.1361635

OECD (2017) Skills for a high performing civil service. OECD Publishing, Paris

OECD (2020a) Building capacity for evidence-informed policy-making. OECD Publishing, Paris

OECD (2020b) Policy framework on sound public governance: baseline features of governments that work well. OECD Publishing, Paris

OECD (2022) Improving decision making and policy development in Portugal, No. 29. OECD Publishing, Paris

OECD (2023) Lessons from the OECD Trust Survey in Portugal, No. 27. OECD Publishing, Paris

Oliver TH, Benini L, Borja A, Dupont C, Doherty B, Grodzińska-Jurczak M, Iglesias A, Jordan A, Kass G, Lung T (2021) Knowledge architecture for the wise governance of sustainability transitions. Environ Sci Policy 126:152–163. https://doi.org/10.1016/j.envsci.2021.09.025

Parker J, Crona B (2012) On being all things to all people: boundary organizations and the contemporary research university. Soc Stud Sci 42(2):262–289. https://doi.org/10.1177/0306312711435833

Pedersen DB (2023) An evaluation framework for institutional capacity of science-for-policy ecosystems in EU Member States. In: Krieger K, Melchor Fernandez L (eds) Developing an evaluation framework for science-for-policy ecosystems. Publications Office of the European Union, Luxembourg

Pereira ÂG, Völker T (2020) Engaging with citizens. In: Šucha V, Sienkiewic M (eds) Science for policy handbook. Elsevier, Amsterdam, pp. 20–30

Peters BG (1998) Managing horizontal government. the politics of coordination. Public Adm 76(2):295–311. https://doi.org/10.1111/1467-9299.00102

Peters BG (2018) The challenge of policy coordination. Policy Des Pract 1(1):1–11. https://doi.org/10.1080/25741292.2018.1437946

PlanAPP (2022a) PlanAPP—Presente e Futuro. Accessed 11 Jul 2023

PlanAPP (2022b) Plano de Atividades do PlanAPP—2023. PlanAPP. https://www.planapp.gov.pt/wp-content/uploads/2023/12/Plano-de-Atividades-PlanAPP-2023.pdf. Accessed 12 Jul 2023

PlanAPP (2023a) Projetos. https://planapp.gov.pt/projetos/. Accessed 11 Jul 2023

PlanAPP (2023b) Mapa de Projetos PlanAPP. Accessed 11 Jul 2023

PlanAPP (2023c) RePLAN—composição. https://planapp.gov.pt/composicao-replan/. Accessed 12 Jul 2023

PlanAPP (2023d) RePLAN—Plano de Ação 2023–2024. Accessed 12 Jul 2023

Rathwell KJ, Armitage D, Berkes F (2015) Bridging knowledge systems to enhance governance of the environmental commons: a typology of settings. Int J Commons 9(2):851–880. https://doi.org/10.18352/ijc.584

Rice JL, Burke BJ, Heynen N (2015) Knowing climate change, embodying climate praxis: experiential knowledge in Southern Appalachia. Ann Assoc Am Geogr 105(2):253–262. https://doi.org/10.1080/00045608.2014.985628

Rittel HW, Webber MM (1973) Dilemmas in a general theory of planning. Policy Sci 4(2):155–169

Schwendinger F, Topp L, Kovacs V (2022) Competences for policymaking. Publications Office of the European Union, Luxembourg

Sienkiewicz M, Mair D (2020) Against the science–policy binary separation: science for policy 1.0. In: Šucha V, Sienkiewic M (eds) Science for policy handbook. Elsevier, Amsterdam, pp. 20–30

Simões VC (2021) Science for policy in Portugal. In: Melchor Fernandez L, Krieger K (eds) Developing an evaluation framework for science-for-policy ecosystems. Publications Office of the European Union, Luxembourg

Star SL, Griesemer JR (1989) Institutional ecology, translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. Soc Stud Sci 19(3):387–420. https://doi.org/10.1177/030631289019003001

Šucha V, Dewar M (2020) Institutional framework for the science–policy interaction. In: Šucha V, Sienkiewic M (eds) Science for policy handbook. Elsevier, Amsterdam, pp. 20–30

Tengö M, Brondizio ES, Elmqvist T, Malmer P, Spierenburg M (2014) Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. Ambio 43:579–591. https://doi.org/10.1007/s13280-014-0501-3

Topp L, Mair D, Smillie L, Cairney P (2018) Knowledge management for policy impact: the case of the European Commission's Joint Research Centre. Palgrave Commun 4:1–10. https://doi.org/10.1057/s41599-018-0143-3

Topp L, Mair D, Smillie L, Cairney P (2020) Skills for co-creation. In: Šucha V, Sienkiewic M (eds) Science for policy handbook. Elsevier, Amsterdam, pp. 20–30

Trein P, Ansell CK (2020) Countering fragmentation, taking back the state, or partisan agenda-setting—explaining policy integration and administrative coordination reforms. Governance 34(4):1143–1166. https://doi.org/10.1111/gove.12550

Trein P, Maggetti M (2019) Patterns of policy integration and administrative coordination reforms: a comparative empirical analysis. Public Adm Rev 80(2):198–208. https://doi.org/10.1111/puar.13117

van der Molen F, van der Windt HJ, Swart JA (2016) The interplay between knowledge and governance: insights from the governance of recreational boating in the Dutch Wadden Sea area, 1981–2014. Environ Sci Policy 55:436–448. https://doi.org/10.1016/j.envsci.2015.02.012

van Enst WI, Runhaar HA, Driessen PP (2016) Boundary organisations and their strategies: three cases in the Wadden Sea. Environ Sci Policy 55:416–423. https://doi.org/10.1016/j.envsci.2015.08.016

Van Kerkhoff L (2014) Knowledge governance for sustainable development: a review. Chall Sustain 1:82–93. https://doi.org/10.12924/cis2013.01020082

West S, van Kerkhoff L, Wagenaar H (2019) Beyond "linking knowledge and action": towards a practice-based approach to transdisciplinary sustainability interventions. Policy Stud 40(5):534–555. https://doi.org/10.1080/01442872.2019.1618810

Wyborn C, van Kerkhoff L, Dunlop M, Dudley N, Guevara O (2016) Future oriented conservation: knowledge governance, uncertainty and learning. Biodivers Conserv 25:1401–1408. https://doi.org/10.1007/s10531-016-1130-x

Author contributions

All authors participated in conceptualising the study and conducting the literature review. This paper builds upon three previous works presented at congress meetings by the authors. The current manuscript underwent substantial revision by Fronika de Wit, Susana Sobral, and Filipa Vala, based on those earlier works. Filipa Vala edited the manuscript incorporating feedback from four reviewers of previous versions (refer to Acknowledgements). The development of this manuscript was supervised by Filipa Vala.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information

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