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Bringing together unlikely innovators: do connective and learning capacities impact collaboration for innovation and diversity of actors?

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Abstract: Recent scholarly wisdom suggests that public sector organisations (PSOs) should not always innovate alone. Collaboration with diverse actors is often proposed so that more and better innovations can be developed. However, it remains unclear what capacities PSOs need in order to participate in collaborative arrangements for innovation and to collaborate with diverse innovation partners. Using survey data from Belgian federal and Flemish public managers, we show that the connective and learning capacities of PSOs contribute positively to their participation in collaborative arrangements for innovation, and to the diversity of actors with which they collaborate.

Keywords: Public sector organisations; innovation; collaboration; diversity; connective capacity; learning capacity

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Introduction

Public sector organisations (PSOs) across the world are compelled to innovate in order to better address complex societal issues (Ansell, Sørensen, & Torfing, 2020). This involves the development, adoption, implementation or diffusion of new public policies, services, administrative processes and technologies qualitatively different from existing policies, services, processes and technologies (Osborne & Brown, 2011; Potts & Kastle, 2010). Because of its documented impact on (inter)organisational performance, legitimacy and trustworthiness, there is growing scholarly and policy interest in how to enhance public sector innovation (Torfing & Ansell, 2017). The recent scholarly literature largely agrees that the increasing complexity of societal problems requires public sector innovations that emanate from multi-actor collaborative arrangements involving diverse actors. Such collaborations, it is thought, may enhance both the quality and quantity of public sector innovations (Ansell & Torfing, 2014; Bommert, 2010; Sørensen & Torfing, 2011; Torfing, 2019). However, PSOs are not always inherently oriented towards innovation, let alone collaborative innovation (Gieske, Duijn, & van Buuren, 2020; Piening, 2013).

Collaborative innovation promises to be a powerful strategy to solve complex or intractable issues by opening up the public innovation cycle to a diversity of actors (Bommert, 2010). Through intense collaboration with various actors, PSOs can access resources and expertise that transcend their own boundaries; fruitful configurations between existing knowledge and novel ideas needed for innovation can emerge (Bommert, 2010; Hartley, Sørensen, & Torfing, 2013; Mintrom & Vergari, 1998; Sørensen & Torfing, 2011). In any case, there can be no collaborative innovation without collaboration for innovation. Understanding which factors influence whether and to what extent PSOs collaborate with diverse actors on the development or implementation of innovations is therefore crucial to better understanding the occurrence and implications

of collaborative innovation. Although inter-organisational collaboration for innovation (which goes beyond mere activities of coordination or cooperation) and the diversity of actors in such collaborations have long been the subject of innovation research (Granovetter, 1983), the current public sector innovation literature has only marginally touched upon their antecedents (De Vries, Bekkers, & Tummers, 2016).

This article will therefore develop and test the argument that PSOs increasingly collaborate with other actors for innovation, and that these actors are increasingly diverse, to the extent that these PSOs can counter fragmentation (in their own organisation as well as in their interactions with other organisations) and can acquire new knowledge (from their own employees as well as from external actors). Our framework draws on theories of public sector innovation, collaborative innovation, and on the capacity for innovation framework of Gieske, van Buuren, and Bekkers (2016). Combined, these conceptual sources form a comprehensive theoretical lens that helps us assess the organisational antecedents of collaboration for innovation with diverse innovation partners. In doing so, we illustrate which of the outlined organisational characteristics can foster intense and diverse collaboration for innovation. Accordingly, our study asks: Do the capacities of PSOs to connect and learn influence (1) the extent to which they engage in collaborative arrangements for innovation, and (2) the diversity of partners with which they collaborate on innovations?

The study of collaboration for innovation in the public sector has steadily grown in recent years and has become increasingly relevant in the aftermath of the COVID-19 pandemic (Mazzucato & Kattel, 2020). The pandemic has not only reaffirmed the importance of fostering crisis and dynamic capabilities of public organisations to combat the ‘grand challenges’ of our time. It has also accelerated the need for an integrative insight into how public sector capabilities and incentives enable PSOs to participate in collaborative

arrangements for innovation, devising and developing concrete solutions to these challenges. This article makes an original contribution to the literature on collaborative innovation in the public sector, by examining the relevance of organisational capacities and incentives to the intensity and diversity with which public organisations collaborate on innovations. The study does so in a novel empirical setting: all the ministries and semi-autonomous agencies in the Belgian federal and Flemish public sectors. As such, our study is able to capture insights from a large variety of PSOs in two governments and it provides practical insights into key characteristics that compel them to collaborate with diverse actors on innovations.

The remainder of this article is structured as follows. The theoretical framework considers the conceptual links between innovation, inter-organisational collaboration, diversity, and connective and learning capacities. The methods section outlines which data were gathered and how they were analysed. Thereafter, the results section presents descriptive and explanatory findings. Finally, we provide a discussion and conclusion in which we also address limitations and avenues for future research.

Theoretical framework

Collaborative approaches to public sector innovation

Innovation is not idiosyncratic to the private market sector (Pollitt, 2003). Public sector organisations (PSOs) are also increasingly developing, testing, and implementing innovations. Some of the most notable innovations (e.g. the Internet and the World Wide Web) have even emanated from the public sector (Mazzucato, 2013; Mulgan, 2007). Looking at existing public sector innovation research, innovation is usually defined as an idea, product or technique perceived as novel by a particular public actor (De Vries et al., 2016; Rogers, 2003). This novelty may already exist or be applied elsewhere, but for the

developing or implementing PSO, it must represent a creative and radical difference compared to how a given issue was addressed in the past (Stevens & Agger, 2017). Relatedly, Sørensen and Torfing (2011) consider innovation an *intentional process that involves the generation, practical adoption and spread of new and creative ideas, which aim to produce a qualitative change in a specific context* (p. 849). Both definitions say much about what innovation is, but little about what innovation is not: an incremental change, improvement or adaptation of policies, technologies, services or processes that represent a continuity with the past (Damanpour, Walker, & Avellaneda, 2009; Gieske et al., 2016).

Conceptualising and exploring strategies to foster innovation has been a recurring topic in public sector innovation literature. Recently, scholars of New Public Governance (NPG) have proposed collaborative innovation as a superior approach (as opposed to hierarchical and market-based approaches) to public sector innovation (Agranoff, 2007; Bommert, 2010; Emerson, Nabatchi, & Balogh, 2012; Hartley et al., 2013; Roberts, 2000; Torfing, 2019). Starting from theories of collaborative governance, open innovation and networked government, the key tenet of collaborative public sector innovation is one of innovation processes wherein *actors from within the organisation, other [public] organisations, the private and third sector and citizens are integrated into the innovation cycle [...] from the earliest stage onwards* (Bommert, 2010, p. 16). This article scrutinises two aspects of collaborative innovation: intensity of collaboration for innovation and the diversity of actors in collaborative arrangements for innovation.

Inter-organisational collaborative arrangements for innovation

Collaborative innovation is impossible without collaboration. Hence, a substantial body of literature has focussed on the importance of the embeddedness of PSOs in inter-organisational collaborative arrangements (Ansell & Torfing, 2014). Collaboration is a

process of horizontal integration between actors that is more intensive than other forms of integration such as cooperation or coordination. Essentially, cooperation means that actors simply take into account each other's objectives and try to achieve them. Coordination goes further and constitutes an instrumental process that requires actors to “work together” through structured mechanisms and goals established in advance. Collaboration, on the other hand, requires “*much closer relationships, connections and resources and even a blurring of the boundaries between [the actors involved]*” (Keast, Brown, & Mandell, 2007, p. 19). Unlike cooperation and coordination, collaboration involves bringing together resources, expertise, and skills to achieve common objectives that the collaborating actors cannot achieve alone. More specifically, we define inter-organisational collaboration for innovation as: any form of interaction between two or more actors based on a mutual commitment to work together for a(n) (un)defined period, with a view to achieving a common goal that can only be realised through the exchange of resources and ideas. This definition covers collaborations originally aimed at developing or implementing an innovation, but also collaborations set up for a different purpose but in which the actors gradually felt compelled to develop or implement an innovation. It may include a wide range of arrangements, such as public-private partnerships (Brogaard, 2021; Callens, Verhoest, & Boon, 2021), governance networks (Sørensen & Torfing, 2017), intergovernmental networks (Voets & De Rynck, 2011) or collaborative innovation platforms (Ansell & Gash, 2018).

Recently, various arguments have been put forward as to why inter-organisational collaboration might spur the development and dissemination of public sector innovations (Torfing, 2019). In essence, collaboration may spark innovation through a process of synergy and learning if skilful metagovernance and leadership are applied (Ansell & Gash, 2012; Sørensen & Torfing, 2017). These synergy and learning processes may then

generate novel ideas combining the different perspectives that actors bring to the table. Nevertheless, a critical note on (collaborative) innovation is warranted. First, innovation outcomes are not necessarily welcomed by all stakeholders (Dudau, Kominis, & Szocs, 2018). Meijer and Thaens (2021) highlight ten ways in which public innovations can be considered ‘perverse’ or unwanted. Furthermore, innovation does not only follow from inter-organisational collaboration and, by the same token, collaboration does not always yield (expected) innovative outcomes (Hartley, 2016). The risks involved may well discourage PSOs from collaborating with others for innovation. However, even when collaboration is unsuccessful at first, it may produce *spin-offs*: continuing interactions and creative ideation processes that may still result in successful innovations later on (Sørensen & Torfing, 2017).

Diversity of actors in collaborative arrangements for innovation

A second key element of collaborative innovation is the involvement of a creativity-enhancing diversity of actors in the innovation process (Bommert, 2010; Hartley et al., 2013; Sørensen & Torfing, 2017). Diversity may increase the likelihood of a new nuanced understanding of the problem at hand, of synergy and mutual learning, and of better access for PSOs to the knowledge and resources needed to develop, test, and implement public sector innovations (Emerson et al., 2012; Hartley & Benington, 2006; Koppenjan & Klijn, 2010; Nooteboom, Van Haverbeke, Duysters, Gilsing, & Van den Oord, 2007; Siddiki, Kim, & Leach, 2017; Sørensen & Torfing, 2011; Torfing, 2019; Vangen, 2017). However, Torfing, Cristofoli, Gloor, Meijer, and Trivellato (2020) have recently warned that a high degree of diversity of actors can be a double-edged sword, intensifying the complexities that surround a policy problem, generating misunderstandings, and removing the common ground needed to collaborate and innovate (Bassett-Jones, 2005; Newig, Günther, & Pahl-Wostl, 2010; Siddiki et al., 2017; Torfing et al., 2020; Varda &

Retrum, 2015). Collaboratively developing innovations and obtaining goal congruence or a shared understanding can therefore become more difficult when the involved actors are too diverse (Cinar, Trott, & Simms, 2019). However, it is still very useful to which organisational capacities allow PSOs to collaborate with a diverse set of partners, thus extending our current knowledge of the antecedents of collaborative innovation. We therefore conceptualise diversity of actors as the degree to which a PSO collaborates with different types of societal actors. We distinguish between other public sector actors, research and knowledge institutions, private companies, non-profit organisations, and citizens. As such, the diversity of actors with which PSOs collaborate is determined by both the number of different types of actors involved and the intensity of collaboration with these actors.

Collaboration and diversity as functions of organisational capacities?

The organisational capacities of PSOs to innovate have recently received much attention from innovation scholars attempting to clarify why some PSOs are able to innovate, while others do not (Gieske et al., 2016; Lewis & Ricard, 2014; Piening, 2013; Timeus & Gascó, 2018). However, few connections have been made between such capacities and the extent to which PSOs take part in processes of collaborative innovation and do so with diverse actors. In this section, we draw from the literature on strategic management (e.g. Andrews, Boyne, Law, & Walker, 2012; Bryson, 2018; Doz & Kosonen, 2014; Rosenberg Hansen & Ferlie, 2016; Teece, 2007), organisational learning (e.g. Crossan, Lane, White, & Djurfeldt, 1995; Rashman, Withers, & Hartley, 2009) and dynamic capabilities (e.g. Lawson & Samson, 2001; Pablo, Reay, Dewald, & Casebeer, 2007; Piening, 2013; Teece, Pisano, & Shuen, 1997) to develop the argument that PSOs need connective and learning capacities in order to collaborate for innovation, with a diverse

set of actors. Figure 1 shows the conceptual framework and hypotheses that are tested in this article.

[Please include Figure 1 here]

Our approach is based on the capacity for innovation framework of Gieske et al. (2016). Here, the authors combine insights and findings from public and private sector literature and identify three capacities that can theoretically determine whether public PSOs innovate: connective capacity, ambidextrous capacity and learning capacity. Recent research has documented the impact of these capacities on public sector innovation (Edelenbos & van Meerkerk, 2015; Gieske, van Meerkerk, & van Buuren, 2018), but it remains unclear to what extent they also influence the degree of collaboration for innovation and the diversity of actors involved. However, we do not suggest a direct overlap between capacities for innovation and capacities for collaboration. Ambidextrous capacity, which Gieske et al. (2016) conceptualise as the ability of an organisation to balance exploration (radical innovation) and exploitation (incremental innovation), will therefore not be considered here. This is certainly an important aspect of the innovative capacity of PSOs, but its relevance to their decision to collaborate and to do so with diverse actors is far less clear.

Connective capacities: countering fragmentation

Innovation and creative ideation processes are strongly associated with the ability of individuals to bring together and exploit various insights, resources and knowledge (Hartley et al., 2013; Jansen, Van Den Bosch, & Volberda, 2006). In a public sector context, this connective capacity can be defined as the ability of PSOs and their employees to counter fragmentation within the organisation or within its broader network by bridging gaps between various actors, their interests, loosely associated ideas and

knowledge frameworks (Edelenbos, Bressers, & Scholten, 2013; Fenger & Bekkers, 2012; Gieske et al., 2018).

Individual employees and managers are a clear first source of the connective capacity of PSOs. At the individual level, connective capacity can therefore be understood as the presence of staff members able to establish relationships between actors and between ideas (Gieske et al., 2016). This reflects strongly what the literature has referred to as ‘boundary spanning’ (van Meerkerk & Edelenbos, 2019; Williams, 2012) and ‘policy entrepreneurship’ (Kingdon, 1995; Mintrom & Norman, 2009). Boundary spanners and policy entrepreneurs are driving forces behind both general collaboration and innovation (van Meerkerk & Edelenbos, 2014; Voets & De Rynck, 2011); they may therefore also provide a crucial advantage to PSOs seeking to collaborate for innovation with diverse societal actors. A key strength of such individuals is their role in environmental scanning and information filtration prior to the decision of PSOs to collaborate with innovation partners (Tushman, 1977; Tushman & Scanlan, 1981; Williams, 2012). Furthermore, boundary spanners may mediate and negotiate between different actor interests and policy entrepreneurs are keen to identify windows of opportunity by considering and connecting different ideas, policy areas and agendas (Birkinshaw, Ambos, & Bouquet, 2017; van Meerkerk & Edelenbos, 2019). Having such staff thus increases the connective capacity of PSOs, which may render these PSOs more inclined to participate in collaborative arrangements for innovation and to attract a wider diversity of actors.

Another part of the connective capacity of PSOs is found at the level of the organisation itself. Next to staff with strong connective competences, the connective capacity of PSOs is also shaped by the presence of instruments, policies, routines, and processes that can spark and maintain interactions between different actors. Here, the

literature distinguishes between intra-organisational connective capacity and inter-organisational connective capacity (Gieske et al., 2016). Both may be conducive to collaboration for innovation and to working with a wide range of actors. Intra-organisational connective capacity involves the presence of instruments, routines, skills and functions that facilitate trust building, information sharing, informal interaction and the development of social capital among employees, teams and units (Coleman, 1988; Jansen et al., 2006). It may thus also be crucial to disseminating information internally about potential avenues for collaboration and to accelerating the flow of externally acquired knowledge into the organisation. And as such it may be a prerequisite for participation in external collaborations for innovation with diverse actors. Furthermore, inter-organisational connective capacity involves the presence of specific functions, roles, training and organisational policies that facilitate the management and coordination of collaborative arrangements and network-related activities (Agranoff & McGuire, 2001; Gieske et al., 2016; van Meerkerk, Edelenbos, & Klijn, 2015). Klijn, Steijn, and Edelenbos (2010) similarly emphasise the importance of network management strategies to include and connect a wide range of actors in governance networks. It can also be argued that in order to engage diverse actors in public sector innovation processes, appropriate roles and functions will need to exist in the organisation to manage such collaborative innovation arrangements.

The literature thus consistently underlines the importance of various connective capacities to sparking general interactions among individuals and organisations, yet says less about their specific importance to inter-organisational collaboration for innovation and the diversity of actors in such collaborations. However, considering the outlined characteristics of connective capacities, we expect all three types of connective capacities to be important. Accordingly, we expect:

H₁: The presence of connective capacities in PSOs has a positive effect on their participation in collaborative arrangements for innovation.

H₂: The presence of connective capacities in PSOs has a positive effect on the diversity of actors with which these PSOs collaborate on innovations.

Learning capacities: absorbing and transforming new knowledge

Innovation and creative problem solving are also an outcome of learning (March, 1991; Riche, Aubin, & Moyson, 2020; Torfing, 2019; Trivellato, Martini, & Cavenago, 2021), associated with cognitive changes emanating from the interactions between two or more individuals (Crosby, 't Hart, & Torfing, 2017; Hartley & Rashman, 2018). Transformative learning has recently been proposed as a key generative mechanism of collaborative innovation (Torfing & Ansell, 2017). Through intense collaboration, new knowledge is acquired and different insights and opinions are exchanged; this allows for established ideas, knowledge and normative assumptions to be challenged, combined and transformed (Torfing, 2019). Collaboration with diverse actors is thus a precursor for transformative learning. However, the ability of PSOs to absorb, generate and transform new and diverse knowledge may be an important precursor of how much they collaborate with others on innovations and do so with diverse partners. Therefore, PSOs with strong learning capacity may well collaborate more with external actors for innovation, and with more diverse actors, than PSOs without this learning capacity. Also from a regional innovation perspective, scholars have argued that learning and absorptive capacity can explain why some organisations innovate collaboratively and others do not (Asheim, Isaksen, & Trippel, 2019); innovators in regions with strong absorptive capacity receive more stimuli to reach out to external partners and are able to take full advantage of the knowledge and information flows that emanate from these external collaborations (Fitjar & Rodríguez-Pose, 2015; Trippel, Grillitsch, & Isaksen, 2018).

Drawing from recent literature on organisational and collaborative learning and based on Gieske et al. (2016), we distinguish between the ability of PSOs to spark learning within the organisation (i.e. intra-organisational learning capacity) and their ability to learn with and from actors outside the organisation (i.e. inter-organisational learning capacity) (Gerlak & Heikkila, 2011; Rashman et al., 2009; Riche et al., 2020). The importance of such learning capacities to public sector innovation has recently been documented (Gieske et al., 2018). However, its impact on the intensity with which PSOs collaborate on innovations with diverse partners is understudied, but no less important. Opening public innovation processes and attracting other public actors, research institutions, private actors or citizens – all with different levels of legitimacy, different access to resources and sometimes incompatible goals and values – requires PSOs to be able to identify, scan, absorb and apply the different types of knowledge these actors can bring to the table (Harvey, Skelcher, Spencer, Jas, & Walshe, 2010). This requires PSOs to establish specific instruments, routines, strategies, and policies in order to spark learning both within and across the organisational boundaries (Gieske et al., 2018). Specifically, strategies and routines for joint learning, piloting and experimenting with external actors should be developed to render PSOs capable of participating in processes of collaborative innovation with diverse actors (Choi & Chandler, 2015). However, specific routines, training, and policies must also exist; this will enable employees and managers to incorporate diverse information that may emanate from interorganisational collaborations into existing organisational policies, routines and goals (Hildén, Pekkola, & Rämö, 2014). Consequently, we expect that both the intra-organisational and inter-organisational learning capacity of PSOs will make them more likely to collaborate for innovation and to involve a wide range of diverse actors in these collaborations. More specifically, we formulate two additional hypotheses:

H₃: The presence of learning capacities in PSOs has a positive effect on their participation in collaborative arrangements for innovation.

H₄: The presence of learning capacities in PSOs has a positive effect on the diversity of actors with which these PSOs collaborate on innovations.

Methods

Empirical setting

As mentioned, this article focusses on collaboration for innovation in the Belgian federal and Flemish public sectors.¹ In the Belgian federalised system, Flanders is an autonomous region. The federal and Flemish governments have equivalent legislative and executive powers within their proper policy domains. Furthermore, both governments have their own public administration to exercise their respective competences. In turn, both are characterised by the presence of directly supervised ministries or departments as well as departmental agencies and public law agencies. Consequently, both can be considered as fully-fledged governments, making their public administration comparable to that of other Western European states (Swenden, 2006). Nevertheless, there are also important differences between federal and Flemish PSOs. Since the state reform of 1989, both levels of government have been able to draw up their own rules of governance. As a result, federal and Flemish PSOs have diverged over the years, especially in terms of their

¹ The rationale for selecting Belgian federal and Flemish public sector organizations as the population for this study stems from research funded by the federal and Flemish governments. This includes fundamental research as well as the request to formulate policy recommendations on collaborative innovation in the public sector.

structures, processes, and culture. This makes comparing the two public administrations all the more interesting.²

From previous research, we know that both Belgian federal and Flemish PSOs participate in various collaborations that – at a certain point in their existence – focused on innovation. These arrangements may include, for example, intergovernmental networks, innovation partnerships, triple helix configurations or multi-actor working groups. They are active in different domains of society, such as healthcare, environmental policy, social services, or crisis management, and as such can include a variety of stakeholders: public actors, private companies, research institutions, non-profit organizations, or citizens.³ To provide a better understanding of which actors PSOs are working with on innovations, we provide more information in the descriptive results section of this article.

² Our analyses account for the differences between Belgian federal and Flemish government organisations by including organisation dummies (see control variables).

³ We illustrate what such collaborations can look like by the means of two examples. One is a project wherein federal, Flemish and local PSOs collaborated with private actors (such as hospitals, general practitioners and pharmacists) and interest groups (such as patient representatives) to develop a digital system that allows for medical aid granted by Public Centres for Social Welfare to be electronically managed. In another collaboration, a federal public actor collaborated with municipal public actors, as well as with private non-profit actors and citizens to find innovative dispatching solutions for disabled persons. A third example is a working group composed of federal public services and local public actors. Through this collaboration there was interaction with a private IT company that was tasked with unifying and professionalizing crisis management and emergency planning practices across Belgium using a tool that would be shared by all actors involved.

Sample

The data for this study were gathered between September and December 2019 through an online survey of public managers at the first and second management level of all Belgian federal and Flemish PSOs.⁴ In total, 869 managers from 104 PSOs were invited to take part, of which 455 managers from 103 organisations completed the survey.

[Please include Table 1 here]

Table 1 provides an overview of the targeted population and the final sample. The final response rate varies between the two governments and across the two management levels. The overall response rate was 51% of the entire population of Belgian federal and Flemish senior public managers. The representativeness of our data was tested and confirmed by means of Chi-square goodness-of-fit tests with which we compared the federal and Flemish sample against their respective population of public managers, based on the type of organisation and their management level. No significant differences were found in any of these tests, which suggests that our sample is representative of the overall population of managers in Belgian federal and Flemish public organisations.

Survey design and measures

The survey questionnaire was designed by a team of researchers from four Belgian universities (UAntwerpen, KU Leuven, UCLouvain and ULiège). Where possible, the questionnaire drew on previously validated survey items and scales. A draft version was cognitively tested with several federal and Flemish public employees to better understand

⁴ The original data on which this [article](#) is based also include managers from the third management level in the Belgian federal government, but for reasons of comparability we considered only the first and second management levels within both governments.

how potential respondents think about the questionnaire, how respondents understand the questions, whether items make sense to respondents, and to assess whether respondents are able to provide accurate answers. Therefore, cognitive testing was used to minimize response errors and further refine the questionnaire (Collins, 2003). Moreover, the survey was administered in Dutch and in French, to accommodate the bilingualism of Belgian federal public personnel. We control for this in our statistical analyses. We next describe the different measures used in this article.⁵

Dependent variables

Two dependent variables were measured.

Collaboration for innovation was measured by asking managers to indicate on a scale of 1–7 to what extent their organisation or unit had collaborated intensively with external actors in the last three years on the development or implementation of innovations (e.g. new policies, technologies, services, or processes) took place. 1 indicates that no or very little collaboration for innovation happened, whereas 7 indicates that the organisation or unit had participated significantly in such collaborations.

Diversity of actors was measured using eight survey questions. More specifically, respondents were asked to indicate on a scale of 1–7 to what extent their organisation or unit collaborates on innovations with the following eight actors: public actors at the same government level and in the same policy field, public actors at the same government level and in different policy fields, public actors at another level of government (local, regional and/or federal), international public actors, private companies, non-profit organisations,

⁵ For most of the dependent and independent variables, respondents at the highest management level were asked to answer for the entire organisation, whereas respondents at the second management level were asked to answer for their specific organisational unit.

research institutions, and citizens.⁶ We counted the number of different actors with which the organisation or unit had collaborated specifically (i.e. a value higher than 1 for each individual actor item). We then generated a diversity index score, by multiplying this number by the average degree of collaboration with any actors given a score of 2 or more to. Values on the diversity index could therefore range from 0 (i.e. no diversity) to 56 (i.e. the organisation strongly collaborates on innovations with all eight types of actors). We thus assessed diversity by considering both the number of different actors with which a PSO collaborates, and how intense these collaborations are.

Independent variables

Our handling of connective and learning capacities was inspired by Gieske et al. (2016), adapted slightly to the context of Belgian and Flemish public sectors. Our survey included 16 Likert-items (scaled 1–7) to measure connective and learning capacities. In order to obtain useful independent measures for our statistical analyses, we conducted an exploratory factor analysis (EFA) on the survey items that make up the five theoretical constructs. A parallel analysis (using the *psych* package in R) empirically confirmed that the 16 items fell under five different latent factors. To extract regression scores, we used the principal axis factor method with Varimax rotation and considered only factor loadings greater than 0.40. The retained factors can be considered reliable according to their Cronbach's alpha, which range between 0.76 and 0.91. The EFA results can be found in Appendix Table A.

⁶ The sample size for the second dependent variable ($N = 425$) is lower than for the first dependent variable ($N = 443$). The questionnaire design namely presented respondents with the eight different items on innovation partners only when they indicated that their organisation or unit has, at least to some extent, collaborated for innovation.

Control variables

We also measured a number of control variables to account for the potential effect of variables not included in our main causal mechanisms. First, since the respondents are nested in different organisations, we had to take organisational clustering into account to ensure unbiased results. Using organisational dummies, we investigated the hypothesised relationships while controlling for organisation characteristics. These dummies also account for the difference between federal and Flemish organisations. Second, we controlled for the management level of respondents. Third, we included the orientation of the main tasks of the organisation or unit of respondents, as this might influence both the extent of collaboration for innovation and the diversity of innovation partners. PSOs with tasks oriented to public and/or private actors outside the organisation might well inherently need to collaborate more on innovations and with more diverse partners. This control variable thus considers whether the main tasks of the organisation or unit are oriented (1) towards other actors in the organisation, (2) towards other public actors outside the organisation, (3) towards private actors, or (4) equally to public and private actors. Furthermore, we controlled for the educational level of respondents, the language in which they filled in the questionnaire, their gender, their age group and how long they have been working in the organisation (tenure). Finally, we also controlled for three variables that may influence how respondents report on collaboration for innovation and diversity of actors: their personal experience with collaboration for innovation, their personal attitude towards collaboration (conceptualised as the willingness of public managers to collaborate), and their perception of the attitude of their hierarchical superior towards collaboration (conceptualised as top-down support for collaboration). Each of these three variables were measured by a 7-point Likert item.

Statistical analyses

To estimate the effect of the independent variables on the two dependent variables, we employ Tobit regression models. Econometrically, this is preferred: OLS models do not fail to account for the fact that we measured collaboration on a 1–7 scale and diversity on a 0–56 scale. An OLS approach could result in nonsensical predictions (McDonald & Moffitt, 1980). Tobit models can address this issue by fixing the lower and upper bounds. Two separate Tobit models were analysed: one on collaboration for innovation and one on diversity of actors.

Mathematically, a Tobit regression specifies two equations at once (Wooldridge, 2010). This makes interpretation of the regression coefficients unintuitive, although the coefficient sign and level of significance still provide a good point of reference. Basically, results from a Tobit model are interpreted similarly to those from OLS models, although the linear effect of coefficients only concerns the uncensored latent variable y_i^* and not the observed outcome y_i . The first equation for the latent variable can be formulated as:

$$y_i^* = \beta'x_i + \varepsilon_i$$

where β is the parameter vector to be estimated, x_i is the vector of independent variables, and ε_i is the error term. By contrast, the second equation of the observed outcome, which is conditional on the first equation, can be formulated as:

$$y_i = \begin{cases} 0 & \text{if } y_i^* \leq 0, \\ y_i^* & \text{if } y_i^* > 0 \end{cases}$$

To facilitate the interpretation of Tobit regression coefficients, McDonald and Moffitt (1980) proposed decomposing them into (1) a marginal effect on the probability of experiencing a given outcome, and (2) a marginal effect on the expected degree of that outcome which is conditional on the first equation. In this article, we are mainly interested

in the latter (i.e. the marginal effect of a regressor on the latent variable y^*) which, following McDonald and Moffitt (1980) and others, can be computed as:

$$\frac{\partial E y_i^*}{\partial x_i} = \beta_i * \left[1 - \left(z * \frac{f(z)}{F(z)} \right) - \frac{f(z)^2}{F(z)^2} \right]$$

where y_i^* is the latent variable, x_i a given independent variable, β_i the parameter estimate, z the z-score on a normal distribution, $f(z)$ the associated normal density function, and $F(z)$ the associated cumulative normal density function.

Common method bias

Various strategies were used to reduce common method bias (CMB) in our results, since the data are self-reported and collected in a cross-sectional research design (Podsakoff, MacKenzie, & Podsakoff, 2012). Addressing potential issues of CMB is very important for public management studies that draw on same-source perceptions of public managers (Jakobsen & Jensen, 2015; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), although these effects should not be overestimated (see George & Pandey, 2017). A first strategy involved introducing a temporal and proximal separation between the main predictors (i.e. the connective and learning capacities) and outcomes (i.e. the collaboration and diversity measures) in our survey design. Questions on the dependent and independent variables were therefore placed in different parts of the survey, and we also used separate web pages. As mentioned, moreover, the survey was reviewed by federal and Flemish public employees, to adapt the phrasing to the relevant context and to reduce item ambiguity (Meier & O'Toole, 2013). Respondents were guaranteed full anonymity, to potentially reduce social desirability bias (George & Pandey, 2017). Furthermore, to statistically assess whether our data are affected by CMB, we employed a Harman's

single factor test (Podsakoff et al., 2003).⁷ We thus entered the dependent, independent and control variables into a single exploratory factor analysis, to observe if one single factor accounted for more than 50% of the total variance. The test indicates that a single factor does not account for the majority of the explained variance. Thus, both procedural and statistical remedies suggest that CMB cannot, in itself, adequately account for our findings.

Results

Descriptive analysis

Before the Tobit results, we present some descriptive findings. The summary statistics shown in Appendix Table B indicate that, on average, respondents reported relatively high collaboration for innovation (4.72 on a scale of 1–7) and moderate diversity of actors (26.36 on a scale of 0–56). Both the standard deviations and Appendix Figures A and B show that there is a wide variation in the respondents' answers. Overall, we see relatively few PSOs not collaborating at all with the aim to create innovations (4%), but this proportion is higher in the federal government than in the Flemish government. The distribution of partner diversity is also slightly more negative skewed (i.e. in favour of more diversity) for Flemish PSOs than for federal PSOs. Appendix Figure C also provides an overview of the degree of collaboration for innovation with specific partners. In general, both federal and Flemish PSOs collaborate most with public actors of their own government and in their own policy domain. They collaborate relatively less with public actors outside their own government, and even less with non-profit organizations or

⁷ The results from this procedure are available upon request from the authors.

citizens. Collaboration with other innovation partners is moderate, but significant differences in respondents' answers can again be observed.

Furthermore, Appendix Table B indicates that collaboration for innovation and diversity of actors are, as expected, strongly correlated. The different independent variables are, however, weakly correlated, and an analysis of variance inflation factors (VIF) suggests that multicollinearity is not an issue. Accordingly, the discriminant validity of the involved independent variables is considered high.

Tobit analyses

Table 2 shows the results of the Tobit regressions. The table includes two Tobit models with coefficients and standard errors (in columns A and C) and marginal effects (in columns B and D). Columns A and C are used to verify if the observed effects are (jointly) significant, while columns B and D provide information about the direction and magnitude of the marginal effects of interest. Additionally, Table 2 shows models that include (a) individual characteristics, (b) connective capacities, and (c) learning capacities. These three sets of variables were added stepwise to assess their relative impact on the model fit. Likelihood ratio tests indicate that the models including connective and learning capacities have a significantly better fit compared to the model without these variables.

Based on columns A and B, representing the Tobit model for collaboration for innovation, most connective and learning capacities have a significant positive effect on the extent of collaboration for innovation. The intra-organisational connective capacity does not seem to affect whether and to what extent PSOs participate in collaborative arrangements for innovation. Further analysis shows that the individual connective capacity matters most, followed by the inter-organisational connective and learning

capacity. Intra-organisational learning capacity contributes less to participation in collaborative arrangements for innovation than other organisational capacities.

In terms of control variables, several individual characteristics of respondents also produce significant results. Managers from organisations with tasks oriented towards both private and public actors reported significantly more participation in collaborative arrangements for innovation. Additionally, male respondents reported significantly less collaboration for innovation (albeit only at the 0.10 level of significance). Furthermore, the results indicate that experience with collaboration for innovation also has a significant positive effect. The marginal effect of experience is similar to that of individual connective capacity. Other individual characteristics of respondents, such as management level, education, language, age, tenure, and willingness to collaborate, do not seem to produce significant results. Neither does the perceived top-down support for general inter-organisational collaboration.

[Please include Table 2 here]

Turning to the results for diversity of actors, columns C and D show similar findings concerning the contribution of connective and learning capacities for PSOs that collaborate for innovation. Apart from intra-organisational connective capacity, we find that all connective and learning capacities have a statistically significant positive effect on the diversity of innovation partners with which PSOs collaborate. The marginal effects suggest that inter-organisational connective capacity matters most, followed by individual connective capacity. We observe far smaller marginal effects for learning capacities, with inter-organisational learning capacity only significant at the 0.10 level.

Again, several individual characteristics of respondents also significantly affect the extent of diversity of actors. For instance, respondents at the second management level report significantly less diversity of actors than those at the highest level (albeit only at

the 0.10 level of significance). Additionally, managers active in organisations with tasks oriented to private actors or equally oriented to private and public actors report collaboration with a significantly broader range of actors. Adding age group to the model significantly improves the model fit (as indicated by the joint significance) and it can be observed that respondents aged 50–59 report collaboration with a significantly smaller range of actors. The organisational tenure of respondents also contributes to the model fit (as indicated by the joint significance), but none of the four tenure categories produce statistically significant effects. Furthermore, respondents also report more diversity of innovation partners if they have more experience with collaboration for innovation and if they perceive more top-down support for collaboration in general. The educational level of respondents, their language, gender, and own attitude towards general collaboration do not produce significant results.

The presented findings generally support all our hypotheses, but two exceptions are notable. In general, connective and learning capacities positively influence the intensity and diversity of collaborations for innovation. More specifically, however, intra-organisational connective capacity does not seem to affect these outcomes. Therefore, we find only partial support for H₁ and H₂, while we find full support for H₃ and H₄. We review the support for these hypotheses in Table 3 below.

[Please include Table 3 here]

Discussion and conclusions

This study seeks to determine whether connective and learning capacities of PSOs affect (1) the extent to which they collaborate with others to develop or implement innovations and (2) the diversity of the actors with which they collaborate in such arrangements. PSOs have always faced the challenge of inter-organisational collaboration, but this has become

more prominent in light of today's focus on innovation through collaboration. Knowing which capabilities lead PSOs to collaborate on innovations with diverse societal actors is therefore necessary to better understand how to foster public sector innovation (OECD, 2017). Our theoretical model started from existing empirical research on public sector innovation capabilities and applied these insights to the topics of collaboration for innovation and diversity of innovation partners. Taken together, our analyses provide empirical support for the argument that PSOs need both connective and learning capacities to increase their participation in innovation collaborations and to expand the diversity of innovation partners.

Firstly, our results demonstrate the importance of individual-level connective capacity within PSOs to both their involvement in collaborative arrangements for innovation and to attracting a wide range of actors to these arrangements. Public managers who report that their employees are capable of building and maintaining relationships with external parties, and connecting loosely coupled or strongly divergent ideas, also report more collaboration for innovations and with more diverse actors. Boundary spanning competences and organisational entrepreneurship have been put forward as key determinants of inter-organisational collaboration (van Meerkerk & Edelenbos, 2014; Williams, 2012) and public sector innovation (Leyden & Link, 2015; Windrum, 2008); however, we find that they are also important to collaboration specifically for innovation, as well as to the diversity of innovation partners in such networks. Collaborative innovation processes may involve several barriers resulting from the inclusion of diverse innovation partners (Cinar et al., 2019). In the comments section of the questionnaire, one respondent stated that their *“biggest obstacle to external collaboration [for innovation] is the lack of connective manpower to handle collaboration requests”*. Scanning, scanning, and trust-building competencies of highly connective employees are therefore

crucial to reach out to others, but also to be able to take advantage of incoming requests for collaboration. Furthermore, our results stress that connectivity in individual employees and managers needs to be flanked by organisational procedures, routines, and policies that incentivise and support inter-organisational interactions. Our results show that PSOs collaborate more on innovations and with more diverse partners when they have clear policies and routines for managing inter-organisational networks, distinct roles and functions for these management activities, and sufficient training for employees enabling them to fulfil these roles and functions. They also suggest that this inter-organisational connective capacity is more conducive to diversity of innovation partners than to the general intensity of collaboration for innovation; individual connective capacity, on the other hand, impacts the extent of collaboration on innovations far more than the diversity of actors. However, further investigation of this difference in impact is warranted. Furthermore, we found no evidence of the impact of intra-organisational connective capacity on either collaboration for innovation or the diversity of actors. This is not surprising, as this capacity is theoretically much more conducive to stimulating collaboration within the organisation. In fact, overly strong ties within the organisation may even prevent or discourage employees from searching for external insights (Granovetter, 1983). This suggests that PSOs do not necessarily need to develop all three dimensions of connective capacity if they wish to increase their external collaboration for innovation and expand the diversity of actors involved.

Secondly, we show that learning capacities also matter for both collaboration for innovation and diversity of actors. As theorised, engaging in multi-actor collaborative arrangements for innovation requires PSOs to cultivate a strong inter-organisational learning mindset. Being capable to learn from external actors, to use pilots and experiments to test new solutions with these actors, and to absorb and exploit knowledge

from the direct environment is thus an important prerequisite for PSOs to collaborate on innovation with different partners. Moreover, our findings also highlight the importance of intra-organisational learning capacity to collaboration and diversity. This accords with the theoretical argument that PSOs must be capable of reflecting on what externally acquired new insights and knowledge mean for the organisation, regularly adjusting policies and routines to these new insights, and learning from their own employees in order to successfully collaborate with external and diverse actors on innovations (Crossan, Lane, & White, 1999; Holmqvist, 2003).

Thirdly, our results highlight two additional powerful incentives to collaboration for innovation and diversity of partners: task orientation and top-down support for inter-organisational collaboration. We find that organisations and units with a clear mandate to orient their tasks toward both public and private actors are more likely to collaborate on innovations and do so with a broader range of actors. Furthermore, managers who report hierarchical superiors generally in favour of external collaboration, also indicate that their own organisation or unit collaborates with more diverse partners on innovations. This points to the crucial role of supportive innovation leadership in the organisation (Janssen, 2005; Oldham & Cummings, 1996). One of our respondents illustrates it as follows: "In my unit, as in most of our units, external collaboration is weak. This is mainly due to the reluctance of our management. Although direct stakeholders and our external partners in [our policy field] found the desired innovation relevant and useful, my team and I were discouraged by our superiors from capitalising on our partners' willingness to collaborate. We were eventually forced to pursue, less innovative innovation activities internally.

Conclusion and implications

This study showed that organisational connective and learning capacities may offer PSOs a viable basis for collaboration for innovation with diverse actors. Connective capacity is

needed to consider, initiate, and manage such collaborations, while learning capacity is needed to deal effectively with the diverse knowledge available in these networks, which needs to be absorbed and transformed in the organisation itself for subsequent innovations to succeed. The extent to which PSOs participate in collaborative innovation networks and the diversity of actors in these arrangements will depend on whether they have such connective and learning capacities. However, there should also be a clear necessity to collaborate (through an outward task orientation of PSOs) and adequate top-down support for inter-organisational collaboration (through a positive attitude of political and administrative hierarchical superiors towards collaboration).

A number of tentative implications for public managers can be formulated. Inter-organisational collaboration and diversity of actors are important but complex requirements for public sector innovation. Knowing how to encourage collaboration and diversity is therefore crucial for public managers. Collaboration for innovation with diverse external stakeholders will almost always introduce uncertainty and conflict, but managers and employees who can rely on competent individuals, tools, and strategies able to attenuate these barriers will have a significant advantage. According to our results, the main implication for public managers is that they should devote increased attention to the connective and learning capacities in their organisation. With regard to individual managers and employees, HR management is crucial, to identify and empower staff capable of dealing with a variety of actors and perspectives in a context of collaborative innovation. Additionally, sufficient instruments and methods (such as stakeholder management, actor analysis or cognitive mapping) need to exist in the organisation to consider, initiate and manage collaborative projects with external actors, and these tools and methods should be flanked by appropriate functions and roles (such as relationship managers, regional coordinators, process facilitators or network champions). Training of

staff and executives to adopt these functions and to work effectively in collaborative innovation networks is also crucial. Furthermore, sufficient learning opportunities – a key precursor to collaborative innovation – can be created by emphasising pilots or experiments to try out new solutions with other actors, and by training personnel in employing these methods. These routines should also be accompanied by an institutionalised reflection about what externally acquired insights mean for existing organisational approaches.

Limitations and future research

Our study is limited by its reliance on cross-sectional survey data, which prevents strong causal claims. Causality between the variables in our statistical models is therefore mainly based on the theoretical arguments developed. Moreover, in the presented analyses, we did not consider interaction effects between connective and learning capacities, although a theoretical argument can be made for this. Preliminary analysis does not point to any evidence for such an effect, whereas our direct effects remain stable, but future research should study this relationship further. Another point of attention is that our survey relies on self-reported perceptions of senior managers; their subordinates may not see things the same way. We employed several strategies to reduce potential common method bias, but an important opportunity for future research to build on this work lies in the use of longitudinal and multiple source data that also covers a broader sample of public sector employees. In terms of empirical research design, we acknowledge that our questionnaire is based on a quite undifferentiated concept of learning; different modes of learning in an organisation may stimulate collaboration for innovation and diversity of actors in different ways. An interesting avenue to explore is the extent to which achieving different styles of learning in an organization (e.g. single-loop learning versus double-loop learning) accelerates the ability to collaborate with more diverse partners. Additionally,

we acknowledge that collaboration does not necessarily mean that governmental actors do not see each other as competitors. It is conceivable that they do this sometimes; for access to ministers and scarce resources, or as rivals in a turf war over who gets to provide what services. In the current article, we did not work with this idea of *coopetition*, but it is definitely worth investigating in future research. Further, our study did not consider the impact of national culture, as we only examined public organisations within a single country. However, the use of Belgian federal and Flemish data should make our results more robust. Relatedly, we found that there are small differences in the baseline levels of collaboration and diversity between federal actors and Flemish actors, but it was not the purpose of this article to explore why such differences emerge. Given these limitations, we emphasize the important role for future research to use other methodological approaches (e.g., QCA or qualitative focus groups), to include case studies in a broader range of countries or politico-administrative settings, and to further explain potential differences in levels of collaboration and diversity in these settings.

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Ethics statement

This research and the way data were handled has been approved by the Social and Societal Ethics Committee (SMEC) of KULeuven (with approval number: G-2019/04/1646). We

obtained a digital informed consent to participate in the survey from all participants prior to the commencement of the study.

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No potential conflict of interest was reported by the author(s).

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Tables and figures

Figure 1. Conceptual model

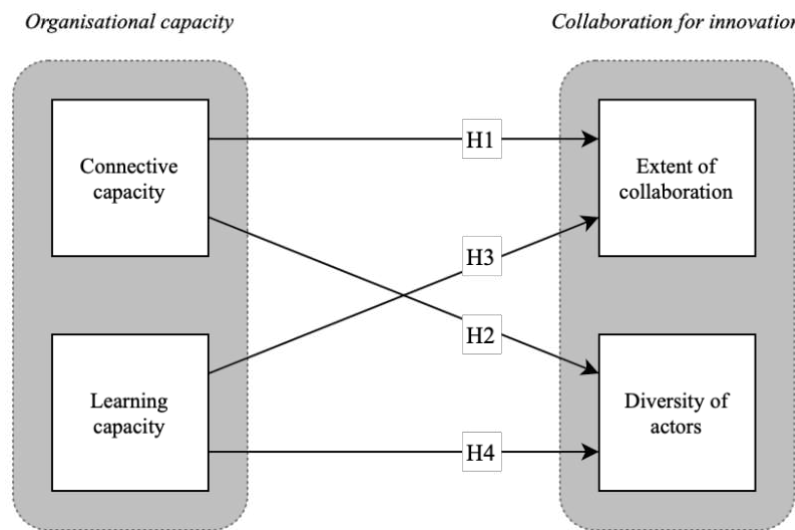


Table 1. Overview of response rates

	Organisations		Managers at highest level		Managers at second level	
	Approached	Participated	Approached	Participated	Approached	Participated
Total	104	103 (99%)	104	68 (65%)	792	387 (49%)
Federal	37	37 (100%)	37	15 (52%)	387	139 (36%)
Flemish	67	66 (99%)	67	53 (79%)	405	248 (61%)

Table 2. Tobit models for collaboration and diversity

Variables	(A)	(B)	(C)	(D)
	Collaboration for innovation		Diversity of actors	
	Coefficients & standard errors	$\frac{\partial E y_i^*}{\partial x_i}$	Coefficients & standard errors	$\frac{\partial E y_i^*}{\partial x_i}$
<i>(a) Individual characteristics</i>				
Management level	-0.29 (0.22)	-0.2853	-2.05 (1.20) *	-2.0235
Task orientation	$X^2(3) = 6.90$ *		$X^2(3) = 28.67$ ***	
Public actors	0.41 (0.27)	0.4068	0.21 (1.45)	0.2011
Private actors	0.18 (0.22)	0.1779	3.29 (1.24) ***	3.2186
Public & private actors	0.55 (0.23) **	0.5476	6.26 (1.27) ***	6.1512
Education	$X^2(2) = 2.52$		$X^2(2) = 2.90$	
Master	-0.57 (0.36)	-0.5713	0.88 (2.06)	0.8634
PhD	-0.57 (0.43)	-0.5725	3.03 (2.40)	2.9795
Language	-0.09 (0.27)	-0.0899	0.78 (1.51)	0.6718
Gender	-0.28 (0.15) *	-0.2730	-0.74 (0.83)	-0.7237
Age	$X^2(3) = 5.27$		$X^2(2) = 6.52$ *	
40–49	-0.28 (0.29)	-0.2740	-1.59 (1.62)	-1.5722
50–59	-0.38 (0.30)	-0.3706	-3.46 (1.67) **	-3.4093
>59	-0.77 (0.35) **	-0.7534	-1.85 (2.00)	-1.8251
Tenure	$X^2(3) = 4.83$		$X^2(2) = 18.27$ **	
3–5	0.61 (0.33) *	0.5966	2.93 (1.84)	2.9006
6–10	0.46 (0.34)	0.4520	-0.46 (1.88)	-0.4527
11–25	0.53 (0.31) *	0.5167	-2.51 (1.70)	-2.4687
>25	0.27 (0.33)	0.2591	-1.78 (1.84)	-1.7486
Experience respondent	0.33 (0.057) ***	0.3281	1.86 (0.32) ***	1.8291
Attitude respondent	-0.08 (0.06)	-0.0785	-0.54 (0.34)	-0.5325
Attitude hierarchical superior	0.08 (0.06)	0.0822	1.10 (0.330) ***	1.0785
<i>(b) Connective capacity</i>				
Individual connective capacity	0.34 (0.09) ***	0.3303	2.40 (0.49) ***	2.3613
Intra-organisational connective capacity	0.10 (0.09)	0.1006	0.73 (0.53)	0.7201
Inter-organisational connective capacity	0.23 (0.11) **	0.2243	3.08 (0.59) ***	3.0250
<i>(c) Learning capacity</i>				
Intra-organisational learning capacity	0.21 (0.09) **	0.2062	1.17 (0.50) **	1.1493
Inter-organisational learning capacity	0.23 (0.09) **	0.2215	0.93 (0.51) *	0.9122
N	443		425	
Log likelihood (a)	-693.52		-1446.10	
Log likelihood (a and b)	-685.52		-1423.00	
Log likelihood (a, b, and c)	-679.59		-1418.30	
Improvement adding (b) to (a)	$X^2(3) = 15.99$ ***		$X^2(3) = 46.12$ ***	
Improvement adding (c) to (a and b)	$X^2(2) = 11.85$ ***		$X^2(2) = 9.48$ ***	
McFadden's R^2 base model (a)	0.172		0.093	
McFadden's R^2 full model (a, b, and c)	0.207		0.136	

Note: Standard errors in parentheses. All models include organisation dummies. *** p < 0.01; ** p < 0.05; * p < 0.10

Table 3. Confirmation of hypotheses

	Extent of collaboration	Diversity of actors
	H ₁ (connective) and H ₃ (learning)	H ₂ (connective) and H ₄ (learning)
Connective capacity	Partially supported	Partially supported
<i>Individual</i>	<i>Supported</i>	<i>Supported</i>
<i>Intra-organisational</i>	<i>Not supported</i>	<i>Not supported</i>
<i>Inter-organisational</i>	<i>Supported</i>	<i>Supported</i>
Learning capacity	Fully supported	Fully supported
<i>Intra-organisational</i>	<i>Supported</i>	<i>Supported</i>
<i>Inter-organisational</i>	<i>Supported</i>	<i>Supported</i>

Appendix

Appendix Table A. Results factor analysis

Concept/Items	FA1	FA2	FA3	FA4	FA5
<i>(a) Individual connective capacity (Cronbach's alpha: 0.91)</i>					
We have staff that can build and maintain lasting relationships with other actors.	0.869				
We have staff that connect the interests of different actors.	0.791				
We have staff that have experience collaborating across organisational boundaries.	0.709				
<i>(b) Intra-organisational connective capacity (Cronbach's alpha: 0.79)</i>					
We have regular work-related social activities.		0.512			
Collaboration between organisational units is stimulated.		0.646			
There is ample opportunity for informal exchange of information.		0.798			
Our organisation has procedures to effectively share information and knowledge.		0.448			
<i>(c) Inter-organisational connective capacity (Cronbach's alpha: 0.76)</i>					
There are methods for entering into and managing collaborations with other actors.			0.599		
There is training to work effectively in partnerships.			0.625		
There are roles aimed at relationship management or managing partnerships.			0.529		
<i>(d) Intra-organisational learning capacity (Cronbach's alpha: 0.81)</i>					
Our policies and procedures are regularly adapted to new insights or techniques.				0.504	
There are work processes to investigate what new insights mean for the organisation.				0.732	
My organisation learns from my experiences				0.470	
<i>(e) Inter-organisational learning capacity (Cronbach's alpha: 0.86)</i>					
My organisation stimulates joint learning with and from other actors.					0.663
My organisation uses pilots or experiments to test new solutions with other actors.					0.655
My organisation learns from collaboration with other actors.					0.743

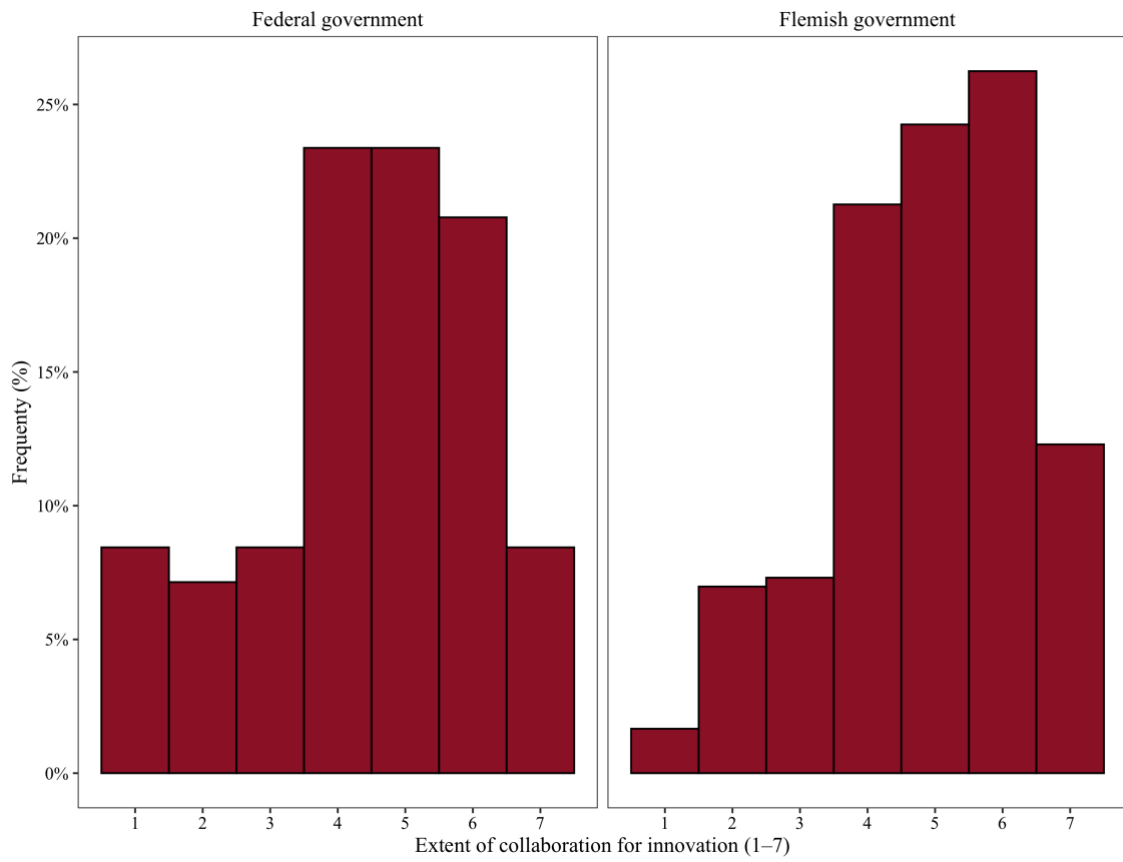
Note: Principal axis factoring with Varimax rotation was used to extract factor scores.

Appendix Table B. Descriptive statistics (N=425)

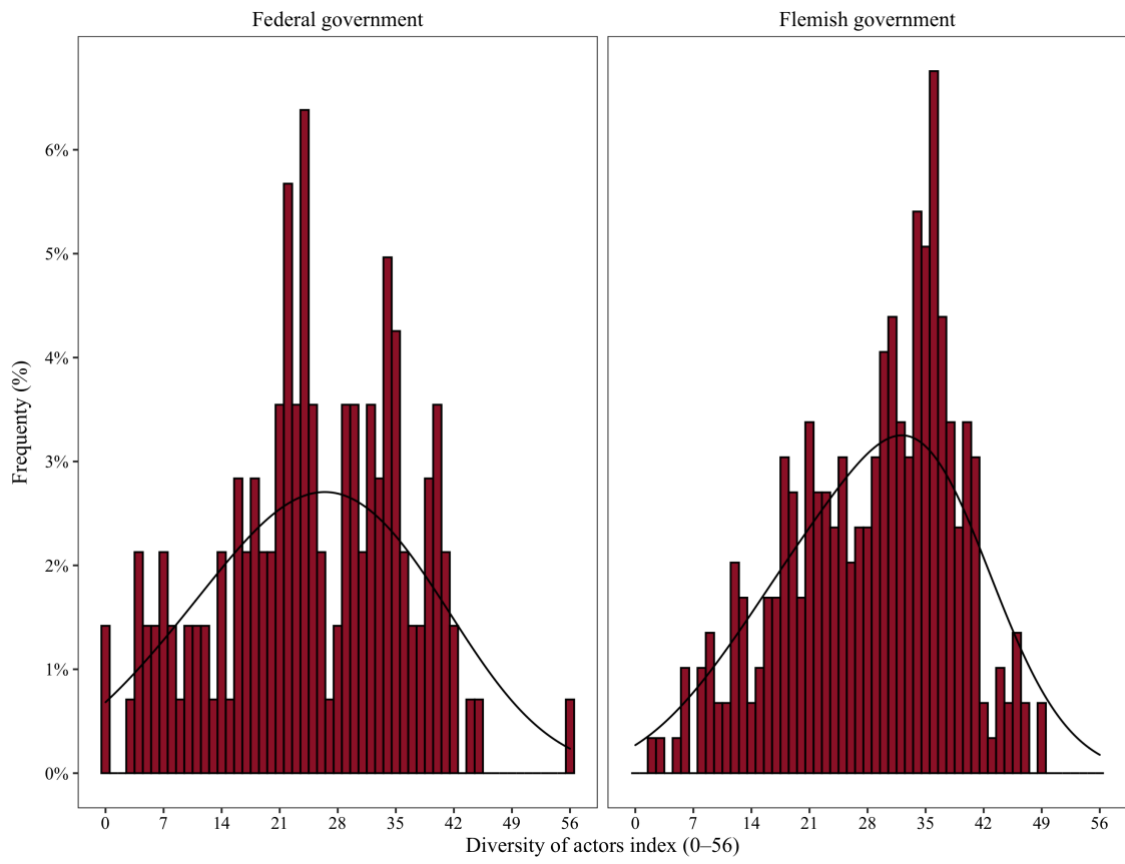
Variable	Mean	SD	Min	Max		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Collaboration	4.72	1.55	1.00	7.00	(1)	1.00																
Diversity	26.36	11.52	0.00	52.00	(2)	0.56	1.00															
Management level	1.85	0.36	1.00	2.00	(3)	-0.14	-0.18	1.00														
Actor orientation	2.76	1.10	1.00	4.00	(4)	0.12	0.26	-0.17	1.00													
Education	2.09	0.41	1.00	3.00	(5)	0.14	0.19	-0.09	0.09	1.00												
Language	1.13	0.34	1.00	2.00	(6)	-0.02	-0.06	0.08	0.06	0.00	1.00											
Gender	1.62	0.48	1.00	2.00	(7)	-0.02	-0.03	-0.07	0.05	-0.08	-0.02	1.00										
Age group	2.64	0.81	1.00	4.00	(8)	-0.10	-0.08	-0.12	0.10	-0.04	0.15	0.16	1.00									
Tenure	3.58	1.19	1.00	5.00	(9)	-0.12	-0.15	0.11	0.00	0.01	0.13	0.02	0.31	1.00								
Experience	4.56	1.41	1.00	7.00	(10)	0.46	0.42	-0.17	0.13	0.24	0.00	0.07	0.01	-0.05	1.00							
Attitude respondent	2.75	1.38	1.00	7.00	(11)	-0.17	-0.20	0.12	-0.01	-0.09	0.32	0.10	-0.02	0.08	-0.30	1.00						
Attitude supervisor	4.99	1.43	1.00	7.00	(12)	0.14	0.14	0.23	-0.14	-0.02	0.05	-0.10	-0.05	-0.06	0.09	-0.07	1.00					
Indiv. connect. cap.	0.00	0.94	-2.59	2.66	(13)	0.30	0.32	-0.07	0.09	0.14	-0.03	-0.01	-0.05	-0.03	0.28	-0.19	0.13	1.00				
Intra. connect. cap.	0.00	0.86	-3.10	2.40	(14)	0.07	0.05	-0.19	-0.08	-0.06	-0.12	-0.03	0.16	0.02	0.01	-0.17	0.17	-0.01	1.00			
Inter. connect. cap.	0.00	0.79	-2.41	2.14	(15)	0.14	0.25	-0.06	0.04	-0.05	-0.14	0.05	-0.03	-0.03	0.12	-0.09	0.07	0.09	0.05	1.00		
Intra. learn. cap.	0.00	0.82	-2.88	2.62	(16)	0.11	0.10	-0.05	-0.04	-0.01	-0.04	0.08	0.06	0.06	0.05	-0.08	0.12	-0.02	0.10	0.11	1.00	
Inter. learn. cap.	0.00	0.87	-2.55	2.82	(17)	0.24	0.19	-0.12	0.01	0.05	0.04	-0.01	0.08	-0.14	0.17	-0.12	0.24	0.03	0.05	0.03	0.10	1.00

Note: See Appendix Table A for information about the factor analysis.

Appendix Figure A. Extent of collaboration for innovation by government level



Appendix Figure B. Diversity of actors (index) by government level



Appendix Figure C. Collaboration with specific innovation partners by government level

