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Achieving collaborative innovation by controlling or leveraging network complexities through complexity leadership

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Abstract

Recent innovation research in the public sector demonstrates the advantages of collaborative innovation, but also recognizes the complex character of collaborative innovation processes. These complexities might both stimulate and hinder collaborative innovation. Through a qualitative comparative analysis of empirical data from 19 public–private innovation partnerships (PPIs) in five European Countries, we show how particular types of complexity leadership (i.e., generative leadership and administrative leadership) act on these complexities in PPIs to produce highly innovative services. The results show that small partnerships use generative leadership in the presence of network complexities, and administrative leadership in the absence of network complexities to produce highly innovative services. However, large partnerships only use generative leadership, while abandoning administrative leadership, to produce highly innovative services. These findings bring about theoretical and practical insights as to how various forms of complexity leadership might be employed in varying contexts of partnership complexity.

1 | INTRODUCTION

Although public sector innovation has gained traction in public administration research, much is still unknown about how innovation comes about in the public sector. In the last 10 years, scholars have turned their attention to collaborative innovation as a promising strategy for innovation in the public sector (Bommert, 2010). While initially proposed as an extension of collaborative governance theories (Sørensen & Torfing, 2011), research on how collaborative dynamics affect the innovation process has expanded to other theoretical realms (e.g., dynamic capabilities, Trivellato et al., 2021; team innovation, van der Voet & Steijn, 2020; smart city governance, Nesti, 2020). As governments and societies become increasingly intertwined, and societal issues increasingly more complex, innovation through public–private collaborations provide advantages that in-house or outsourcing innovation strategies cannot obtain. By collaborating between a large diversity of actors, knowledge and resources are shared, creative ideation is stimulated, and innovators can rely on each other's capacities to develop and implement innovative solutions (Torfing, 2019). Furthermore, in some cases, collaboration is simply the only option to solve problems that require the contribution of several actors with indispensable resources (see, Huxham & Vangen, 2005; Klijn & Koppenjan, 2016; Pfeffer, 1981).

However, using collaborative arrangements as vehicles for innovation is far from straightforward. Collaborative arrangements are known for their lengthy and hazardous decision-making processes, potential for interpersonal conflicts, and managerial challenges (Huxham, 2003), which can make collaborative advantages difficult to achieve (Vangen & Huxham, 2011). Various network complexities lie at the core of these difficulties (Huxham & Vangen, 2000). This article considers three types of network complexities: (1) substantive complexities, which relate to the differences in knowledge and perspectives of the involved partners, (2) strategic complexities, which relate to the differences in motives, interests, and agendas of these partners, and (3) institutional complexities, which relate to the differences in organizational cultures and institutional realities of the partners (Klijn & Koppenjan, 2016). Innovations in particular are influenced by these network complexities, as both the development of innovative ideas and the implementation of these ideas are tied to the ability of the involved partners to learn from each other, retain joint ownership over the process and output, and engage in empowered participation throughout the innovation process (Lindsay et al., 2020).

The effect of these network complexities on the innovation potential of collaborative arrangements could be captured through two separate and conflicting theoretical lenses. The first theoretical lens predicts that collaborative arrangements that are able to reduce the network complexities should create highly innovative solutions. Indeed, reducing the network complexities also reduces coordination and transaction costs, and simplifies decision-making regarding the innovative ideas and the solution (Vivona et al., 2022). The second theoretical lens, however, presents that network complexities might also be an opportunity for creative ideation and knowledge cross-fertilization. According to this theoretical lens, innovation thrives on (substantive, strategic, institutional) differences between the involved actors, as these differences might generate partnership synergies, stimulate transformational learning, and enable divergent thinking (Milliken et al., 2003; Sørensen & Torfing, 2017; Torfing et al., 2020).

This article hypothesizes that both of these theoretical lenses might be equally valid, and, hence, highly innovative solutions can arise in partnerships with high levels of network complexities, but also in partnerships with low levels of network complexities. We argue that the particular type of leadership that is used in these partnerships might be important to explain why one or the other theoretical lens can be adopted. Leadership is particularly important in this regard, as it helps innovators in these partnerships to balance efforts toward creativity, experimentation, and exploration with activities aimed at converging toward a supported and practically relevant solution (Torfing et al., 2020). We draw on the concept of "complexity leadership" to explain how these different types of partnerships might both generate highly innovative solutions. As opposed to conventional leadership theories, which perceive leadership from a person-centric perspective, complexity leadership focuses on enabling emergent action by influencing social interactions (Murphy et al., 2017; Uhl-Bien, 2006). Two types of complexity leadership are generally considered: generative leadership and administrative leadership (Hazy & Prottas, 2018). Generative leadership exploits the uncertainties and turbulence in complex systems to uncover novelty (Surie & Hazy, 2006), whereas administrative leadership focuses on alignment and control through structures and procedures to better contain complexities (Uhl-Bien et al., 2007).

We hypothesize that partnerships with low levels of complexities produce innovation through their use of administrative leadership, which allows them to control and align the innovation process and efficiently converge toward a practical solution, without the risk of getting entrenched by collaborative inertia. However, partnerships with high levels of complexities are unable to control all of these complexities, and acquire innovation by exploiting, through generative leadership, the creative interactions that emerge out of this complexity. These hypotheses are supported by recent empirical evidence of Murphy et al. (2017) in public sector organizations, in which administrative leadership practices were particularly found in projects with low to medium complexity, while generative leadership practices were especially found in projects with high complexity. Our hypotheses build further on these insights by considering different types of public–private innovation partnerships (PPIs). We test our hypotheses on a large empirical dataset of 19 PPIs in the healthcare sector in five European countries (Belgium, Denmark, Estonia, the Netherlands, and Spain). Data from more than 130 respondents were collected through surveys and interviews, and analyzed through qualitative comparative analysis (QCA). Surprisingly, we find that small partnerships create highly innovative solutions by both exploiting and controlling complexities by, respectively, generative leadership and administrative leadership. However, large partnerships are only able to produce highly innovative solutions when they use generative leadership and no administrative leadership. These insights lead to implications for how complexity leadership acts on the innovation process in PPIs.

In the following sections of the article, we first elaborate on the theoretical framework, through which we formulate two hypotheses. Next, we describe our case selection and research methodologies. The QCA results are reported in the subsequent section. Finally, we discuss and reflect on these results to derive the theoretical and practical implications of the study.

2 | THEORY AND HYPOTHESES

According to collaborative innovation literature, collaborative arrangements are ideally suited to produce innovation, as they enable the exchange of knowledge, perspectives, and resources, which might enhance creative ideation and implementation capacity (Torfing, 2019). Hence, collaborative innovation affects two generally recognized aspects of the innovation process, that is the generation of new ideas and the implementation of these ideas (Anderson et al., 2014; Walker, 2008). Through processes of transformative learning, joint ownership, and empowered participation, collaborative arrangements create synergies that allow the development of new products and services (Lindsay et al., 2020). PPIs are a type of collaborative arrangement between public and private actors that is specifically oriented toward the production of innovations, and for which it often involves service users (Brogaard, 2021). In contrast to similar collaborative arrangements (e.g., public–private partnerships [PPPs]), PPIs have a rather short lifespan, are less formalized, and come in a large variety of organizational forms (Di Meglio, 2013). For these reasons, they are particularly promising to study the various ways in which innovation arises from partnership synergies (Alonso & Andrews, 2022).

2.1 | Collaborative innovation and network complexities

However, as network literature has repeatedly demonstrated, achieving these "partnership synergies" is not straightforward (Ansell & Gash, 2008; Emerson et al., 2011; Lasker et al., 2001). Seminal work of Huxham and Vangen shows that inter-organizational collaboration often leads to collaborative inertia, in which collaborative advantages such as synergies are very difficult, or sometimes even impossible, to achieve (Huxham, 1996; Huxham & Vangen, 1996). Multiple factors can trigger collaborative inertia, such as difficulties in formulating a joint purpose because of varying interests and motives, communication challenges due to differences in (technical) language, procedural and operational difficulties because of differences in organizational processes and cultures, (perceived) power imbalances, a lack of interpersonal and organizational trust, and managerial difficulties due to working with semi-autonomous actors in complex network structures (Huxham & Vangen, 2000). These factors are often caused by certain ambiguities and complexities during the collaboration process (Huxham & Vangen, 2005).

Klijn and Koppenjan (2016) distinguish three types of these "network complexities." Substantive complexities arise because of the differences in perspectives and knowledge of the involved actors. Involved actors each perceive the problem from their own perspectives, and use their own knowledge to come up with a solution, which might cause difficulties in the joint assessment of the problem and the joint creation of the solution. Strategic complexities arise because of the different interests, agendas, and motives of the involved actors. From these differences, opportunistic behavior might arise, which could hinder joint action and the development of interpersonal trust. Institutional complexities arise from the presence of multiple organizational cultures and institutional realities in collaborative arrangements, which can cause conflicting perspectives on how to proceed in the collaboration.

The presence of the three types of network complexities tends to increase when the number of actors increases in the partnership, as the variation in actors' perspectives and knowledge, interests and motives, and cultural and institutional realities grows (Klijn & Koppenjan, 2016). Furthermore, larger collaborations often have more complicated governance structures (Provan & Kenis, 2007), which can lead to a higher structural complexity of the collaboration (Huxham

& Vangen, 2000). For this reason, we also consider the size of the partnership as a contributing factor to its complexity.

PPIs might be especially sensitive to network complexities as these types of partnerships often have a relatively short lifespan and are intentionally directed toward the realization of an innovative product or service (Di Meglio, 2013). As such, circling too long around concrete solutions due to network complexities is neither opportune nor productive. Moreover, and in contrast to related collaborative arrangements such as PPPs, PPIs are typically less formalized (Di Meglio, 2013). Hence, control instruments such as contractual design and contract management, which can limit the effect of network complexities on the collaboration (Callens et al., 2022), may have less impact on PPIs, and are mostly used to deal with issues related to intellectual property (Brogaard, 2021).

2.2 | Two theoretical lenses for collaborative innovation

Collaborative innovation literature proposes two conflicting theoretical lenses through which partnership synergies can emerge in complex collaborative arrangements. A first theoretical lens focuses on achieving "creative synergies," in which the connection between various ideas, perspectives, and knowledge of the involved actors presents opportunities for innovation (Milliken et al., 2003). By increasing the variation in the innovation process, new associations between ideas can emerge and divergent thinking is stimulated (Bledow et al., 2009). From this theoretical perspective, innovation is created "by harnessing rather than eliminating difference" (Sørensen & Torfing, 2017, p. 828). Proponents of this perspective argue that innovation arises from the interactions between a diversity of actors, each with their own knowledge and perspectives on the problem, their own professional and organizational backgrounds, and, consequently, their own interests and objectives (Sørensen & Torfing, 2011; Torfing, 2019; Torfing et al., 2020). According to this perspective, network complexities should thus be exploited in order to achieve creative synergies and generate innovative solutions.

The second theoretical lens focuses on achieving "operational synergies," in which the alignment of ideas and perspectives, and the mobilization of resources presents opportunities for innovation. Proponents of this theoretical perspective recognize the inherent drawbacks of collaborations and their influence on the innovation process (Diamond & Vangen, 2017). For instance, Vivona et al. (2022) point to (1) the potential coordination costs of collaborations, which makes them costly to manage, (2) the unpredictability of the innovation results and the diversity of values that are assigned to these results, which can lead to opportunistic and noncooperative behavior, and (3) the costs of knowledge sourcing during transformational learning, due to the ambiguity, hiddenness, or unavailability of knowledge. Furthermore, Vangen (2016) suggests the existence of a "culture paradox," as the diversity of organizational cultures in collaborations might indeed create synergies, but might also lead to collaborative inertia due to conflicts, misunderstanding, and frictions. According to this perspective, network complexities should thus be controlled in order to build operational synergies that generate innovation at the lowest costs.

2.3 | Integrating the theoretical lenses through complexity leadership

The two theoretical lenses of collaborative innovation present a paradox in which collaboration can, through their network complexities, both enable and hinder innovation (Diamond & Vangen, 2017). We argue, however, that both collaborations with high levels of complexities and collaborations with low levels of complexities can generate innovative solutions, if particular leadership styles are added to the mix. Leadership, generally defined as the attempt to influence the behavior of others to achieve a specific goal (Torfing & Ansell, 2017), has been broadly used as a critical stimulating condition in both collaborative governance literature (e.g. Ansell & Gash, 2008; Emerson et al., 2011) and collaborative innovation literature (Lindsay et al., 2020; Sørensen & Torfing, 2020; Torfing et al., 2020). We focus on a particularly promising type of leadership, which has recently gained traction in public administration research: complexity leadership.

Complexity Leadership Theory (CLT) starts from the premise that many organizational arrangements resemble complex adaptive systems, which are "neural-like networks of interacting, interdependent agents who are bonded in a collective dynamic by common need" (Uhl-Bien & Marion, 2009, p. 631). CLT recognizes the complex interaction context in which these systems evolve, and theorizes how such systems might be influenced despite their complex behavior. In contrast to classical work on transformational and transactional leadership (and related work on ambidextrous leadership, which combines these leadership types, e.g. Gieske et al., 2020), complexity leadership emerges from the interactive dynamics between the agents (Hazy & Prottas, 2018), and does not emanate from a "strong" and charismatic leader, but from the manipulation of the interaction context (Murphy et al., 2017; Uhl-Bien et al., 2007).

While Uhl-Bien et al. (2007) initially proposed three types of complexity leadership (i.e., administrative leadership, adaptive leadership, and enabling leadership), additional types have been introduced over the decades (Hazy & Uhl-Bien, 2013). Hazy and Prottas (2018) tested the construct validity of all of these types, and found that only two types were retained in their factor analysis: administrative leadership and generative leadership. Generative leadership

refers to practices through which “the ability to seek out, foster and sustain generative relationships” is enabled (Surie & Hazy, 2006, p. 15). Generative leadership is able to exploit complex interactions by stimulating adaptability, optionality, novelty, flexibility, and experimentation (Gibbons & Hazy, 2017; Hazy & Prottas, 2018). Administrative leadership refers to practices through which control and alignment becomes possible (Uhl-Bien et al., 2007). Through the introduction of formal structures for authority and decision-making, and a focus on coordination, resource allocation, and achieving discrete targets (Hazy & Prottas, 2018; Murphy et al., 2017), administrative leadership tries to control and steer complex interactions.

Attention to forms of relational leadership such as complexity leadership has been growing steadily in public administration literature (Crosby & Bryson, 2018). While originally developed for the private sector, CLT has recently been broadly applied to the public sector (Paananen et al., 2022). For instance, Murphy et al. (2017) provide empirical evidence on urban regeneration projects that administrative leadership is particularly found in low to medium complexity projects, while generative leadership1 is particularly found in high complexity projects. Moreover, innovation leadership in the public sector has been shown to emanate from the interaction context instead of the individual leader (Meijer, 2014; van der Voet & Steijn, 2020), as complexity leadership does. However, in contrast to related innovation leadership constructs such as entrepreneurial leadership, which focus exclusively on the ability to support the generation of new ideas (e.g. Meijer, 2014), or other relational leadership theories (e.g., collaborative leadership, shared leadership, distributed leadership), which focus solely on the bottom-up interactions between actors, CLT combines elements of formal/directive leadership, emergent leadership, and distributed leadership (Hazy & Uhl-Bien, 2015), which makes it particularly useful to study complex collaborative innovation arrangements. Indeed, collaborative innovation processes that are not (top-down) directed toward a particular goal, might never materialize into an innovative solution, while they might also never create something bold and novel when they are not (bottom-up) stimulated to use the generative interactions between the actors.

Furthermore, CLT is especially promising in governance networks (e.g., Nooteboom & Termeer, 2013), which resemble many aspects of complex adaptive systems (Klijn, 2008).

Recent empirical research into collaborative innovation networks shows that distributed leadership that empowers the involved actors to take action, is more prevalent in these networks (Lindsay et al., 2020; Sørensen & Torfing, 2020; Torfing et al., 2020). Additionally, a recent

literature survey of public service innovation networks shows that there are two modes of functioning in these types of networks (see, Desmarchelier et al., 2020, p. 1387). Whereas the first mode of functioning is based on directive leadership through a hub actor or system integrator, the second mode is based on distributed leadership, through local interactions. CLT combines these two modes of functioning through, respectively, administrative leadership and generative leadership. As such, complexity leadership might be ideally suited to either exploit or control the existing network complexities, and produce innovative solutions, as the two theoretical lenses of collaborative innovation predict.

As Murphy et al. (2017) indicate that administrative and generative leadership are particularly useful in, respectively, low and high complexity contexts, we propose that the higher the level of network complexities and structural complexities (i.e., size of partnership), the higher the need for generative leadership to produce innovation, and the lower the level of these complexities, the higher the need for administrative leadership to generate innovation:

> Hypothesis 1. Large partnerships with high levels of network complexities use generative leadership to produce highly innovative services.

> Hypothesis 2. Small partnerships with low levels of network complexities use administrative leadership to produce highly innovative services

3 | CASES AND METHODOLOGIES

3.1 | Case selection

This article uses a dataset of 19 PPIs in five European countries: Belgium, Denmark, Estonia, the Netherlands, and Spain. As the European Commission prioritizes technological innovation in the healthcare sector (European Commission (2018), and the majority of PPIs are found in the healthcare sector (Brogaard, 2021), we selected PPIs that produced eHealth solutions. A detailed list of the selected cases is available in the Supporting Information (Table A1). Because of our purposeful sampling of the cases, we used three levels of case selection criteria.

At the level of the country, we selected European countries that represent the two most dominant healthcare systems. Böhm et al. (2013) distinguish National Health Services from

Etatist Social Health Insurance Systems. In the former systems, the regulation, finance, and healthcare delivery are controlled by the government, while in the latter systems, government is responsible for financing the system, but the finance and service provisioning are executed, respectively, by societal actors (e.g., para-fiscal funds) and private actors (non-profit/for-profit). As both of these systems are at least regulated by governments, we also considered four important administrative regimes of continental Europe (Pollitt & Bouckaert, 2017). Based on these criteria, five European countries were selected: Belgium (Etatist Social Health Insurance System, mixed Napoleonic tradition), Denmark (National Health Services, Nordic tradition), Estonia (Etatist Social Health Insurance System, Eastern European tradition), the Netherlands (Etatist Social Health Insurance System, Continental tradition), and Spain (National Health Services, Napoleonic tradition).

At the level of the partnership, we selected collaborations between public actors (e.g., governments, public agencies, public hospitals, etc.), private actors (e.g., non-profit organizations, firms, etc.), and services users (e.g., GPs, health professionals, patients, patient organizations, etc.). Indeed, PPIs are considered to be partnerships between public actors and private actors, which involve service users to innovate services (Brogaard, 2021). Furthermore, because PPIs come in a variety of arrangements (Di Meglio, 2013), we selected both larger (more than 10 partners) and smaller (less than 10 partners) partnerships, and included both PPIs that were coordinated by a public actor, and PPIs that were coordinated by a private actor.

At the level of the eHealth services, we selected partnerships that worked on the two most common types of eHealth solutions: (1) eHealth solutions related to digital information flows between actors (e.g., digital networks for the exchange of health information, registration or monitoring platforms, etc.), and (2) eHealth solutions related to telehealth, mobile health, and smart devices (e.g., integration of motion sensors in health solutions, mobile apps smart cameras, etc.) (Shaw et al., 2017). In order to measure the “innovativeness” of the created services (more on this later), we selected cases that actually tested or implemented their created services in a real-life environment in the period 2015–2020.

Using a rather broad definition of PPIs in the healthcare sector (i.e., collaborations between public actors and private actors with the purpose of creating innovative services in the healthcare sector), we initially selected, through an extensive desk research, 79 cases. From this initial sample, we only retained partnerships that involved service users to innovate, and cases that represented a proper variation between smaller and larger partnerships, which culminated in the selection of 44 cases. From this sample, we only retained the cases that represented a proper variation of the two types of eHealth solutions described above, and cases that implemented or tested their innovations in the period 2015–2020. The final selection round yielded the 19 PPIs that are considered in this study (see Table A1).

3.2 | Fuzzy-set QCA

Fuzzy-set QCA is a case-sensitive, set-theoretic approach that uses Boolean logic to extract patterns from case data (Ragin, 2008). We employ QCA for its configurational causation, which allows researchers to determine the combined effect of multiple conditions on an outcome. After all, both of our hypotheses predict a combined effect between multiple conditions on the innovativeness of the created services. Furthermore, QCA allows a comparative analysis with a medium N-sized sample of cases, which would be too few for standard regression analysis, but too many for qualitative case studies. As we want to infer insights on the European context, but still retain qualitative insights on the mechanisms that are responsible for the relationship between conditions and outcome, QCA is perfectly suited to address our research question.

We refer to the QCA handbook of Schneider and Wagemann (2012) for a thorough introduction into QCA, as we will only summarize some key features of the methodology. In QCA, the conditions and outcome represent different sets in which a case can be present or absent. To find patterns between the conditions and outcome, the QCA researcher determines the degree of overlap between these sets. A large overlap between the sets means that the condition(s) consistently lead to the outcome, which is indicated by its consistency value. A high consistency value between one condition and the outcome indicates that the condition is necessary for the outcome, which is referred as a necessary condition. A high consistency between multiple conditions and the outcome means that the conditions are sufficient for the outcome, which are called sufficient conditions. The more cases that are covered by these overlapping sets, the more prevalent this overlap is. This measure is indicated by the coverage value.

In order to determine the consistency and coverage values of the overlapping sets, one first needs to construct the sets of the conditions and the outcome. During the calibration procedure, case membership values are assigned to each set. These membership values indicate if a case is out of the set (indicated with “0”) or in the set (indicated with “1”). As we employ fuzzy-set QCA, cases may also be partially out of the set (here indicated as 0.33), or partially in the set (0.67). The cross-over point of 0.50 is a point of maximal indifference of the case toward begin in or out of a set, and is a crucial point of reference during the calibration procedure (Schneider & Wagemann, 2012).

3.3 | Data collection

In order to prevent common source bias and common method bias, and ensure a proper calibration of the conditions and outcome, we collected data from different respondents, at different points in time, using different data collection methods. We collected interview data from a total of 132 respondents, including project coordinators, public partners (e.g., representatives of governments agencies, political cabinets, public hospitals, etc.), private partners (e.g., representatives of private home care organizations, consultants, ICT-companies, etc.), and services users (e.g., GPs, health professionals, patients, patient organizations, etc.). A few weeks before each interview, a survey was sent to the respondents, which was answered by 124 respondents. Furthermore, in the months after the interviews, the interviewers each provided a written account of the cases with contextual information on, for example the background of the project and the partners, the collaborative innovation process, the motives and roles of the partners, and so forth. Five research teams (one per country) collected the interview data. The survey data were centrally obtained through Qualtrics software by the coordinating research team. The coordinating research team also ensured consistency in data gathering (e.g., through various meetings regarding case selection, data collection instruments, translation of survey and interview questions, selection of respondents, etc.), and was responsible for the calibration of the data (in collaboration with the other research teams). Detailed information on the data collection per case is provided in the Supporting Information (Table A2).

3.4 | Operationalization and calibration

3.4.1 | Outcome: Perceived innovativeness

Innovation can be defined as something that is perceived as new for a unit of adoption (Anderson et al., 2004; Rogers, 2003; Walker, 2008). The combination of "newness" and "implementability" is present in most definitions of innovation, as creating something new without implementing it in a real-life environment, is less associated with innovation, and more with creativity (Anderson et al., 2014). For this reason, we asked the project coordinators, public actors, private actors, and service users how they perceived the newness and implementability of the services that were created in their PPI. Structured questions, related to these two aspects with bipolar, seven-point scales were used in both the surveys and interviews (see Table A3). As one of the principal aims of PPIs is to create innovations (Di Meglio, 2013) and we ask for the perceptions of the respondents regarding the innovativeness of the created

solutions, we controlled for potential bias in responses by selecting a relatively high cross-over point of 5 on the seven-point scale during the calibration of the outcome. Furthermore, data triangulation of survey/interview data of multiple respondents was required to arrive at one case membership score. Because the interview and survey questions all described the same concept (i.e., perceived innovativeness),2 we calculated the mean values per respondent over these questions. We used qualitative calibration rules to finally arrive at the case membership score (see Table A11).

3.4.2 | Conditions

We operationalized the size of the partnerships by considering the number of individual actors in the partnerships. We drew on previous research into PPIs (Brogaard, 2019), but also considered the characteristics of our data (see Figure A1). We selected a cross-over point of 10 as the eHealth PPIs in our dataset can typically include three types of public actors (governments, hospitals, and public health insurance funds), three types of private actors (private health actors, consultants, and tech firms), and three types of user actors (citizens/patients, patient organizations, and health professionals). As such, the minimum of all these types of actors (plus coordinator, which is often a separate actor) gives us a total number of 10. As we defined PPIs as partnerships between public actors, private actors, and users, the minimal number of actors involved in these partnerships (plus coordinator) is four. We applied the same range between very small and small partnerships to the large partnerships. For this reason, we assigned a 0 for partnerships with less than five actors, 0.33 for partnerships with 5–10 actors, 0.67 to partnerships with 10–15 actors, and 1 to partnerships with more than 15 actors.

Network complexities were operationalized using the definitions of Klijn and Koppenjan (2016). We asked four semi-structured interview questions to the project coordinators, public partners, and private partners, and collected examples of network complexities through these questions (see Table A5). Using these examples, we calibrated case scores for each type of network complexity (i.e., substantive, strategic, institutional), after which we created an aggregated case score that depended on the case scores of the individual network complexities. If the cases scored lower than the 0.50 threshold for all three types of complexities, the aggregated score received a 0. If the cases scored lower than 0.50 for two types of complexities, the aggregated score received a 0.33. If the cases scored lower than 0.50 for only one type of complexity, the cases were assigned an aggregated score of 0.67. If the cases scored lower than 0.50 for none of the types of complexities, the cases received an aggregated score of 1 (see Table A11).

Generative leadership and administrative leadership were operationalized using the 10 survey items from the validated construct of Hazy and Prottas (2018). We asked the project coordinators, public actors, and private actors these items using a seven-point scale (see Table A6). Similar as with the outcome, the mean value over the items was calculated for each condition. Due to the distributed character of complexity leadership (Crosby & Bryson, 2018), potential self-assessment biases in the answers might not only arise from the project coordinators, but also from the public actors and private actors. To ensure that these biases did not artificially increase the case membership score, we selected a relatively high cross-over point of 5 on the seven-point scale. Qualitative calibration rules were applied to arrive at a final case score (see Table A11).

Additional information regarding the calibration of the outcome and conditions can be found in Table A11, and the calibrated dataset is illustrated in Table A7. Note that we did not ask the users to answer the questions regarding the network complexities and leadership items, as their involvement did not allow them to dive deep enough into the governance dynamics of the partnership to make sound judgments on these conditions. With our four conditions and 19 cases, the probability of generating solution paths on random data is only 7%, which is well below the 10% threshold Marx and Dusa (2011) suggest.

4 | RESULTS

We conducted the QCA analyses with fsQCA software, version 3.1b (Ragin & Davey, 2017). Table 1 shows the distribution of the case above and below the cross-over point. There is a relatively equal distribution of cases over the countries, and over the types of created services. All five countries are represented in the covered cases above the cross-over point, in which seven cases created eHealth services related to digital information flows, while five cases created eHealth services related to telehealth, mobile health, and smart devices.

Table 1: Set membership of the cases for the outcome

Innovativeness of created services in the projects		Number of cases	Cases
High innovativeness	Above 0.5	12	B1, B2, B3, B4, N2, S1, S2, S3, S4, E2, D1, D3
Low innovativeness	Below 0.5	7	B5, N1, N3, N4, E1, E3, D2

Standards of practice were followed when performing the QCA analyses (Schneider & Wagemann, 2012). We first conducted the analysis of necessary conditions, which is reported in Table 2. According to Schneider and Wagemann (2012), a raw consistency level of at least 0.90 is advised to consider a condition necessary for the outcome. As is visible from Table 2, none of the conditions come close to this threshold, which means that none of the individual conditions are necessary for the creation of highly innovative services. We also checked the necessity of the conditions for the absence of highly innovative services (Table A8), which shows that none of the conditions are necessary for the absence of the outcome.

Table 2: Analysis of necessary conditions

Presence of high innovativeness		
Conditions	**Consistency**	**Coverage**
Large partnerships	0.565	0.607
Small partnerships	0.666	0.689
Presence of network complexities	0.666	0.626
Absence of network complexities	0.532	0.639
Presence of generative leadership	0.798	0.686
Absence of generative leadership	0.465	0.636
Presence of administrative leadership	0.497	0.788
Absence of administrative leadership	0.734	0.580

In order to analyze the sufficiency of (the combination of) the conditions, a truth table is constructed (Schneider & Wagemann, 2012), which is illustrated in Table 3. The truth table lists all the logically possible combinations of conditions. We only report the combinations (i.e., truth table rows) that are covered by at least one case. Ragin (2009) suggests a raw consistency threshold of 0.80 to retain consistent truth table rows for the next steps in the analysis. Furthermore, an extreme drop in the proportional reduction in inconsistency (PRI) consistency and the product of the raw consistency and PRI consistency is visible from Row 7 onwards (i.e., from 0.512 to 0.269), which also indicates that the threshold is reached (Schneider &

Wagemann, 2012). For these reasons, we only retain truth table Rows 1 through 6 for the next step in the analysis.

Table 3: Truth table

	Partnership size	Network complexities	Generative leadership	Administrative leadership	Innovativeness[1]	#cases	Raw consist.	PRI consist.
1	0	1	1	0	**1**	2	**1**	**1**
2	0	0	0	1	**1**	1	**1**	**1**
3	0	1	1	1	**1**	1	**1**	**1**
4	1	0	1	0	**1**	1	**0.889**	**0.670**
5	0	0	1	1	**1**	2	**0.872**	**0.746**
6	1	1	1	0	**1**	2	**0.847**	**0.605**
7	0	0	0	0	0	2	0.798	0.337
8	0	0	1	0	0	3	0.783	0.400
9	1	1	1	1	0	1	0.698	0.497
10	1	1	0	0	0	4	0.665	0.337

[1] The 1 in the columns indicates that only rows 1 through 6 consistently lead to the outcome.

Next, the six retained truth table rows are logically minimized and the consistency and coverage values of these minimized rows are calculated (Schneider & Wagemann, 2012). During the minimization procedure and subsequent Standard Analysis, we encounter two tied prime implicants, which indicates model ambiguity (Baumgartner & Thiem, 2017). More specifically, truth table Row 1 leads to two tied prime implicants: (1) Small partnerships x Generative leadership x Network complexities, and (2) Generative leadership x Administrative leadership x Network complexities. As both of the prime implicants are not fully consistent with our hypotheses, we decide to run three models, in which, respectively, the first, the second, and both of the prime implicants are selected in the final model. The third model, in which we select both prime implicants, provides the most theoretically coherent solution paths, as it is the only model in which the combination of the conditions size, network complexities, and leadership is present in the first and second solution paths (which follows our hypotheses). Furthermore, the intermediate solution for this model is identical to the complex solution, while this is not the case for the other models. The first two models are reported, respectively, in Tables A9 and A10, while the third model is illustrated in Table 4. We also observe one contradictory case (i.e., N3), which is a case that is part of the solution path, but does not exhibit the outcome.

To summarize, we find the following solution paths:

- Solution path 1: Small PPIs with high levels of network complexities use generative leadership to create highly innovative services;

• Solution path 2: Small PPIs with low levels of network complexities use administrative leadership to create highly innovative services;

• Solution path 3: Large PPIs only use generative leadership (i.e., no administrative leadership), to create highly innovative services.

Table 4: Intermediate solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases in path
Small partnerships * Generative leadership * Network complexities	1	0.431	0.135	D3, S2, B4
Small partnerships * Administrative leadership * ~Network complexities	0.887	0.265	0.134	N3~, E2, S1
Large partnerships * Generative leadership * ~Administrative leadership	0.801	0.398	0.135	D1, B2, S3
Solution consistency	**0.841**			
Solution coverage	0.700			

Slight recalibrations to the data and rerunning the analyses with the recalibrated conditions is recommended to test the robustness of the results (Schneider & Wagemann, 2012). We recalibrated the data by using different criteria for set membership. These criteria can be found in the Supporting Information (Table A12). The recalibrated dataset, truth table, and intermediate solution can also be found in the Supporting Information (Tables A13–A15). The results confirm the solution path of the original QCA analysis, which proves the robustness of the solution.

5 | DISCUSSION AND CONCLUSION

Our results show that PPIs with high levels of network complexities tend to use generative leadership to produce innovative services, while PPIs with low levels of network complexities tend to use administrative leadership to produce innovative services. These results match the findings of Murphy et al. (2017) in urban regeneration projects, and, therefore, extend these findings to collaborative innovation projects. The results also confirm our assumption that PPIs can generate innovative services by both exploiting network complexities through generative leadership in their search for creative synergies, and controlling network complexities through administrative leadership in their search for operational synergies, which confirms the existence of both of the two theoretical lenses of collaborative innovation.

However, two aspects of the QCA results are not in line with what we expected. First, the PPIs in which we see a combination of, on the one hand, high levels of network complexities and generative leadership, and, on the other hand, low levels of network complexities and administrative leadership are both small partnerships. Hence, it appears that partnerships that are quite similar in size use different types of complexity leadership when different levels of network complexities are present. Second, large partnerships only use generative leadership (and no administrative leadership) to produce highly innovative services. In these partnerships, the structural complexity is typically higher, as they use more sophisticated governance structures (Huxham & Vangen, 2000; Provan & Kenis, 2007). This is also the case in the studied PPIs. For instance, all the covered cases in the third solution path have intricate governance structures with several project teams, core teams, steering committees, advisory boards, and so forth. In contrast, all of the partnerships that are covered in the first and second solution path are lead-organizations with rather straightforward governance structures in which a lead actor is responsible for the governance of the partnership (Provan & Kenis, 2007). Moreover, as truth table Rows 4 and 6 indicate (Table 3), two of the three covered cases in the third solution path also exhibit high levels of network complexities.

These results suggest that a rise in complexity pushes partnerships to use generative leadership and abandon administrative leadership in order to produce highly innovative services. A possible explanation for this might be the steady rise of “collaborative inertia” in these partnerships. Collaborative inertia refers to the slow, lengthy, and hazardous progress many collaborations undergo as a result of various ambiguities and complexities (Huxham & Vangen, 2005). Because of this collaborative inertia, collaborative advantages such as partnership synergies (Lasker et al., 2001) are difficult, and sometimes even impossible, to achieve (Huxham, 2003). Collaborative inertia is often a symptom of the inability of collaborative partners to successfully control the ambiguities and complexities in the partnership (Huxham & Vangen, 2005).

We see this illustrated in case B2, where a federation association of home care organizations was in charge of creating a new tool for patient information sharing between home care organizations and GPs. Because of the large size of the partnership (several home care organizations, but also government organizations, technology firms, and patient representatives) and the variety of institutional practices (each home care organization had their own processes and procedures for information exchange) and perspectives on the solution (e.g., conflicting views on how patient information should be shared), the partnership encountered several delays (some up to 4 months) throughout the project.

In low complexity partnerships, achieving operational synergies by controlling the complexities through administrative leadership seems to present the most effective way to create innovative solutions. However, when complexity rises, a certain threshold might be reached at which effective control over the complexities through administrative leadership is no longer possible. At this point, operational synergies become difficult to realize, as collaborative inertia starts to build up in the partnership (Huxham, 2003). Further increasing administrative leadership might, in this case, even stifle the innovation process because the bureaucratic focus of administrative leadership (Uhl-Bien & Marion, 2009) could prevent creative exploration in favor of operational efficiency (Sørensen & Torfing, 2011). However, generative leadership is ideally suited in such a context, as it is directed toward adaptability, flexibility, and experimentation (Gibbons & Hazy, 2017).

We see this illustrated in our example of Case B2. The project coordinator used high levels of generative leadership by encouraging the open communication of differences in opinions between the actors regarding the way in which patient information should be exchanged, by securing additional resources and knowledge from government actors to facilitate a new approach on patient information exchange, and by creating experimental settings in which new ideas could be tested. In such a dynamic context, the project coordinator was unable to pursue high levels of administrative leadership, as rigid goal-setting would have been obsolete due to the ever-changing process. However, the dynamic setting of the partnership enabled the coordinator to exploit the creative synergies that emerged out of the complexities, which facilitated the generation of an innovative information exchange service. In contrast, the project coordinator of Case S1, which was a partnership between a limited number of actors and with low levels of network complexities, was able to use high levels of administrative leadership by introducing a contract in which rigid goals, deadlines, and steps of the innovation process were formalized. Due to the contract, the partnership was able to exploit operational synergies and achieve a workable innovation.

These results indicate that the emphasis on distributed forms of leadership in recent collaborative innovation research (e.g., Lindsay et al., 2020; Sørensen & Torfing, 2020; Torfing et al., 2020) is indeed justified, but our results also introduce more nuance into this discussion. Our results show that, depending on the degree of network complexities, different leadership styles tend to dominate. In low-complexity partnerships, formal leadership styles (i.e., administrative leadership) become more important than distributed leadership (i.e., generative leadership) to generate highly innovative services, and vice versa. Thus, an exclusive focus on distributed forms of leadership in collaborative innovation research should be avoided. These results underline the findings of Desmarchelier et al. (2020) that different leadership modes exist in PPIs (i.e., an vertical, directive mode, and a horizontal, distributed mode). We contribute to this research by showing that different degrees of network complexities lie at the basis of these different leadership modes, and that CLT shows that these leadership modes are different sides of the same coin.

These theoretical insights also entail practical implications. The empirical findings suggest that a rise in complexity demands a shift in leadership style in PPIs. To produce highly innovative solutions, small partnerships with limited complexities are best led by coordinators who emphasize accountability, set objective metrics for success and failure, quite voices that distract from the purpose, stimulate the partners to invest more time and energy, and establish specific targets and deliverables. These coordinators might adopt managerial strategies that are directed toward the structural features of the partnership (e.g., contract management, adopting process rules, creating new ad hoc arrangements, Klijn & Koppenjan, 2016). However, from the moment this administrative leadership style and the associated managerial practices become insufficient to control the rising complexities, the partnership will need coordinators who support the expression of differences of opinions, mobilize resources and time to try new things, encourage learning from other contexts and taking new approaches, and create a setting in which failure is forgiven. From this moment, the focus of the coordinator shifts from a controlling stance toward a generating approach, and managerial practices related to the exploration and connection of new knowledge and information (Klijn et al., 2010) might be emphasized. In sum, contingent on the level of complexity of the PPI, coordinators should apply administrative leadership or generative leadership, and should also be able to shift between the two if the level of complexity should change.

These reflections provoke the question if these results are generalizable to other types of partnerships. Although we believe this is the case because conditions such as leadership and network complexities are not restricted to PPIs, we urge caution when generalizing the findings. PPIs are quite specific types of partnerships, with their own dynamics and processes, which are not necessarily present in other types of partnerships. Furthermore, we only considered cases in (continental) Europe, which limits the generalization potential of the study. Moreover, due to our research design (i.e., QCA), we were not able to reconstruct the precise causal mechanisms that are responsible for the link between the conditions and the outcome, nor were we able to add additional control conditions to the analysis. Future in-depth qualitative case studies, process tracing studies, or large-N quantitative studies might shed light on this. Still, this article presents new comparative evidence on a large set of PPIs, which provides important theoretical and practical implications for contemporary collaborative innovation research.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data underlying this article are available in the article and in the article's supplementary material. Other data (i.e., survey and interview data) underlying this article cannot be shared publicly in order to protect the privacy of individuals who participated in the study.

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ENDNOTES

1 The authors actually refer to “adaptive leadership” (Uhl-Bien et al., 2007), which has been showed by Hazy and Uhl-Bien (2015) to strongly align with the concept of generative leadership.

2 We also checked this by looking at the factor loadings for the interview and survey questions, which are illustrated in the Supporting Information (Table A4).

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SUPPORTING INFORMATION

Table A1: Selected cases

Case			Case description
Belgium	Mixed Napoleonic adm. regime Etatist Social Health Ins.	B1	Multiple national government agencies, ministerial cabinet, multiple hospital networks, regional governments, private health suppliers, and insurance organizations, and user organizations created a portal website which provides patient information for citizens at a national level.
		B2	Private nursing organizations and federation, ministerial cabinets, national government agencies, hospital networks, individual GPs, and several private health organizations created a tool which provides access for general practitioners (GPs) to home care organisations' patient information.
		B3	Universities, private health organizations, national and regional government agencies, red cross organizations, knowledge organizations, ICT suppliers, and individual health professionals created a way of creating, validating, and disseminating official evidence-based guidelines for health care providers.
		B4	Public nursing home (local government), private construction companies and contractors, consultant companies, nurses, and patients created a nursing home which implemented several technologies (wearables, smart cameras, etc.) to support residents and nurses in their daily activities.
		B5	Municipalities, communal network, private hospitals, private ICT companies, consultant companies, citizens, and health professionals created a platform which brings people with health/social care demands together with volunteers who provide help.
The Netherlands	Continental adm. regime Etatist Social Health Ins.	N1	Municipality, public hospital, and several private health organizations created a ICT platform which facilitates the exchange of health information between partners and patients.
		N2	Municipality (departments of social affairs, ICT, and service quality), private health care provider, neighbourhood teams, citizens created a digital platform designed to foster neighbourhood collaborations between clients and consultants.
		N3	Semi-private association, software developer, and patient organization created a tracking technology which allows an open floor and the possibility for dementia patients to walk around freely.
		N4	Semi-private association, ICT company, consultant company created a smart diaper which automatically detects defecation and signals this to the nurses.
Spain	Napoleonic adm. regime National Health	S1	Several public hospitals, private ICT companies, several patient organizations, university created an electronic prescription system, a patient appointment system for the Outpatient Dispensing Unit, a robot for automatic storage and dispensing in assisted and unassisted mode.
		S2	Public hospital/health service, regional government, ICT companies, consultancy companies, several other private companies, universities, health professionals and patients created advanced ICT systems designed to enable an integrated patient-centred care model to deliver home health care for chronic patients.
		S3	Public hospitals and healthcare services, public research institute, private technology centre, several health professionals (e.g. psychiatrist, psychologists, physicians, etc.) created a computerised cognitive behaviour therapy (CCBT) through a web application which allows for self-administered treatment regardless of time or place.

Case			Case description
		S4	Public hospitals, ICT and telecom companies, physicians created an AI application to diagnose uncooperative patients. It serves to determine whether they have any problems with their eyesight. In some cases, it also enables the diagnosis of the problem.
Estonia	Eastern-European adm. regime Etatist Social Health Ins.	E1	Ministry, government agencies and public authorities, ICT companies, private health care providers, physician associations, hospital associations, individual physicians created a centralised registration system within the national patient portal where patients can book appointments with all health care providers that have partnered with the project.
		E2	Ministries, public health insurance authority, government agencies, physician association, interest groups created a redesigned service process that combines three standalone services (application for disability; application for rehabilitation services; application for aids) into one logical service. It is achieved through changes in data processing and analytics.
		E3	Ministry, public health insurance authority, colleges, network of healthcare providers, ICT companies, several health care organizations created an app with a voice command function that supports the health care provider in carrying out procedures through digitalised guidelines.
Denmark	Nordic adm. regime National	D1	Regional government, municipalities, public hospitals, ICT company, representatives of health professionals created an e-learning programme that provides health professionals with knowledge about dysphagia.
		D2	Public hospital, ICT company, health professionals created a smartphone app for patient reported outcomes.
		D3	Public hospital, university, ICT and health service companies, patient associations, health professionals created a smartphone app that helps convey the results of bone scans to patients with osteoporosis.

Table A2: Data collection

Case			Data collection	
			Surveys	Interviews
Belgium	Mixed Napoleonic adm. regime Etatist Social Health Ins.	B1	Government agency, ministerial cabinet, public hospital, private ICT company, representatives of patient organizations, physician association, and user groups	Government agency, ministerial cabinet, public hospital, private ICT company, representatives of patient organizations, physician association, and user groups
		B2	Project coordinator, government agency, private service provider, ICT company, GPs	Project coordinator, government agency, private service provider, ICT company, GPs
		B3	Chairman and CEO network, representative government steering committee, private service providers, ICT company, GPs	Chairman and CEO network, representative government steering committee, private service providers, ICT company, GPs
		B4	Manager nursing home, municipality, nurses	Manager nursing home, municipality, external private consultant, nurses
		B5	Project coordinator municipality, employee municipality, ICT company, citizens	Project coordinator municipality, employee municipality, ICT company, citizens
The Netherlands	Continental adm. regime Etatist Social Health Ins.	N1	Project coordinator, public service organization, ICT company, service organization, physicians	Project coordinator, public service organization, ICT company, service organization, physicians
		N2	Project coordinator municipality, coordinator private service provider, employee municipality, social workers and other professional users	Project coordinator municipality, coordinator private service provider, employee municipality, social workers and other professional users
		N3	Manager/project coordinator, public service provider, ICT company, representative user organization, nurse, physician	Project coordinator, public service provider, ICT company, representative user organization, nurse, physician
		N4	Manager/project coordinator, public service, provider	Manager/project coordinator, public service, provider, nurses
Spain	Napoleonic adm. regime National Health Service	S1	Public hospital, public hospital, ICT company, health professionals	Public hospital, public hospital, ICT company, health professionals
		S2	Innovation director ICT company, public hospital, private service organization, patient, physician, social worker	Innovation director ICT company, public hospital, private service organization, patient, physician, social worker
		S3	Public hospital, public hospitals/health care organization, ICT company, physicians, nurse and technician	Public hospital, public hospitals/health care organization, ICT company, physicians, nurse and technician
		S4	Public hospital, public hospital, ICT company, health professionals	Public hospital, public hospital, ICT company, health professionals
Estonia	Eastern-European adm. regime Etatist Social Health	E1	Project coordinator, ministry, ICT company, ICT technicians	Project coordinator, ministry, ICT company, ICT technicians
		E2	Project coordinator, ministry, physicians association, representatives of users and individual user	Project coordinator, ministry, physicians association, representatives of users and individual user
		E3	Project coordinator, ministry, private health network, representatives users, nurse	Project coordinator, ministry, private health network, representatives users, nurse
Denmark	Nordic adm. regime National Health Service	D1	Program manager, public hospital, ICT company, health professionals	Program manager, public hospital, ICT company, health professionals
		D2	Project coordinator, public hospital, physician, nurse	Project coordinator, public hospital, physician, nurse
		D3	Project coordinator, public hospital and ICT company, health professional, social worker, user representative	Project coordinator, public hospital and ICT company, health professional, social worker, user representative

Table A3: Operationalization of *innovativeness*

Newness	Implementability
No/A lot of innovative ideas are developed in this project	The frequency of use will typically be very low/high
The innovativeness of the developed innovation is very low/high	The effect on a user's life will be very small/extensive
The innovative character of the project is lower than/exceeds my initial expectations	Only a selective subgroup of users/All users that would benefit from this innovation can use it
The users could do exactly the same thing with other tools/would be unable to do those things without this innovation	The innovative ideas that are developed in the project are not feasible at all/very feasible
It is very easy/difficult (or impossible) to find tools that have the same functionalities as this innovation (at the moment of implementation)	The innovation does not deal with the problems at hand at all/really deals with the problems at hand

Table A4: Factor loadings survey-based data outcome/conditions

	Survey items	Factor loadings
Innovativeness (structured interview items)	(Newness) The users could do exactly the same thing with other tools/would be unable to do those things without this innovation	0.738
	(Newness) It is very easy/difficult (or impossible) to find tools that have the same functionalities as this innovation (at the moment of implementation)	0.768
	(Implementability) The frequency of use will typically be very low/high	0.683
	(Implementability) The effect on a user's life will be very small/extensive	0.676
	(Adoption) Only a selective subgroup of users/All users that would benefit from this innovation can use it	0.630
Innovativeness (survey items)	(Newness) No/A lot of innovative ideas are developed in this project	0.823
	(Newness) The innovativeness of the developed innovation is very low/high	0.853
	(Newness) The innovative character of the project is lower than/exceeds my initial expectations	0.741
	(Implementability) The innovative ideas that are developed in the project are not feasible at all/very feasible	0.567
	(Implementability) The innovation does not deal with the problems at hand at all/really deals with the problems at hand	0.825

Cronbach's alpha of 0.822 for the structured interview items and 0.737 for the survey items, and 0.784 for all the items together.

Figure A1: Distribution of partnership size

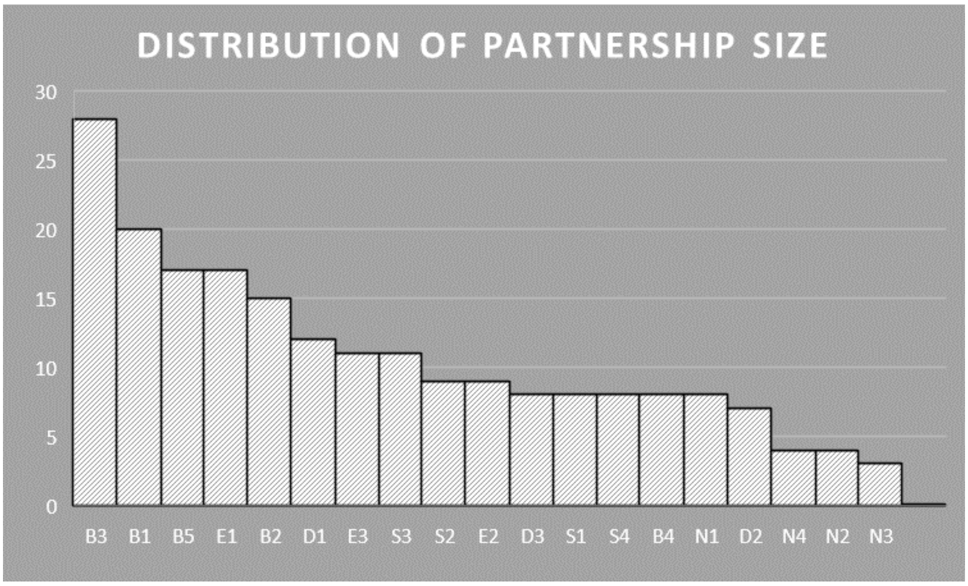

Table A5: Operationalization of network complexities

	Interview questions
Substantive complexity	• Were there actors with conflicting or very different perspectives on the problem definition and solution for that problem present in the project? YES/NO + examples • Was there additional knowledge and information required that was not yet present in the project? YES/NO + examples
Strategic complexity	• Was there strategic behavior of actors present in the project (actors who pursue their own interests and hence display opportunistic behavior)? YES/NO + examples
Institutional complexity	• Did differences in organizational cultures cause tensions in the way the actors were supposed to act in the project? YES/NO + examples

Table A6: Operationalization of complexity leadership (Hazy and Prottas 2018)

	Survey items
Generative leadership	• The coordinating actors supported differences of opinions to be expressed • The coordinating actors mobilized resources and time to try new things • The coordinating actors encouraged learning from other contexts • The coordinating actors encouraged us to take new approaches • The coordinating actors created an atmosphere in which failure is forgiven
Administrative leadership	• The coordinating actors emphasized accountability • The coordinating actors set objective metrics of success or failure • The coordinating actors quieted voices which distracted from the purpose • The coordinating actors asked actors in the partnership to invest more time and energy • The coordinating actors established specific targets and deliverables

(1) Not at all; (2) To a very low extent; (3) To a low extent; (4) To a moderate extent; (5) To a high extent; (6) To a very high extent; (7) Completely.

Table A7: Calibrated dataset

Case	Partnership size	Generative leadership	Administrative leadership	Network complexities	Innovativeness
N3	0	0.67	0.67	0	0.33
B5	1	1	0.67	1	0
E1	1	0.33	0.33	1	0
E3	0.67	0	0	1	0
D1	0.67	1	0	0.33	0.67
B3	1	0.33	0.33	1	0.67
N4	0	0.67	0.33	0	0.33
N2	0	0.33	0	0	0.67
S3	0.67	0.67	0.33	0.67	0.67
B1	1	0	0.33	1	0.67
B2	0.67	0.67	0	0.67	0.67
D3	0.33	0.67	0	0.67	0.67
S2	0.33	1	0.33	1	0.67
E2	0.33	0.33	0.67	0.33	0.67
D2	0.33	1	0	0.33	0.33
S1	0.33	1	1	0.33	1
S4	0.33	1	0.33	0.33	1
B4	0.33	0.67	1	1	1
N1	0.33	0.33	0	0	0

Table A8: Analysis of necessary conditions – absence of high innovativeness

Absence of high innovativeness		
Conditions	**Consistency**	**Coverage**
Large partnerships	0.665	0.641
Small partnerships	0.592	0.550
Presence of generative leadership	0.703	0.541
Absence of generative leadership	0.591	0.724
Presence of administrative leadership	0.406	0.578
Absence of administrative leadership	0.851	0.602
Presence of network complexities	0.665	0.560
Absence of network complexities	0.556	0.598

Table A9: Model 1: Intermediate solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases in path
Small partnerships * Generative leadership * Network complexities	1	0.431137	0.0678642	D3, S2, B4
Small partnerships * Administrative leadership	0.915	0.365269	0.233533	N3, E2, S1, B4
Large partnerships * Generative leadership * ~Administrative leadership	0.801205	0.398203	0.0339321	D1, B2, S3
Solution consistency	**0.841**			
Solution coverage	0.700			

Tied prime implicants when minimizing the following truth table row: Small partnerships * Generative leadership * ~Administrative leadership * Network complexities. Two tied prime implicants: 1) small partnerships * Generative leadership * network complexities, 2) Generative leadership * ~Administrative leadership * Network complexities → Selection of the former in this model

Table A10: Model 2: Intermediate solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases in path
Small partnerships * Administrative leadership	0.915	0.365	0.234	N3, E2, S1, B4
Generative leadership * ~Administrative leadership * Network complexities	0.868	0.432	0.068	B2, D3, S3, S2
Large partnerships * Generative leadership * ~Administrative leadership	0.801	0.398	0.034	D1, B2, S3
Solution consistency	**0.841**			
Solution coverage	0.700			

Tied prime implicants when minimizing the following truth table row: Small partnerships * Generative leadership * ~Administrative leadership * Network complexities. Two tied prime implicants: 1) small partnerships * generative leadership * network complexities, 2) Generative leadership * ~Administrative leadership * Network complexities → Selection of the latter in this model

Table A11: Calibration rules for outcome and conditions

<table>
<tr><th>Innovativeness of services (outcome)</th><th>Partnership size</th><th>Generative leadership</th><th>Administrative leadership</th><th>Network complexities</th></tr>
<tr>
<td>Survey data leading

Questions: see table A1
Measurement: seven-point scale, cross-over point = 5

• All answers of the respondents above the cross-over point → 1
• More than half of the answers above the cross-over point → 0.67
• More than half of the answers below or on the cross-over point → 0.33
• More than half of the answers below the cross-over point → 0
• Equal amount above and below/on the cross-over point → Larger distance to the cross-over point of answer resp. above and below/on cross-over point is indicative for assigning case score above or below cross-over point (i.e. 0/0.33 or 0.67) + qualitative interpretation to assign 0 or 0.33

Qualitative check of the assigned scores using the interview data</td>
<td>1-5 partners → 0
5-10 partners → 0.33
10-15 partners → 0.67
>15 partners → 1</td>
<td colspan="2">Survey data:

Questions: see table A3
Measurement: seven-point scale, cross-over point = 5

• All answers of the respondents above the cross-over point → 1
• More than half of the answers above the cross-over point → 0.67
• More than half of the answers below or on the cross-over point → 0.33
• More than half of the answers below the cross-over point → 0
• Equal amount above and below/on the cross-over point → Larger distance to the cross-over point of answer resp. above and below/on cross-over point is indicative for assigning case score above or below cross-over point (i.e. 0/0.33 or 0.67) + qualitative interpretation to assign 0 or 0.33</td>
<td>Interview data:

Questions: see table A4

STEP 1:
Determining the case scores for individual network complexities (i.e. substantive, strategic and institutional complexities):
• 0 examples of complexities → 0
• 1 example of complexities → 0.33
• 2 examples of complexities → 0.67
• >2 examples of complexities → 1

STEP 2:
Aggregating the case scores of the individual network complexities (i.e. substantive, strategic and institutional complexities):
• If all types of network complexities < 0.5 → 0
• If two types of network complexities < 0.5 → 0.33
• If one type of network complexity < 0.5 → 0.67
• If none of the types of network complexities < 0.5 → 1</td>
</tr>
</table>

Table A12: Recalibration rules for outcome and conditions

<table>
<tr><th>Innovativeness of services (outcome)</th><th>Partnership size</th><th>Generative leadership</th><th>Administrative leadership</th><th>Network complexities</th></tr>
<tr>
<td>Survey data leading

Questions: see table A1
Measurement: seven-point scale, cross-over point = 5

• More than half of the answers of the respondents between 6 and 7 → 1
• More than half of the answers of the respondents between 5 and 6 → 0.67
• More than half of the answers of the respondents between 3 and 5 → 0.33
• More than half of the answers of the respondents between 1 and 3 → 0</td>
<td>1-3 partners → 0
4-10 partners → 0.33
10-16 partners → 0.67
>16 partners → 1</td>
<td colspan="2">Survey data:

Questions: see table A3
Measurement: seven-point scale, cross-over point = 5

• More than half of the answers of the respondents between 6 and 7 → 1
• More than half of the answers of the respondents between 5 and 6 → 0.67
• More than half of the answers of the respondents between 3 and 5 → 0.33
• More than half of the answers of the respondents between 1 and 3 → 0</td>
<td>Interview data:

Questions: see table A4

STEP 1:
Determining the case scores for individual network complexities (i.e. substantive, strategic and institutional complexities):
• 0 examples of complexities → 0
• 1 example of complexities → 0.33
• 2 examples of complexities → 0.67
• >2 examples of complexities → 1

STEP 2:
Aggregating the case scores of the individual network complexities (i.e. substantive, strategic and institutional complexities):
• If all types of network complexities = 0 → 0
• If two types of network complexities < 0.5 → 0.33
• If one type of network complexity < 0.5 → 0.67
• If all types of network complexities = 1→ 1</td>
</tr>
</table>

Table A13: Robustness check – Recalibrated scores

Case	Size	Size (recal.)	Generative leadership	Generative leadership (recal.)	Administrative leadership	Administrative leadership (recal.)	Network complexities	Network complexities (recal.)	Inno.	Inno. (recal.)[1]
N3	0	0	0,67	0,67	0,67	0,67	0	0	0.33	0.33
B5	1	1	1	0,67	0,67	0,67	1	1	0	0.33
E1	1	1	0,33	0,33	0,33	0,33	1	0,67	0	0.33
E3	0,67	0,67	0	0,33	0	0,33	1	1	0	0.33
D1	0,67	0,67	1	1	0	0,33	0,33	0,33	0.67	0.67
B3	1	1	0,33	0,33	0,33	0,33	1	1	0.67	0.67
N4	0	0,33	0,67	0,67	0,33	0,33	0	0	0.33	0.33
N2	0	0,33	0,33	0,33	0	0,33	0	0,33	0.67	0.67
S3	0,67	0,67	0,67	0,67	0,33	0,33	0,67	0,67	0.67	0.67
B1	1	1	0	0,33	0,33	0,33	1	0,67	0.67	0.67
B2	0,67	0,67	0,67	0,67	0	0,33	0,67	0,67	0.67	0.67
D3	0,33	0,33	0,67	1	0	0,33	0,67	0,67	0.67	0.67
S2	0,33	0,33	1	1	0,33	0,33	1	1	0.67	0.67
E2	0,33	0,33	0,33	0,33	0,67	0,67	0,33	0,33	0.67	0.67
D2	0,33	0,33	1	0,67	0	0,33	0,33	0,33	0.33	0.33
S1	0,33	0,33	1	0,67	1	0,67	0,33	0,33	1	1
S4	0,33	0,33	1	1	0,33	0,33	0,33	0,33	1	0.67
B4	0,33	0,33	0,67	0,67	1	0,67	1	0,67	1	0.67
N1	0,33	0,33	0,33	0,33	0	0,33	0	0	0	0.33

[1] This calibration is problematic because it removes almost all of the differentiation between full and partial membership/non-membership. In other words, almost all the cases with a case score of 0 or 1 changed, due to this calibration, into resp. 0.33 and 0.67. The risk of changing to such a calibration is that the raw consistency levels of the truth table rows become very difficult to interpret, as overlaps of the sets of the conditions and the outcome become more likely if no differentiation is made between cases that are partially and totally in/out the set (in such case, a crisp-set QCA should be considered, which is not in line with our research design). As such, the analyses for the robustness test only test the recalibrated conditions, not the recalibrated outcome.
To be sure however, we also ran an analysis with the recalibrated conditions ánd outcome. However, as expected, the more 'crude' calibration for the outcome made the truth table very opaque and the interpretation of the raw consistency values of the truth table rows almost impossible. The six truth table rows that were selected in the previous analyses remained also present in this analysis, but other truth table rows also appeared, each with only one covered case, but a very high raw consistency. In fact, all of the first five truth table rows had a raw consistency of 1, which indicates an improper calibration of the outcome.

Table A14: Robustness check – Truth table alternative calibration of the conditions

	Size	Generative leadership	Administrative leadership	Network complexities	Innovativeness[1]	#cases	Raw consist.	PRI consist.
1	0	1	0	1	**1**	**2**	**0.928879**	**0.835**
2	0	1	1	1	**1**	**1**	**0.923256**	**0.801205**
3	0	0	1	0	**1**	**1**	**0.909341**	**0.75188**
4	1	1	0	0	**1**	**1**	**0.866935**	**0.668342**
5	0	1	1	0	**1**	**2**	**0.865191**	**0.665**
6	1	1	0	1	**1**	**2**	**0.833893**	**0.62782**
7	0	0	0	0	0	2	0.831658	0.598802
8	0	1	0	0	0	3	0.809793	0.568376
9	1	1	1	1	0	1	0.763345	0.426724
10	1	0	0	1	0	4	0.68609	0.445183

[1] The 1 in the columns indicates that only rows 1 to 6 consistently lead to the outcome. The other rows have low raw/PRI consistency levels.

Table A15: Robustness check – Intermediate solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases in path
Small partnerships * Generative leadership * Network complexities	0.934	0.464	0.102	D3, S2, B4
Small partnerships * Administrative leadership * ~Network complexities	0.874	0.463	0.101	N3~, E2, S1
Large partnerships * Generative leadership * ~Administrative leadership	0.810	0.562873	0.168	D1, B2, S3
Solution consistency	**0.822**			
Solution coverage	0.765			