Unlocking the process of collaborative innovation : combining mechanisms of divergence and convergence

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ABSTRACT

In recent years, collaborative innovation of public services has become a growing research field. However, how collaborative arrangements lead to innovation remains quite unclear. We propose that collaborative innovation is dependent on processes of divergence and convergence, which are enhanced by four conditions of collaborative innovation: diversity of ideas and perspectives, learning through interaction, consensus building, and implementation commitment. The combination of these conditions is explored through qualitative comparative analysis (QCA) in 19 European eHealth partnerships. The results suggest a combined effect of these conditions on service innovativeness, which rejects contemporary views on the dichotomous nature of divergence and convergence.

KEYWORDS

Collaborative innovation; public service innovation; eHealth innovation; fsQCA

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Introduction

Ever since Schumpeter (1934) introduced the concept of innovation to the broader (research) community, it has been understood as one of the principal mechanisms of organizational renewal and growth. Innovation helps organizations to respond to pressures from the external environment (e.g. competition, resource scarcity, user demands, isomorphism, etc.), and to obtain distinctive competencies, enhanced reputation and a better quality of processes and services (Fariborz, Walker, and Avellaneda 2009). As public services are increasingly provided by a broad range of actors (e.g. governments, private contractors, citizen or user groups) (Di Meglio 2013), the sources to achieve public service innovation become more complex (Cruz, Paulino, and Gallouj 2015). As a result, governments increasingly involve a wide variety of stakeholders in the innovation process, which has led to a rise of interest in 'collaborative innovation' (Hartley, Sørensen, and Torfing 2013; Torfing 2013; Sørensen and Torfing 2018; Torfing 2019).

The concept of collaborative innovation reflects the rationale that the involvement of a broad range of stakeholders (including citizens and users) is necessary to mobilize resources, tackle wicked problems, and discover inventive solutions (Sørensen and Torfing 2011). Complex societal problems require multiple actors to work together in order to find proper solutions. Collaborative innovation also enables the mobilization of a large variety of resources and capabilities, which enhances creativity and increases implementation capacities (Torfing 2019). This unique connection between collaboration and innovation is echoed in organizational learning and business management research, where concepts such as 'open innovation' (Chesbrough 2003), 'open collaborative innovation' (Baldwin and von Hippel 2011), 'triple-helix innovation' (Leydesdorff and Meyer 2003) and 'group innovation' (Anderson and West 1998) have received a lot of attention over the past decades.

However, this connection between collaboration and innovation also remains quite illusive. Although we are beginning to understand the conditions that influence innovation in collaborations (e.g. process management, Stevens and Verhoest 2016; Callens, Verhoest, and Boon 2021; mutual trust, Brogaard 2017; Cinar, Trott, and Simms 2019; user involvement, Baldwin and von Hippel 2011; psychological safety, Anderson, Potočnik, and Zhou 2014; Paulus, Baruah, and Kenworthy 2018; organizational support West et al. 2003), we still struggle to comprehend the overarching relationships between these collaboration-related conditions and the innovation process. Some attempts have been made to unite these different conditions in one theoretical framework of the collaborative innovation process (e.g. Sørensen and Torfing 2011; Ansell and Torfing 2014), but these attempts have remained mostly conceptual in nature.

This article argues that the collaborative innovation process, just as any other innovation process, undergoes pressures to increase and decrease the variation in attained ideas (Bledow et al. 2009). From these ideas, innovations can emerge. On the one hand, a process of divergence leads to the increase of variation in ideas by stimulating the search for ideas that deviate from each other (Sousa et al. 2014). On the other hand, a process of convergence causes a decrease of variation in ideas by aligning ideas to each other and to the specific implementation context (David, Hocking, and Tyler 2016). By combining processes of divergence and convergence, innovators can attain a solution that is both highly creative and practically implementable (Sousa et al. 2014). Hence, these processes relate directly to popular descriptions of the

innovation process in which a phase of creative idea generation is followed by a phase of idea implementation (Walker 2007; Damanpour and Schneider 2008; De Vries, Bekkers and Tummers 2015).

Conditions related to collaborative governance arrangements are particularly promising to enhance the processes of divergence and convergence because of four conditions, which each stimulate a specific process. For the process of divergence, these conditions are 1) the diversity of ideas and perspectives and 2) learning through interaction. For the process of convergence, these conditions are 3) consensus building and 4) implementation commitment. Although already recognized at a conceptual level by collaborative innovation scholars such as Sørensen and Torfing (2011) and Ansell and Torfing (2014), how these conditions increase the innovativeness of services that are produced by public-private innovation partnership (PPIs) (Brogaard 2021), remains unclear. Because of the simultaneous presence of divergence and convergence in the innovation process, we expect a combined effect of these conditions on the innovativeness of the created solutions. Hence, we propose the following research question:

How do conditions related to the process of divergence and conditions related to the process of convergence increase the innovativeness of created services in PPIs, and what is their combined effect on the innovativeness of these services?

This combined effect of the conditions on the innovativeness of the created services is especially important in public-private collaborations because of the specific setting in which the innovation process unfolds. Divergence and convergence are processes that work towards opposite goals (i.e. increase vs. decrease of variation in ideas). Stimulating both processes implies upholding a delicate balance between the two, i.e. stimulating divergence at the cost of convergence might result in more novel ideas, but also in ideas that are not practically adoptable, and vice versa. In public-private collaborations, upholding this balance becomes even more difficult because of the presence of network complexities (Klijn and Koppenjan 2016) and the inherent tension between collaboration or innovation (Torfing 2019). We test the supposed combined effect of these four conditions on collaborative innovation through a qualitative comparative analysis (QCA) of 19 public-private innovation partnerships (PPIs) in the healthcare sector. Data from over 130 respondents from five European countries (Belgium, Denmark, Estonia, the Netherlands, Spain) were collected and analysed.

In the next section, the theoretical framework is proposed. We first elaborate on the definition of innovation, as it is of primary importance to understand how innovation is created. Next, we introduce our conceptual framework, which is based on the mechanism of divergence and convergence, and in which the four conditions are introduced. Next, we introduce our cases and methodology and test our theoretical model on the 19 eHealth partnerships. The results of the qualitative analyses are described using both the QCA results and the qualitative data from the cases. Finally, a discussion and conclusion section summarizes the most important insights from this study and formulates implications for research and practice.

Theory

The innovation process

Most definitions of the innovation process recognize two important features. On the one hand, the innovation process entails the creation of something that is perceived to be novel by an individual, organization or community (De Vries, Bekkers, and Tummers 2015). This

'perceived newness' is key, as innovation is not necessarily totally new, as long as it is new for a specific context in which it is introduced (Rogers 2003; Anderson, Potočnik, and Zhou 2014). On the other hand, the innovation process also implies that something is brought into a real-life environment, by testing, adopting or implementing the end product of the innovation process (i.e. the innovation) (Damanpour and Schneider 2008; Meijer 2014). The consideration that the innovation process is directed towards the implementation of something, sets it apart from related concepts such as 'invention' and 'creativity', which are mainly related to the creation of novelty (Anderson, Potočnik, and Zhou 2014).

The combination of creating novelty and implementing something in a real-life environment is reflected in most definitions of the innovation process (De Vries, Bekkers, and Tummers 2015). For instance, Sørensen and Torfing (2011, 849) consider the innovation process as 'the generation and practical adoption and spread of new andcreative ideas', and Brogaard (2017, 1186) defines the innovation process as 'the development and implementation of new ideas, objects, and practices'. The combination of these two features has also led scholars to think of the innovation process in separated phases, i.e. an ideation phase in which new ideas are generated, and an implementation phase in which these new ideas are implemented (Walker 2007; Damanpour and Schneider 2008). Different authors use different phases. For instance, Sørensen and Torfing (2011) approach the innovation process through four phases: generation of ideas, selection of ideas, implementation of ideas, and dissemination of practices. Meijer (2014) applies five phases to the innovation process: idea generation, selection, testing, scaling-up, and diffusion. As the diffusion of innovation is a research field on its own (cf. Rogers 2003), we limit our interpretation of the innovation process to the phases of idea generation and idea implementation (Damanpour and Schneider 2008).

The dichotomy of divergence and convergence

The core characteristics of novelty and implementability, and the related phases of idea generation and idea implementation, correspond to the central mechanism of this article: the dichotomy of divergence and convergence. The core rationale of this dichotomy is fairly straightforward: in order to produce highly innovative services, innovation processes undergo pressures to increase and decrease the variation in attained ideas (Bledow et al. 2009). On the one hand, generating novel ideas implies the increase of variation in ideas, as the likelihood of discovering something new increases when more ideas are circulated and connected with each other (Harvey 2014). Divergence can be seen as the process through which this increased variation can be achieved, as it stimulates the search for alternative ideas by letting these ideas deviate from each other (Reiter-Palmon and Illies 2004; Sousa et al. 2014; Althuizen and Wierenga 2014). Divergence encourages innovators to refrain from an early commitment to one particular viewpoint or idea, and recognize that multiple, alternative solutions can exist for a given problem (Basadur, Basadur, and Licina 2012; Sousa et al. 2014).

On the other hand, producing highly innovative solutions also requires that suitable ideas are selected and, eventually, implemented, and that the initial variation in ideas is, therefore, reduced (Bledow et al. 2009). Convergence helps to reduce this variation by aligning ideas to each other and to the implementation context (Reiter-Palmon and Illies 2004; Vernon, Hocking, and Tyler 2016). Ideas are retained or abandoned, or they are transformed to better fit with other ideas or the needs of the implementation context (Basadur, Basadur, and Licina 2012; Dell'era et al. 2019). Convergence stimulates innovators to commit themselves to one particular idea,

and abandon other, alternative ideas. Models such as the Creative Problem Solving (CPS) framework have integrated divergence and convergence in one process, of which innovation is the primary outcome (e.g. Sousa et al. 2014). Bledow et al. (2009, 316) summarizes the relationship between divergence and convergence as follows:

The creation of new ideas is an exploratory activity that is based on divergent processes and leads to increases in variability. In contrast, implementation activities are based on convergent processes aimed at exploiting the potential value of new ideas and leading to a reduction of variability

The combined presence of divergence and convergence in one innovation process also suggests a delicate balance between the two (Bledow et al. 2009). Indeed, too much attention towards divergence might generate endless cycles of idea generation, which never converge towards a single feasible, implementable and generally supported solution. In contrast, too much attention towards convergence might result in a premature closure of idea generation, and the implementation of a solution that lacks originality, novelty and creativity. For instance, a large emphasis on brainstorm activities during the innovation process might indeed produce a lot of creative ideas, but it also ignores the later development of a implementable solution (Basadur, Basadur, and Licina 2012). Large discrepancies between divergence and convergence might therefore damage the innovation process.

Divergence-convergence in collaborative innovation

In Public Administration literature, collaborative innovation is often perceived as an extension of collaborative governance (Sørensen and Torfing 2011). Recent evidence into collaborative governance arrangements shows that such arrangements are excellent breeding grounds for innovation. Public-private innovation partnerships (PPIs), for instance, are collaborative governance arrangements between public and private service stakeholders (e.g. governments, non-profit organizations, firms, users), which are specifically directed towards creating new services (Brogaard 2021). These types of arrangements are often established in complex service environments (e.g. healthcare sector), in which specialized services are difficult to procure, and individual stakeholders struggle to create these services on their own (Brogaard 2021; Di Meglio 2013). Hence, the service stakeholders in PPIs rely on each other to innovate, but can also exploit each other's innovation capabilities, which stimulates collaborative advantages and partnership synergies (Lasker, Weiss, and Millier 2001).

The divergence-convergence mechanism holds great promise to explain why and how such collaboration leads to highly innovative solutions. We theorize that conditions related to collaborative innovation enable collaborations to enhance both the divergence and convergence of ideas in the innovation process. Scholars such as Sørensen and Torfing (2011) and Ansell and Torfing (2014) have recognized such conditions in collaborative innovation processes. The authors identify four conditions, which we will here label as: 1) diversity of ideas and perspectives, 2) learning through interaction, 3) consensus building, 4) implementation commitment.

Divergence stimulating conditions of collaborations

From the perspective of increasing variation in the innovation process, collaborative governance unites distinct stakeholders, from both the public and private sector, in one partnership (Ansell and Gash 2007). The multiplicity of backgrounds (e.g. different policy

fields, domains of expertise, spheres of society, etc.) from these stakeholders, increases the likelihood that a large *diversity of ideas and perspectives* on the problem and possible solution is introduced at the start of the collaboration (Hartley, Sørensen, and Torfing 2013; Torfing 2019). Consequentially, this diversity might then spontaneously drive the divergence of ideas if this diversity is used in the innovation process (Milliken, Bartel, and Kurtzberg 2003). Furthermore, an increase in the (perceived) diversity of ideas and perspectives can stimulate individuals to elaborate on taskrelated information and perspectives of others (van Knippenberg, De Dreu, and Homan 2004), which can then enhance divergent thinking and group creativity (Basadur, Gelade, and Basadur 2014). However, perceived diversity in ideas and perspectives might also cause social categorization (i.e. 'similarities and differences are used as a basis for categorizing self and others into groups', van Knippenberg, De Dreu, and Homan 2004, 1009), which could lead to a loss in group cohesion and an increase in relational conflicts (Paulus, Baruah, and Kenworthy 2018).

Nevertheless, in collaborations, actors are dependent on each other to achieve their objectives, for which they need to interact with each other (Klijn and Koppenjan 2016). Through collaborative interactions in phases of idea generation, the actors learn from each other by actively sharing their own ideas and by challenging the ideas of others (Agranoff 2007; Sørensen and Torfing 2011). *Learning through inte*raction enhances the cross-fertilization of ideas and the emergence of new insights and knowledge (Crosby, 't Hart, and Torfing 2017; Trivellato, Martini, and Cavenago 2021), which can increase the variation in ideas even more. Indeed, empirical research indicates that interactions between individuals during idea generation, allow these individuals to build on the ideas of others, which fosters the creation of novel combinations of ideas (Kohn, Paulus, and Choi 2011). During the creation of new ideas, these ideas are influenced and shaped by the ideas of others in what scholars call 'creative synthesis', which enhances the creation of radically new ideas (Harvey 2014). Research also demonstrates that learning through interaction (e.g. during team learning) improves the intrinsic motivation of individuals to accrue knowledge and develop skills (i.e. the learning orientation of individuals), which enhances their creative expression during idea generation (Hirst, van Knippenberg, and Zhou 2009).

Convergence stimulating conditions of collaborations

From the perspective of decreasing variation in the innovation process, collaborative governance engages multiple stakeholders to work towards a single, shared goal, which none of the involved actors can achieve on their own, and for which they need *consensus building* (Ansell and Gash 2007). During creative problem solving, individuals detect similarities between ideas, and build further on these similarities in order to synthesize these ideas (Harvey 2014). By synthesizing ideas, individuals can work towards shared ideas that are supported amongst the involved actors. However, emphasizing the search for consensus amongst the involved actors might also increase the risk of group-think, which can induce a too one-sided evaluation of the created ideas (Reiter-Palmon and Illies 2004). Collaborative arrangements are particularly useful to overcome this group-think and exploit the advantages of consensus building, as ideas are evaluated against a broad range of believes, knowhow and interests of the involved actors (Sørensen and Torfing 2020). For instance, commercial interests of firms need to be weighed against the political and societal interests of governments and non-profit organizations, and the usability interests of service users. This makes collaborative

arrangements ideal environments for optimizing the quality of idea selection (Sørensen and Torfing 2011, 852).

A second aspect of collaborative governance that is connected to convergence in the innovation process is the shared ownership of the involved actors over the process (Ansell and Gash 2007). In collaborative innovation processes, the involved actors have a shared ownership over the development and implementation of the innovation, and are, thus, committed to jointly implement the innovation (Lindsay et al. 2020). Such an *implementation commitment* is an important advantage of collaborative innovation that allows the innovation process to converge towards an implemented solution, as we see that innovation processes often fail during the implementation phase (Piening 2011). For instance, Cinar, Trott, and Simms (2019) indicate that more than half of the identified barriers to successful innovation in their literature review were related to the implementation phase of the innovation process. Implementation commitment in a collaboration enables the access and mobilization of a broad set of resources and capabilities, which could expedite the realization of the retained ideas, and remove potential implementation resistance (Sørensen and Torfing 2011; Trivellato, Martini, and Cavenago 2021). As a variety of stakeholders (including service users) are involved in the innovation process, an optimal fit between the innovation and the service context might also be easier to achieve.

Hypothesis

Gaining insights into the combination of conditions that relate to divergence and convergence is not only important because we assume that these conditions are crucial enablers for the innovation process in collaborative arrangements. Indeed, collaboration might enhance various aspects of divergence and convergence in innovation processes, but it might also make the delicate balance between divergence and convergence even more fragile. This is due to two important drawbacks of collaborative innovation.

First, collaborative arrangements often encompass a lot of network complexities. Klijn and Koppenjan (2016) describe three of these network complexities, i.e. substantive complexities (complexities regarding joint assessment of the problem because of differences in the backgrounds of the partners), strategic complexities (complexities regarding conflicting interests and agendas), and institutional complexities (complexities regarding different institutional realities). PPIs are quite sensitive to accumulating these complexities as they typically unite a wide variety of stakeholders (Brogaard 2021). For instance, small and agile start-ups often need to work together with large, bureaucratic government agencies, which have different organizational cultures (institutional complexities), interests (strategic complexities) and conceptions about the problem and solution (substantive complexities).

These network complexities can make collaborations slow, laborious, and sometimes underperforming (Huxham 2003), as increases in transaction costs, risks and uncertainties may rise disproportionally to the collaborative advantages (Vivona, Demircioglu, and Audretsch 2022). In similar partnerships, such as public-private partnerships (PPPs), these complexities are often reduced through control instruments such as contractual design and contract management (Callens, Verhoest, and Boon 2021). However, due to the relatively short lifespan, lower degree of formalization, and innovation objectives of PPIs (Di Meglio 2013), similar control instruments usually have a more limited impact on these types of partnerships, and are generally used to settle issues regarding intellectual property (Brogaard 2021). Achieving a

proper balance between divergence and convergence might therefore be challenging, as energy needs to be invested in the process management of these network complexities (e.g. through network management strategies, Klijn, Steijn, and Edelenbos 2010), which can then not be invested in the innovation process.

Second, an inherent tension seems to exist between collaboration and innovation. Whereas innovation thrives in dynamic settings with a lot of diversity, collaboration is better suited for relatively stable settings with a lot of similarity (Torfing 2019). Striving for a stable and lasting collaboration might therefore interfere with the pursuit of innovation in that collaboration, and vice versa (Diamond and Vangen 2017). Hence, the relative importance of pursuing innovation or collaboration might incite an emphasis on resp. divergence or convergence, with a possible imbalance between the two processes as a result. Upholding this balance means that all four conditions are equally present in the collaborative innovation process in order to create highly innovative services, which brings us to our hypothesis:

H1: Public-private innovation partnerships in which a combination of diversity of ideas and perspectives, learning through interaction, consensus building, and implementation commitment is present, generate highly innovative services.

Cases and methodologies

European eHealth partnerships

Although the European Union prioritizes the development of health solutions through the use of digital technologies and data analytics (European Commission 2018), current research fails to properly explain the mechanism responsible for creating successful eHealth innovations (Andreassen, Kjekshus, and Tjora 2015). This article contributes to this by analysing data from a total of 19 eHealth partnerships in five European countries: Belgium, Denmark, Estonia, the Netherlands, and Spain. The cases are described in more detail in the supplemental online material (table A1). As public-private innovation partnerships (PPIs) are characterized by their multiplicity of collaborative arrangements (Brogaard 2021), we needed to ensure both the representativeness and comparability of the selected cases. Therefore, we used case selection criteria on the level of the collaborative arrangement, the eHealth services, and the country.

On the level of the collaborative arrangement, three selection criteria were used. First, since PPIs are partnerships between public and private actors, with the purpose to develop innovative services, for which they often involve service users (Brogaard 2021), we selected eHealth collaborations between public actors (e.g. governments, public hospitals, etc.), private actors (e.g. non-profit organizations, firms, etc.), and service users (e.g. patients, citizens, general practitioners, specialists, therapists, etc.). Second, as PPIs can be both coordinated by the public actor or the private actor, we made sure that both 'types' of partnerships were included in the case selection. Coordinators are central actors in collaborative arrangements, as they are responsible for connecting the partners, mobilizing resources, resolving conflicts, achieving project outcomes, and generally, managing the collaboration process (Klijn and Koppenjan 2016). Third, we made sure to select both larger PPIs (i.e. more than ten partners) and smaller PPIs (less than ten partners). These features were relatively equally distributed over the selected cases.

On the level of the eHealth services, two types of eHealth technologies that are most commonly recognized in the literature were selected, i.e. eHealth technologies related to digital

information flows between stakeholders, and eHealth technologies related to telehealth, mobile health, and smart devices (Shaw et al. 2017). Examples of the former include virtual networks for patient information exchange, central patient registration platforms, and central communication systems for monitoring patients, while examples of the latter include health technologies using motion sensors, mobile apps, smart cameras, robots, and security systems. As we are interested in how PPIs go through the whole innovation process (i.e. both idea creation and idea implementation), all of the selected cases implemented or at least extensively tested the developed eHealth technologies in the last five years before the data collection. On the level of the country, two selection criteria were used. First, the selected countries (i.e. Belgium, Denmark, Estonia, the Netherlands, and Spain) represent the two most common European health systems, i.e. Etatist Social Health Insurance System (the Netherlands, Belgium, Estonia), and National Health Services (Denmark, Spain) (Böhm et al. 2013). Second, as both of these systems are regulated by government, we also considered the different administrative traditions of (continental) Europe in our selection of the countries. Pollitt and Bouckaert (2017) distinguish between Nordic (Denmark), Central and Eastern European (Estonia)[1], Continental (the Netherlands), and Napoleonic (Spain/Belgium (mixed)[2]). Table A1 of the supplementary material details the case selection, including a description of the selected cases and countries, and how they relate to the European healthcare systems and administrative regimes.

Note that the selection of the cases involved a step-by-step process in order to reduce potential self-selection bias of the sample. The criteria above were informed by literature on PPIs, eHealth services, and European healthcare/administrative systems. With these criteria, research teams from the five countries created a longlist for their own country with eHealth PPIs that met the selection criteria. From this longlist, partnerships were selected that properly represented the variance of the partnerships in the larger population. This meant that the 19 selected cases included a relatively equal number of large and small partnerships, partnerships that were coordinated by a public or private actor, partnerships that created the two mentioned types of eHealth services, and partnerships that came from the different healthcare systems and politico-administrative regimes.

Data collection

During the period between September 2019 and February 2020, research teams from the five involved countries collected data from 132 respondents in 19 eHealth partnerships. The respondents included project coordinators, public partners (representatives of e.g. government agencies, local governments, public hospitals, . . .), private partners (representatives of e.g. private home care organizations, consultants, ICT-companies, . . .) and service users (e.g. physicians, patients, medical professionals, citizens, . . .). These respondents were selected because they represent the main types of actors in PPIs (i.e. public actors, private actors, and service users) (Brogaard 2021). In order to ensure the representativeness of the answers, we selected all the project coordinators, at least one private actor and public actor, and at least three service users. A detailed account of the respondents per case and data collection instrument can be found in the supplemental material (table A1). Prior to the interviews, a survey was sent to the respondents, which was answered by 124 respondents. Furthermore, following the survey and interview data collection, each research team provided a written summary of important contextual case information regarding the conditions and the outcome.

The combination of these data collection instruments was beneficial for multiple reasons. First, whereas the surveys provided highly standardized data, which was ideally suited to ensure a consistent calibration (more on this later), the interview data and case information added rich qualitative data which was used to check and enhance the calibration and to gain deeper insights on our results. Second, the analysed data originated from multiple data sources (i.e. the different types of respondents, but also the accounts and case knowledge of the different research teams), and was obtained through multiple data collection instruments at different points in time (i.e. survey, interview, case summaries), which reduced the risks of common source bias and common method bias.

One research team coordinated the data collection and processing. Interviews and surveys were prepared in English and later translated to Dutch, Danish, Estonian and Spanish by the respective research teams. Data from the different translated surveys were collected through Qualtrics software, and could be accessed directly by the coordinating research team. The interviews were conducted, recorded and processed by the respective research teams, and centralized and structured through a standardized questionnaire, which provided all the relevant details obtained in the interviews. To ensure a consistent calibration, one research team (i.e. the coordinating team) calibrated the conditions and outcome in interaction with the other research teams.

Qualitative comparative analysis (QCA)

We analysed the data through fuzzy-set qualitative comparative analysis (QCA). QCA is a set-theoretic method that uses Boolean logic to investigate whether or not a (combination of) condition(s) corresponds to a certain outcome (Ragin 2008). Because of its configurational causation (i.e. a combination of conditions can lead to a certain outcome) (Ragin 2008), QCA is particularly useful to analyse the combined effect of the studied conditions on innovation. Methodologically, the standardized features of QCA facilitate a broader comparative study, without losing the qualitative richness of an in-depth case-study. This enables us to test our hypothesis in multiple European partnerships, which enhances the generalizability of the results to similar projects in Europe, while simultaneously enabling a deeper qualitative interpretation of the findings.

We refer to the QCA handbook of Schneider and Wagemann (2012) for a more substantive introduction to QCA. Here, we will only focus on the most relevant aspects of the method. In QCA, patterns are investigated between 'sets' of conditions (i.e. diversity of ideas and perspectives, learning through interaction, etc.) and outcomes (i.e. innovativeness). Cases can be present in or absent from these sets. As this article uses 'fuzzy-set' QCA, the boundaries of these sets can also be 'fuzzy' and, instead of being in or out of the set (resp. 1 or 0), some cases may be partially in or partially out of a set (indicated here resp. as 0.67 or 0.33). The cross-over point of 0.5 represents a point of maximal indifference towards membership or non-membership of a case in a set (Schneider and Wagemann 2012).

QCA uses two measures to assess the relationship between condition(s) and outcome. *Consistency* measures the degree to which the cases in the sets share the same membership of the sets (i.e. presence/absence in the sets). A very high consistency (i.e. 0.9 and higher) between a single condition and the outcome reflects that every time the condition is present, the outcome will be present too. Such a condition is called a *necessary condition*. However, the membership of cases in multiple sets might also be consistent with the set membership of the cases in the

outcome. Such conditions are called *sufficient conditions*. A second measure of QCA is the *coverage* of overlapping sets. The more cases are present in these overlapping sets, the more prevalent the relationship between the condition(s) and the outcome.

Operationalization and calibration of outcome and conditions

Operationalization

Innovation can be described as something that is perceived as new for a specific unit of adoption (Rogers 2003; Anderson, De Dreu, and Nijstad 2004; Walker 2007). How actors involved in and impacted by the innovation process experience the newness of the innovation, is therefore essential in measuring the innovativeness of the created services. For this reason, the actors involved in and impacted by the innovation process (i.e. coordinator, public partners, private partners and users) were asked about the newness of the created solutions. Additionally, innovation requires the implementation of a solution, which implies that an innovation needs to be adopted into and impact a specific implementation context. As such, we measured the degree to which the adopted innovation affected the users and the problem it was meant to tackle. A seven-point scale was used to measure both the newness and adoption of the innovation. These items are visualized in the supplemental material (Table A2).

We also used a similar seven-point scale for the measurement of our conditions. As we mentioned, the diversity of ideas and perspectives comes from the multitude of distinct actors that join the innovation process, each with their own perspectives and ideas on the solution (Hartley, Sørensen, and Torfing 2013; Torfing 2019). This diversity is present in the collaboration at the moment the involved partners initiate the innovation process. As such, the respondents were asked two survey questions about the diversity of ideas and perspectives at the start of the project. Learning through interaction occurs when individuals build further on ideas of others or are inspired by the ideas and perspective of others (Kohn, Paulus, and Choi 2011). We, therefore, asked the respondents three survey questions on how they were influenced by the ideas of others. We defined consensus building as a way to detect similarities between ideas, and find support for ideas by synthesizing these ideas (Harvey 2014). We therefore asked respondents three survey questions about processes related to the connection of ideas and the generation of support for certain ideas. Implementation commitment was defined as the capacity to implement the innovation by ensuring the mobilization of resources, the willingness of the partners to implement the generated ideas, and an optimal fit between the innovation and the service context (i.e. is the innovation feasible for those affected by it) (Sørensen and Torfing 2011; Lindsay et al. 2020; Trivellato, Martini, and Cavenago 2021). Three survey questions were asked to the respondents related to these concepts.

The items used to operationalize the four conditions are visualized in the supplemental material (table A3). These questions were not asked to the users, because not all users were involved from the start of the project, or were intensively enough involved to make an accurate estimate of these conditions. Additionally, interview questions for each of the four conditions were asked to the respondents. These interview questions addressed several components of the idea generation and implementation processes, including whether or not ideas were created through interactions, whether or not individuals were trying to discover similarities between ideas, if the individuals in the partnership were highly committed to realize the innovation, and if they considered how realizable and feasible certain ideas were.

Calibration

QCA calibration allows the researcher to assign a value for the set membership of each case for the conditions and outcome. As we collected rich information on the conditions and outcomes (i.e. multiple items asked to these respondents, multiple types of respondents, multiple sources, i.e. interviews and surveys), proper triangulation is necessary to obtain correct membership scores. Three general rules were applied for each condition/outcome. First, as each of the survey items used for the conditions/outcome described a single concept (e.g. the innovativeness of services), the mean score of these items was applied to calculate the answer for a single respondent in a case (which was also checked through factor analyses, see table A4).

Second, based on the survey scales and qualitative case information, a cross-over point was defined for each condition/outcome. Slightly higher cross-over points were selected for the outcome and for learning through interaction, consensus building and implementation commitment. As PPIs are known for their focus towards the creation of innovation (Meglio and Gisela 2013), only the cases that generated highly innovative services were considered to be (partially) in the set of the outcome. Similarly, as PPIs are also known for their intensive collaborative dynamics, only cases which exhibited relatively high levels of learning through interaction and consensus building were considered to be (partially) in the set of these conditions. Furthermore, as PPIs in the healthcare sector are mostly established to implement solutions for specific problems (Brogaard 2021), only cases which exhibited relatively high levels of implementation commitment were considered to be (partially) in the set of this condition. To ensure an adequate calibration, we also performed a parallel calibration using qualitative case information for these conditions (see supplemental material, table A9).

Third, specific calibration rules were used to calculate the case membership scores (see supplemental material, table A9). These rules allowed to calculate case membership scores out of the multiple types of respondents. These rules also accounted for the different data sources used in the study (i.e. surveys and interviews). The calibrated dataset is visualized in the supplemental material (table A5).

Results

QCA results

We performed the analyses with the fsQCA software version 3.1b (Ragin and Davey 2017). Table 1 visualizes the distribution of cases above and below the cross-over point for high innovativeness. From this table, it is clear that even with strict calibration rules, more cases exhibit high innovativeness of the created services. We also see a relatively even distribution of the countries (i.e. types of healthcare systems and administrative traditions) and types of eHealth services. All five countries are represented in the set of 'high innovativeness', and this set also includes seven eHealth services related to digital information flows, and five eHealth services related to telehealth, mobile health, and smart devices (e.g. telehealth apps).

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

We follow standards of practice for reporting the results (Schneider and Wagemann 2010). We first discuss the analysis of necessary conditions. As we do not expect any of the studied conditions to be necessary for the outcome, we will not elaborate a lot on this analysis. Next, we discuss the analysis of sufficient conditions, on which our hypothesis applies as it examines whether the combination of conditions affect the innovativeness of the created services in the studied cases.

Table 2 illustrates the analysis of necessary conditions. A consistency threshold of 0.90 is advised when assessing the necessity of conditions for the outcome (Schneider and Wagemann 2012). None of the conditions in Table 2 exhibit consistency levels of at least 0.90, which indicates that none of these conditions are necessary for the presence of high innovativeness. A similar result is visible for the absence of high innovativeness (see supplemental material, table A6).

Table 2: Analysis of necessary conditions

Presence of high innovativeness		
Conditions	**Consistency**	**Coverage**
Diversity of ideas and perspectives	0.531	0.639
~Diversity of ideas and perspectives	0.700	0.656
Learning through interaction	0.800	0.728
~Learning through interaction	0.463	0.581
Consensus building	0.798	0.749
~Consensus building	0.597	0.719
Implementation commitment	0.764	0.742
~Implementation commitment	0.565	0.653

Next, we perform the analysis of sufficient conditions by constructing a truth table in which all the logically possible combinations of the conditions are presented. The truth table of this analysis is illustrated in the supplemental material (table A7). Following standards of practice (Schneider and Wagemann 2012), we only report the truth table rows with at least one case covered, which means that only 12 rows are retained in the truth table. The raw consistency values in the truth table are a measure to assess the relationship between the truth table rows and the presence of the outcome. A threshold of 0.80 for the raw consistency is advised to evaluate this relationship (Ragin 2009). Additionally, we observe a strong decrease in raw consistency from row 2 to row 3, and a drop of the PRI (Proportional Reduction in Inconsistency) consistency below 0.50 for row 3, which both indicate that the consistency threshold is reached (Schneider and Wagemann 2012).

Table 3 illustrates the intermediate solution, obtained after the logical minimization of the truth table rows, which takes directional expectations into account. The directional expectations for this analysis are given by the theoretical assumptions of the hypothesis, which essentially mean that we expect that all conditions are present when the outcome is present. A single solution path is presented in Table 3, which indicates that partnerships in which the combination of learning through interaction, consensus building and implementation commitment is present, exhibit high innovativeness of the created services. A high solution consistency and coverage of resp. 0.86 and 0.63 supports the strength of this solution path. A total of 6 cases are covered by this solution path, of which none is contradictory (i.e. a case that is present in the solution path but does not exhibit the outcome). Furthermore, the covered cases in this solution path are relatively well-distributed over the different countries and types of eHealth services. There were no tied prime implicants, which means that there was no model ambiguity.

Table 3: Intermediate solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases
Learning through interaction * Consensus building * Implementation commitment	0.865	0.632	0.632	D3, S2, S4, E2, S1, B4
Solution consistency	**0.865**			
Solution coverage	0.632			

According to Maggetti and Levi-Faur (2014), QCA results should always be interpreted using the intermediate, parsimonious and complex solutions. The complex solution turns out to be exactly the same as the intermediate solution, but the parsimonious solution is slightly different. The parsimonious solution path shows a combination of consensus building and implementation commitment (see table A8, supplemental material). The solution consistency and coverage values are also slightly altered in the parsimonious solution (resp. 0.88 and 0.70). Of course, these results are purely based on the Boolean logic of the shortest possible expression of the empirical evidence, using counterfactual claims about the logical remainders that are not always coherent with the theoretical expectations (Schneider and Wagemann 2012).

To be certain of the robustness of the QCA results, Schneider and Wagemann (2012) recommend slight recalibrations to the data and rerunning the analyses with the recalibrated data. We applied a recalibration of the data by applying different qualitative criteria to assign case membership scores for the survey-based data of the conditions. These calibration rules and the associated calibrated dataset, truth table, and intermediate solution can be found in the supplemental material (table A10, table A11, table A12, table A13). The results confirm the solution path of the original QCA analysis, which proves the robustness of the solution.

Insights from qualitative data

Qualitative information (i.e. interview data) should be leading when researchers want to better understand the QCA solution paths and potentially infer causal relations between conditions and outcome (Schneider and Wagemann 2010). Three main insights were extracted from the qualitative data of the covered cases. First, all of the cases covered by the solution path have very pronounced ideation phases. An active search for new and desirable ideas was of high

priority for all these cases. For instance, the involved partners organized brainstorm sessions in which individuals developed new ideas, or established environments in which ideation was enabled through trial-and-error. A good example of the latter is the experimental testing environment of case B4 (i.e. 'proof of concept') in which new ideas were directly tested in a real-life setting. Second, learning through interaction, consensus building and implementation commitment were never totally disconnected from each other. Intentional phases of ideation were almost always connected to intensive deliberation, in which the involved actors tried to find similarities between ideas and connect different perspectives.

Learning through interaction unfolded naturally towards the creation of shared perceptions and mutually supported ideas (i.e. consensus building), through the use of deliberation platforms, bilateral dialogue and project teams. Strongly conflicting ideas were prevented by early connecting ideas, or postponed so they would not push away some partners, which enabled a strong basis for idea sharing and learning. Learning through interaction and consensus building caused early involvement of all of the relevant actors (including users), which proved to be crucial to establish the proper capacity for implementation as it gave these actors the opportunity to share their motivations and interests, which were then taken into account during the development of the innovation.

Third, the qualitative information shows a more complicated role of the diversity of ideas and perspectives in the innovation processes of the covered cases. Three observations are made. First, the covered cases show that the diversity in ideas and perspectives often has a cultural or organizational origin (e.g. different organizational cultures, procedures, routines, interests, etc.), which can lead to conflicts between the involved partners. This, in turn, can harm the innovation process. For instance, in one case, the differences between the partners were so substantial that they led to the premature termination of the collaboration with this partner. Second, when such differences in ideas and perspectives were apparent from the start of the project, the involved partners were more cautious in forcing ideas upon others and were stimulated to discuss these differences early on in the process. These early discussions evolved into an open ideation process in which learning and consensus building created novel and feasible ideas, which enhanced the innovation process. Third, diversity in ideas and perspectives was actively searched for by many of these partnerships. For instance, some partnerships organized work visits to other organizations to collect new ideas and perspectives, or worked together with specialized organizations, which could enrich their own knowledge pool and stimulate the innovation process.

Discussion and conclusion

The general objective of this article was to explain how public-private innovation partnerships create highly innovative public services. For this, we introduced the divergence-convergence mechanism, which poses that innovation processes undergo pressures to increase and decrease the variation in attained ideas (Bledow et al. 2009). We demonstrated that collaboration-related conditions can stimulate this mechanism, and that their combined presence in collaborative innovation processes is especially important. We tested the combined effect of these conditions on the innovativeness of created solutions through QCA on data from 19 public-private eHealth collaborations in five European countries.

The QCA results indicate a combined effect of learning through interaction, consensus building and implementation commitment on the innovativeness of the produced solutions. On top of

the high consistency and coverage values of the solution path, and the robustness of the solution path when recalibrated data were used, the solution path also covered cases which are relatively evenly distributed over the selected European countries and types of eHealth technologies, which highlights the strength and generalizable potential of the combination of conditions. Furthermore, the analysis of the qualitative information showed clear evidence for the combined presence of these three conditions. Consequentially, our hypothesis was not fully confirmed, as the diversity of ideas and perspectives could be present or absent in this configuration of conditions.

The qualitative case information also revealed that the three conditions in the solution path, and their related divergence-convergence processes, were actually quite entangled with each other. Conditions that stimulate processes of divergence were closely intertwined with conditions related to processes of convergence, for instance by connecting learning activities during idea generation to intensive deliberation and consensus building. Although this finding confirms the assertion of Ansell and Torfing (2014, 12) that the conditions are 'closely interconnected and perhaps mutually reinforcing', it contradicts current views in the innovation literature that processes of divergence and convergence should be strictly separated (Sousa et al. 2014; David, Hocking, and Tyler 2016; This strict separation of divergence and convergence protects the innovation process from prematurely evaluating and selecting options (Basadur, Basadur, and Licina 2012), and is echoed by the recent interest of innovation scholars in design thinking methodologies, which artificially separate divergence from convergence (Dell'era et al. 2019; Jaskyte and Liedtka 2021).

Notwithstanding that separating divergence and convergence over the innovation process can be seen as a valuable strategy to ensure the balance between the two processes, according to our results, it might not be the only strategy. Our results seem to confirm theoretical models that allow the simultaneous pursuit of divergence and convergence in the innovation process. For instance, Bledow's et al. (2009) dialectic perspective on innovation argues that divergence and convergence occur together throughout the innovation process, and are not restricted to separated phases (i.e. idea generation or idea implementation). According to the authors, divergence and convergence should jointly occur during creative ideation, as an increased variation of ideas is only valuable if these ideas all relate to a common goal, comply to particular performance criteria (e.g. quality or efficiency), and generate a shared vision on the solution. Hence, no time should be invested in creating ideas that are disconnected from the objectives, which implies a certain degree of convergence. Similarly, both processes should also occur simultaneously during idea implementation, as converging towards a shared solution does not mean that new ideas, which can enhance the innovation, should be negated. Testing environments (e.g. proof of concepts) in which, for instance, users test some of the implemented solutions and provide new information on the usability of the solution, which is then used to improve the solution even further, are examples of the latter.

Such dialectic models of the innovation process might also explain why diversity of ideas and perspectives can be present and absent in the cases that are covered by our solution path. Instead of focusing on an equal presence of divergence and convergence to uphold a balance between the two processes, dialectic models demonstrate that, dependent on the context of the innovation process, the relative importance of one of the processes can shift (Bledow et al. 2009, 321). As divergence and convergence are closely integrated in these models, giving relatively more importance to, for instance, convergence, should not mean that divergence is totally abandoned.

The complex context in which collaborative innovation occurs, might therefore require the partnerships to give more importance to conditions related to convergence. Indeed, underemphasizing convergence in these arrangements might push away the partners, and could endanger the continuity of the partnership.

We find evidence for these assumptions in two instances. First, when we apply all counterfactual claims about the logical remainders in our QCA analysis, and not only those that fit our theoretical assumptions (i.e. apply the parsimonious solution, table A8), we see that only the two conditions that are related to convergence (i.e. consensus building and implementation commitment) are retained. Furthermore, the qualitative case information indicates that strongly conflicting ideas were avoided, as they would have pushed other partners away. Second, while 'diversity of ideas and perspectives' was not part of the solution path, the qualitative case information revealed two different types of diversity. On the one hand, knowledge-related diversity was actively pursued in the partnerships (e.g. through work visits), and contributed to the knowledge and know-how of the partners, and the innovativeness of the solution. On the other hand, some of the diversity was related to differences in organizational cultures and characteristics, which caused conflicts between the partners that damaged the collaboration. Hence, it seems that in collaborative arrangements, conditions and activities that do not pose a threat to the stability of the partnership (e.g. convergence-related conditions, knowledge-related diversity) are emphasized, but not at the expense of divergence-related conditions. In fact, in some cases, we even see that an early identification of the differences between the partners (even those related to differences in organizational cultures) also invoked early discussion and dialogue, which enhanced the collaboration between the partners.

All of these insights might suggest that a dichotomous view on collaborative innovation (i.e. idea generation vs. idea implementation, divergence vs. convergence, innovation vs. collaboration) is ill-suited to capture the inherent complexities of such processes. In this sense, there is no real tension between focusing on innovation at the expense of collaboration and vice versa as, for instance, Torfing (2019) suggests. However, managers and involved individuals/organizations should be able to dynamically switch between divergence and convergence when the context in which they operate requires them to do so (Bledow et al. 2009). According to our findings, the more volatile the context becomes (e.g. through collaborative arrangements), the higher the relative importance of convergence-related conditions and activities to generate innovation.

Hence, three important theoretical contributions arise from this article. First, we proposed a theoretical model that explains how collaboration leads to innovation by adopting conceptual ideas of contemporary collaborative innovation scholars (e.g. Sørensen and Torfing 2011; Ansell and Torfing 2014) and by applying them to broader dynamics of the innovation process (i.e. divergence and convergence). Second, we explored the relationship between divergence and convergence further and found evidence for the combined effect of the collaboration-related conditions that underlie these processes. Third, we found evidence for the intertwined nature of divergence and convergence, which suggests that a dialectic approach to divergence and convergence is better suited than a dichotomous perspective to explain the collaborative innovation process. These insights underline the dynamic nature of the collaborative innovation process, and show that manipulating one aspect of this process (e.g. organizing brainstorm sessions with service users in the early ideation phases of the process) can have a rippling effect

on other, seemingly unrelated aspects of the innovation process (e.g. which support is secured, how the innovation is implemented, which resources are mobilized, etc.).

Empirically, this article contributed with a large comparative analysis on public-private healthcare collaborations in Europe. The QCA method enabled a comparative case study analysis on 19 European eHealth partnerships. This comparative analysis and the incorporation of different European administrative regimes, healthcare systems, and eHealth technologies (which were all represented in the final results), allowed cautious generalization to similar European projects. However, this study was conducted in a specific empirical context, which included specific countries (European countries), a specific policy sector (healthcare sector), specific partnerships (PPIs) and specific types of innovation (technological service innovations). Hence, generalization to other types of collaborative innovation projects (e.g. inter-agency collaboration, citizen participation projects, etc.) in other countries and policy sectors, and with other innovation outcomes (e.g. policy innovations) should be made with the appropriate caution. Further research is needed to uncover if the theoretical mechanisms identified in this study also apply to other collaborative innovation projects. Furthermore, although the qualitative analysis helped us to uncover the relationships between the conditions in the cases that were covered by the QCA solution, this was limited to a retrospective analysis, and a lot of questions remain as to how these complex dynamics arise and evolve throughout the innovation process. Qualitative process tracing in a limited number of cases might provide more insights into the causal relationships between the processes and the produced innovation, and is regarded as a standard of good practice to complement QCA research (see Schneider and Rohlfing 2013).

Notes

1. Note that Estonia is considered to be part of the Central and Eastern European tradition, as the country was largely moulded by the administrative traditions in the Soviet Union (Tõnnisson, Randma-Liiv, et al. 2008).
2. Belgium has characteristics of both the continental tradition and the Napoleonic tradition. However, its large politization of the administration, legal tradition and administrative culture, justify the choice to consider Belgium as a mixed-Napoleonic country.

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Ethics declaration

This study has been approved by the ethical commission of the University of Antwerp. Interview respondents signed a consent form before the interviews and surveys which detailed how their data would be used and stored. All the information from the respondents that is used in this article is anonymized.

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Supplemental online material

Table A1: Selected cases and data collection

Case ID			Short description of the case	Data collection	
				Surveys	Interviews
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.	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	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.	Project coordinator, government agency, private service provider, ICT company, GPs	Project coordinator, government agency, private service provider, ICT company, GPs
		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.	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	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.	Manager nursing home, municipality, nurses	Manager nursing home, municipality, external private consultant, nurses
		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.	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	Municipality, public hospital, and several private health organizations created a ICT platform which facilitates the exchange of health information between partners and patients.	Project coordinator, public service organization, ICT company, service organization, physicians	Project coordinator, public service organization, ICT company, service organization, physicians
		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.	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	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.	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

Case ID			Short description of the case	Data collection	
				Surveys	Interviews
		N4	Semi-private association, ICT company, consultant company created a smart diaper which automatically detects defecation and signals this to the nurses.	Manager/project coordinator, public service, provider	Manager/project coordinator, public service, provider, nurses
Spain	Napoleonic adm. regime National Health Service	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.	Public hospital, public hospital, ICT company, health professionals	Public hospital, public hospital, ICT company, health professionals
		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.	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 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.	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 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.	Public hospital, public hospital, ICT company, health professionals	Public hospital, public hospital, ICT company, health professionals
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.	Project coordinator, ministry, ICT company, ICT technicians	Project coordinator, ministry, ICT company, ICT technicians
		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.	Project coordinator, ministry, physicians association, representatives of users and individual user	Project coordinator, ministry, physicians association, representatives of users and individual user
		E3	Ministry, public health insurance authority, colleges, network of healthcare providers, ICT companies, several health care organizations created an app	Project coordinator, ministry, private health network, representatives users, nurse	Project coordinator, ministry, private health network, representatives users, nurse

Case ID			Short description of the case	Data collection	
				Surveys	Interviews
			with a voice command function that supports the health care provider in carrying out procedures through digitalised guidelines.		
Denmark	Nordic adm. regime National Health Service	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.	Program manager, public hospital, ICT company, health professionals	Program manager, public hospital, ICT company, health professionals
		D2	Public hospital, ICT company, health professionals created a smartphone app for patient reported outcomes.	Project coordinator, public hospital, physician, nurse	Project coordinator, public hospital, physician, nurse
		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.	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 A2: Operationalization of *innovativeness*

Newness	**Adoption**
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 A3: Operationalization of the conditions

Diversity of ideas and perspectives								
There were no differences in opinions or perspectives of the actors	1	2	3	4	5	6	7	There were a lot of differences in opinions and perspectives of the actors
My own ideas and opinions were very similar to the ideas and opinions of other actors	1	2	3	4	5	6	7	My own ideas and opinions were very distinctive from the ideas and opinions of the other actors
Learning through interaction								
The involved actors stayed close to their initial ideas	1	2	3	4	5	6	7	The involved actors built further on the ideas of other involved actors
When interacting with each other, the involved actors did never come up with new ideas or insights regarding the innovation	1	2	3	4	5	6	7	When interacting with each other, the involved actors came up a lot with newly developed ideas and insights regarding the innovation
The information or ideas mentioned by the other involved actors never inspired my own ideas	1	2	3	4	5	6	7	The information or ideas mentioned by the other involved actors often inspired my own ideas
Consensus building								
The involved actors were increasingly emphasizing the differences between their ideas and perspectives on the innovation, and the ideas of other involved actors	1	2	3	4	5	6	7	The involved actors were increasingly trying to detect the similarities between their ideas and the ideas of the other involved actors in order to come to a shared solution
The involved actors were increasingly trying to prevent that a general support for certain ideas emerged	1	2	3	4	5	6	7	The involved actors were increasingly trying to ensure there was general support in the partnership for certain ideas
My ideas started to diverge more and more from the ideas of the other actors	1	2	3	4	5	6	7	My ideas started to converge more and more towards the ideas of the other actors
Implementation commitment								
Realizing and implementing the proposed innovation was of no concern for the involved actors	1	2	3	4	5	6	7	Realizing and implementing the proposed innovation was of high concern for the involved actors
In developing the innovation, the involved actors departed strongly from what was realizable for those they represented (e.g. own organization)	1	2	3	4	5	6	7	In developing the innovation, the involved actors stayed close to what was realizable for those they represented (e.g. own organization)
My organization was not committed to invest time/resources in the implementation (by itself or by others) of the innovation	1	2	3	4	5	6	7	My organization was fully committed to invest time/resources in the implementation (by itself or by others) of the innovation

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
	(Adoption) The frequency of use will typically be very low/high	0.683
	(Adoption) 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
	(Adoption) The innovative ideas that are developed in the project are not feasible at all/very feasible	0.567
	(Adoption) The innovation does not deal with the problems at hand at all/really deals with the problems at hand	0.825
Diversity of ideas and perspectives	There were a lot of differences in opinions and perspectives of the actors	0.839
	My own ideas and opinions were very distinctive from the ideas and opinions of the other actors	0.839
Learning through interaction	The involved actors built further on the ideas of other involved actors	0.552
	When interacting with each other, the involved actors came up a lot with newly developed ideas and insights regarding the innovation	0.854
	The information or ideas mentioned by the other involved actors often inspired my own ideas	0.779
Consensus building	The involved actors were increasingly trying to detect the similarities between their ideas and the ideas of the other involved actors in order to come to a shared solution	0.822
	The involved actors were increasingly trying to ensure there was general support in the partnership for certain ideas	0.865
	My ideas started to converge more and more towards the ideas of the other actors	0.878
Implementation commitment	Realizing and implementing the proposed innovation was of high concern for the involved actors	0.838
	In developing the innovation, the involved actors stayed close to what was realizable for those they represented (e.g. own organization)	0.784
	My organization was fully committed to invest time/resources in the implementation (by itself or by others) of the innovation	0.733

Table A5: Calibrated dataset

Case	Diversity of ideas and perspectives	Learning through interaction	Consensus building	Implementation commitment	Innovativeness
N3	0.67	0	0.67	0.33	0.33
B5	0.33	0.67	0.33	0.67	0
E1	0.33	0.33	0.33	0.67	0
E3	0	0.33	0.67	0.33	0
D1	1	1	0.67	0.33	0.67
B3	0.67	0.67	0.33	0.33	0.67
N4	0	0.67	0.67	0.33	0.33
N2	0.33	0.33	0.33	0.33	0.67
S3	0.33	0.67	0.67	0.33	0.67
B1	0.67	0	0.33	0.33	0.67
B2	0.33	0.67	0.33	1	0.67
D3	0.33	1	0.67	1	0.67
S2	0	0.67	0.67	0.67	0.67
E2	1	0.67	0.67	0.67	0.67
D2	1	0.33	0.33	0.67	0.33
S1	0.33	0.67	1	0.67	1
S4	0.33	0.67	0.67	0.67	1
B4	0	1	0.67	1	1
N1	0.67	0.67	0.67	0	0

Table A6: Analysis of necessary conditions – absence of high innovativeness

Absence of high innovativeness		
Conditions	**Consistency**	**Coverage**
Diversity of ideas and perspectives	0.591	0.638
~Diversity of ideas and perspectives	0.666	0.560
Learning through interaction	0.628	0.512
~Learning through interaction	0.666	0.749
Consensus building	0.739	0.622
~Consensus building	0.702	0.757
Implementation commitment	0.665	0.578
~Implementation commitment	0.703	0.728

Table A7: Truth table

	Diversity of ideas and perspectives	Learning through interaction	Consensus building	Implementation commitment	Innovativeness[1]	#cases	Raw consist.	PRI consist.
1	1	1	1	1	**1**	1	**0.847**	0.602
2	0	1	1	1	**1**	5	**0.835**	0.731
3	1	0	0	0	0	1	0.751	0.404
4	1	0	0	1	0	1	0.748	0.248
5	1	1	0	0	0	1	0.728	0.404
6	0	1	0	1	0	2	0.713	0.429
7	0	0	0	0	0	1	0.693	0.337
8	1	1	1	0	0	2	0.691	0.429
9	1	0	1	0	0	1	0.691	0.332
10	0	0	0	1	0	1	0.691	0.199
11	0	0	1	0	0	1	0.641	0.284
12	0	1	1	0	0	2	0.615	0.376

[1] The 1 in the columns indicates that only rows 1 and 2 consistently lead to the outcome.

Table A8: Parsimonious solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases in path
Consensus building * Implementation commitment	0.87594	0.697605	0.697605	D3, S2, S4, E2, S1, B4
Solution consistency	**0.876**			
Solution coverage	0.698			

Table A9: Calibration rules for outcome and conditions

Innovativeness of services (outcome)	**Diversity of ideas and perspectives**	**Learning through interaction**	**Consensus building**	**Implementation commitment**
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	Survey data leading *Questions*: see table A2 *Measurement*: seven-point scale, cross-over point = 4 • All of the answers of the respondents above the cross-over point → 1 • More than half of the answers above the cross-over point → 0.67 • Less than half of the answers above the cross-over point → 0.33 • None of the answers above the cross-over point → 0 • An equal amount of answers above and below/on the cross-over point, consider the distance of the answers towards the cross-over point → larger distance is indicative Qualitative check of the assigned scores using the interview data	Survey data + interview data *Survey data:* *Questions*: see table A2 *Measurement*: seven-point scale, cross-over point = 5 • All of the answers of the respondents above the cross-over point → 1 • More than half of the answers above the cross-over point → 0.67 • Less than half of the answers above the cross-over point → 0.33 • None of the answers above the cross-over point → 0 • An equal amount of answers above and below/on the cross-over point, consider the distance of the answers towards the cross-over point → larger distance is indicative *Interview data:* Number of examples of learning through interaction/consensus building is used: • 3 or more examples → 1 • 2 examples → 0.67 • 1 example → 0.33 • 0 examples → 0 *Case membership score*: • Calculate the mean of the survey and interview score → intermediate score • Qualitative assessment of the interview data → qualitative score • Intermediate score exactly (or very close to) 0; 0.33; 0.67; 1 → use intermediate score, but qualitative score is still indicative above and below cross-over point (qualitative score should always be indicative if there is doubt). • Intermediate score not exactly (or very close to) 0; 0.33; 0.67; 1 → qualitative score is leading in assigning case score		Interview data leading *Interview data:* Number of examples of implementation commitment is used: • 3 or more examples → 1 • 2 examples → 0.67 • 1 example → 0.33 • 0 examples → 0 *Survey data:* *Questions*: see table A2 *Measurement*: seven-point scale, cross-over point = 5 • All of the answers of the respondents above the cross-over point → 1 • More than half of the answers above the cross-over point → 0.67 • Less than half of the answers above the cross-over point → 0.33 • None of the answers above the cross-over point → 0 • An equal amount of answers above and below/on the cross-over point, consider the distance of the answers towards the cross-over point → larger distance is indicative *Case membership score*: • Calculate the mean of the survey and interview score → intermediate score • Intermediate score exactly (or very close to) 0; 0.33; 0.67; 1, use intermediate score; if not, use interview score

Table A10: Robustness check – Rules for recalibration

Original calibration of survey-based data	Alternative calibration of survey-based data
• 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	• More than half of the answers of the respondents above the cross-over point, and on or above 5.5 (for diversity of ideas and perspectives) or 6 (for other conditions) → 1 • Half or more than half of the answers of the respondents above the cross-over point, but below 5.5 (for diversity of ideas and perspectives) or 6 (for other conditions) → 0.67 • Half or more than half of the answers of the respondents below the cross-over point, but above 2 (for diversity of ideas and perspectives) or 2.5 (for other conditions) → 0.33 • More than half of the answers of the respondents below the cross-over point, and below 2 (for diversity of ideas and perspectives) or 2.5 (for other conditions) → 0

Table A11: Robustness check – Alternative calibration scores

Case	Diversity of ideas and perspectives (alternative calibration)	Learning through interaction (alternative calibration)	Consensus building (alternative calibration)	Implementation commitment (alternative calibration)	Innovativeness (original calibration)
N3	0.67	0	0.67	0.33	0.33
B5	0	0.67	0.33	0.33	0
E1	0.33	0.33	0.33	0.67	0
E3	0.33	0.67	0.67	0.33	0
D1	0.67	1	0.67	0.67	0.67
B3	0.67	0.67	0.33	0.33	0.67
N4	0.33	0.67	0.67	0.33	0.33
N2	0.33	0.33	0.33	0.33	0.67
S3	0.33	0.67	0.67	0.67	0.67
B1	0.67	0.33	0	0.33	0.67
B2	0.33	0.67	0.33	1	0.67
D3	0.33	1	0.67	0.67	0.67
S2	0.33	0.67	0.67	0.67	0.67
E2	0.67	0.67	0.67	0.67	0.67
D2	0.67	0.33	0.33	0.67	0.33
S1	0.33	0.67	0.67	0.67	1
S4	0.33	0.67	0.67	0.67	1
B4	0.33	1	0.67	1	1
N1	0.67	0.67	0.67	0	0

Table A12: Robustness check – Truth table

	Diversity of ideas and perspectives	Learning through interaction	Consensus building	Implementation commitment	Innovativeness[1]	#cases	Raw consist.	PRI consist.
1	1	1	1	1	**1**	2	**0.883**	**0.717**
2	0	1	1	1	**1**	6	**0.865**	**0.754**
3	0	1	0	1	0	1	0.834	0.573
4	1	1	0	0	0	1	0.813	0.503
5	1	0	0	0	0	1	0.800	0.503
6	1	0	0	1	0	1	0.798	0.398
7	0	0	0	0	0	1	0.750	0.431
8	0	0	0	1	0	1	0.749	0.332
9	1	1	1	0	0	1	0.732	0.332
10	1	0	1	0	0	1	0.713	0.332
11	0	1	0	0	0	1	0.705	0.284
12	0	1	1	0	0	2	0.645	0.248

[1] The 1 in the columns indicates that only rows 1 and 2 consistently lead to the outcome. The other rows have low raw/PRI consistency levels.

Table A13: Robustness check – Intermediate solution for the presence of high innovativeness

	Consistency	Raw coverage	Unique coverage	Cases
Learning through interaction * Consensus building * Implementation commitment	0.877	0.700	0.700	D3, S2, S4, E2, S1, B4, S3, D1
Solution consistency	**0.876**			
Solution coverage	0.700			