11. It is all about interaction: network structure, actor importance, and the relation to innovative outcomes

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INTRODUCTION

In recent years, many governments have been establishing collaborative arrangements to develop public sector innovations to cope with today's societal problems (Hartley et al., 2013; Lopes & Farias, 2020; Torfing, 2019). Public sector innovation entails the development and implementation of new public policies, services, technologies, and administrative processes that represent a qualitative change from how things were done before (De Vries et al., 2016; Gieske et al., 2019). Although working in inter-organisational collaborative arrangements is not a new phenomenon, public sector innovations have been increasingly developed in collaborative arrangements in recent years. New opportunities to interact have arisen in the past decades, such as digital tools that allow interaction with actors that would otherwise be left out of the innovation process (Castells, 2000; Geuijen et al., 2017). But also, the increasing fragmentation of society and the subsequent interdependencies between actors have led to a need for inter-organisational collaboration (Agger & Lund, 2017; Bommert, 2010).

A concept closely related to interdependencies in inter-organisational collaboration is that of actor importance (Koppenjan & Klijn, 2004:178; Meijer, 2014). Stevens (2018) is one of the few scholars who examined actor importance in collaborative arrangements aimed at innovation in relation to network structure. He found that individual actors are in some cases more likely to interact with actors they find 'very necessary' to tackle the policy problem.

Recently, considerable research has examined the relationship between network structure and network effectiveness (e.g., Cepiku et al., 2020; Raab et al., 2015; Stevens, 2018). Research suggests that network structure can positively influence the outcomes of the collaboration. For example, a high degree of network-level connectedness allows information to flow efficiently through the network and is associated with the development of social capital and trust (Bodin et al., 2017; Hu et al., 2022; Yi, 2018).

Clique overlap is named the most effective way type of network integration by milestone studies such as those by Provan and Milward (1995) and Provan and Sebastian (1998). A clique is a group of at least three actors who are directly connected with each other. Cliques overlap when an actor is a member of multiple cliques and thus connects multiple cliques with each other. When clique overlap occurs, actors in the network are more closely connected to each other, while superfluous ties between actors are reduced. Remarkably, little attention has been paid to how innovative outcomes can be explained by the integration through clique overlap of the most important actors. While the inclusion of important actors who are necessary for the realisation of the innovation is at the basis of collaborative innovation (Torfing, 2019), little is known about the extent to which the integration of important actors in collaborative arrangements results in innovative outcomes.

Therefore, this study answers the following research question: *How can innovative outcomes of collaborative public sector innovation projects be explained by the network integration of its most important actors?*

The question is answered by examining three cases in which a collaborative arrangement was established in order to create better digital information exchange in the public sector. For each of these cases, the degree of clique formation and clique overlap, and the resulting network integration of the most important actors are examined in two interaction networks: interaction outside meetings and interaction during meetings.

THEORETICAL FRAMEWORK

Collaborative Innovation and the Importance of Actors

Governments increasingly turn to the development of public sector innovations as a way to deal with wicked problems that arise from a complex, fragmented society, unpredictable events, and increasing citizens' demands for public services (Ansell et al., 2021; Lopes & Farias, 2020; Torfing, 2019; Wegrich, 2019). Although research on innovation has gained increasing attention, no clear consensus on the definition of the concept is present. Following the literature review by De Vries and colleagues (2016) definitions of public sector innovation commonly emphasise innovations as being something new within a given context. This can be a new or changed service, but also a new policy, technology, process, etc. This novelty might exist somewhere else but is new in its context and represents a change and discontinuity with how things were done before (Damanpour et al., 2009; Gieske et al., 2019; Osborne & Brown, 2011). Innovation is, therefore, something different from optimisation in the sense that innovation represents a break from the past and concerns the implementation of something new in the context. Optimisation is, on the other hand, an improvement of existing routines in line with the past. In recent studies, one additional characteristic of public innovation is commonly acknowledged. Unlike private sector innovation, which is driven by competitive advantage over others, public sector innovation is specifically aimed at the creation of public value instead. The innovation aims to solve a societal problem and adds value to society in that way (Chen et al., 2020; Crosby et al., 2017).

As all necessary resources for the development of innovations are usually not available within one single government organisation, governments increasingly develop public sector innovations in collaborative arrangements (Bommert, 2010; Torfing, 2019). In these collaborative arrangements resources such as knowledge, financial means, and production resources are combined to develop an innovation to cope with the problem at hand. Still, merely bringing actors together does not result in innovations. Several factors are closely linked to the process between collaboration, on the one hand, and the creation of innovation, on the other hand. Among them are:

(1) The inclusion of the necessary actors in the collaborative arrangement and their importance (Ansell & Torfing, 2014:11; Godenhjelm & Johanson, 2018; Siddiki et al., 2017). For example, actors with knowledge, financial means, decision-making power, etc.
(2) The interactions among these actors (Agger & Sørensen, 2018; Lewis et al., 2018; Lopes & Farias, 2020). For example, interaction among people with different insights or knowledge allows actors to learn and spurs the generating of new ideas (Koebele, 2019; Voorberg et al., 2017).

Actor Inclusion, importance, and Interaction

Concerning the inclusion of actors, actors are included for different reasons in the innovation process (Godenhjelm & Johanson, 2018). These can be the resources these actors can bring to the process, such as different insights or financial resources (see, e.g., resource dependency theory; Hillman et al., 2009; Pfeffer & Salancik, 1978; Scharpf, 1978), the coordinating role the actor fulfils, their decision-making power, or simply because they are interested in the problem at hand and want to think along (Koppenjan & Klijn, 2004:178). Actors become more important as the substitutability of, for example, their knowledge or decision-making power is low. Therefore, a low substitutability of necessary resources is a basis of power in collaborative arrangements aimed at innovation and thus can make certain actors more important than others.

Next, the premise of collaborative innovation is to interact with each other in order to combine different resources and perspectives, learn from each other, and subsequently implement the innovation (Ansell & Torfing, 2014:11). Information sharing is crucial for the development of innovations (Koliba et al., 2017). During meetings, actors need to build upon each other's ideas to deepen discussions, come to a synergetic process, and learn from each other. Outside meetings, information sharing is necessary to elaborate on the things discussed during official meetings, work out details etc.

The structure of the interaction in these collaborative arrangements (also referred to as networks) can take many forms and shapes. Network characteristics such as the density, centrality of individual actors, and structural holes reflect the shape of the network, and thus the interaction patterns within the collaborative arrangements (Lusher et al., 2012:7). Individuals gain access to information, social support, and other resources through the ties with other actors (Agneessens & Wittek, 2012; Bodin et al., 2017; Hu et al., 2022; Yi, 2018). Moreover, research suggests that central actors are more likely to access useful knowledge from others and therefore become more important (Tsai, 2001; Zhao, 2022). They are the 'spiders in the web'. Hence, the causal relation between importance and network integration is somewhat unclear as importance might not only be attributed to actor-specific characteristics such as the possession of resources, but also to an actor's central network position.

Milestone studies in the relation between network structure and network outcomes are the studies of Provan and Milward (1995) and Provan and Sebastian (1998), who provided a framework for the determinants of effective network outcomes; one of them being the integration of actors in the network. Three types of integration are commonly distinguished in the inter-organisational network literature. First, density-based integration, which is the type of integration based on the total level of ties among the actors in the network (Scott, 2000:69). In this type of integration the observed number of ties between the actors is compared to the maximum number of ties. A higher density resembles a higher degree of network integration. A second type of integration is centralised integration, which is the extent to which the network ties are organised around particular focal actors (Borgatti et al., 2013:149). The third type of commonly distinguished type of integration is clique overlap (Borgatti et al., 2013:184; Raab et al., 2015). Cliques are a minimum of three different actors who are directly connected to each other in a network. When actors are a member of multiple cliques it results in clique overlap. In the case of clique overlap, an actor connects multiple cliques with each other and thus indirectly connects actors who are not in the same clique.

The discussion has focused on what kind of integration is best for effective network outcomes and is commonly focused on the balance between density-based integration and centralised integration (Provan & Sebastian, 1998; Saz-Carranza & Ospina, 2011; Ngamassi et al., 2014; Turrini et al., 2010). Several studies found that centralised integration organised around a central coordinator is positively associated with network outcomes (Cristofoli & Markovic, 2016; Provan & Milward, 1995; Raab et al., 2015). Free-wheeling behaviour in the network can be prevented as the central coordinator is able to control and monitor the behaviour of all the other actors, especially in sparsely connected networks (Cristofoli et al., 2021).

However, in this study, we examine integration through clique overlap which is found to combine the advantages of strong density-based integration and strong centrality-based integration and enhances the overall network outcomes but is very overlooked in current literature (Provan & Sebastian, 1998). The membership of a clique in the network has been linked to several benefits, such as a higher pace of information sharing through the network and facilitation of learning (Provan & Sebastian, 1998). It was found that network outcomes are evaluated more positively when cliques overlap each other, but less positively when too many actors in the network are connected to each other. Having clique overlap is effective because members who are in several cliques are brokers and thus connect different cliques to each other. In this structure, not everyone in the network needs to be directly connected to each other because the information is transferred through the actors that are members of multiple cliques. Moreover, while a certain amount of dispersion of important actors throughout the network seems needed, (complete) separation of certain actors is found to be detrimental to successful outcomes (Yi, 2018). Stevens (2018) examined how actor importance determines interaction in collaborative innovation networks that work towards a joint outcome and found that actors are in some cases more likely to interact with actors they find 'very necessary' to tackle the policy problem. This suggests that actors who find each other important tend to stick to each other. A core group of important actors that mainly directly interact with each other without interacting with others in the network would be an obstacle to the development of innovations (Provan & Kenis, 2008).

From these previous findings we expect that cases with successful innovative outcomes are characterised by a high degree of clique overlap in terms of the most important actors being included in multiple cliques, both during and outside meetings.

RESEARCH DESIGN AND MEASUREMENT

Cases and Data Collection

Three Belgian cases were examined in which a collaborative arrangement was created with the goal to implement a public sector innovation. These innovations aimed to create a better digital information exchange between the key players involved in the policy field at hand. They all focus on a more effective way to cope with information needs by transforming information systems in order to work more effectively. They are clear examples of the line of reasoning that effective information-sharing systems are a lynchpin in critical public policy areas to be effective and that government must embrace the digital era to optimise inter-organisational information integration (Meijer and Bekkers, 2015; Pardo and Tayi, 2007).

All actors in the network were asked to participate in a survey that asked about their interactions with, and their perception of the importance of the other actors.[1] The cases were selected based on the following criteria: (1) The cases entail arrangements involving public actors and to the extent possible also private actors and citizens; (2) In order to avoid the pro-innovation bias we included also cases which did not materialise in innovations, or in which innovation processes were particularly difficult in their progress; (3) Comparability in terms of network size, goal of the innovation (creating new digital procedures to solve difficulties in governmental processes), and accessibility were important criteria as well.

CareLab was a project initiated by the Belgian federal government focusing on the simplification of rules and bureaucracy for parents with a disabled child. A core group of 18 actors, such as health professionals, civil servants, and parents could be identified. The project ended with the idea selection of four innovations, including a digital government tool to reduce the administrative burden for parents with a disabled child, and a first step towards implementation. After that, core actors left the process and sustainable implementation of these solutions did not take place.

Invasive Species was a project to generate a more comprehensive and effective policy on invasive species by creating a new institutional arrangement that organises and formalises digital information exchange between institutions dealing with invasive species policies across Belgian regions and communities. A core group of 11 actors could be identified. These included federal and regional policy officers, scientists, and legal experts.

Radicalisation was a process innovation with the goal to change the digital information exchange procedure concerning signs of radicalisation within the group of asylum seekers or refugees to ensure that the transfer of information on radicalism is effective, both horizontally and vertically. A new (digital) notification procedure to detect radicalisation and the new way of information exchange was implemented. A core group of ten actors, such as representatives of the Federal Agency for the Reception of Asylum Seekers and the General Intelligence and Security Service could be identified.

Interaction

Two types of interaction networks were studied in each case. To capture interaction in the collaborative arrangement outside official meetings we looked at the network of information sharing *outside official meetings*. Moreover, we also looked at the network concerning elaboration upon others' ideas *during official meetings* to determine which actors interact with each other during meetings. We will refer to these networks as *interaction outside meetings* and *interaction during meetings.*

To map the interactions outside formal meetings, the following question was asked:

- *Could you please indicate to whom you gave and from whom you received information, after and outside of formal meetings? 'Information' includes reports, statistics, advice, and remarks. This information can be both verbal and written*.

A tie between actors was only considered when it was confirmed from both sides. For example, if actor 'i' claimed that he gave information to actor 'j', it was only regarded a tie when actor 'j' indicated that he received information from actor 'i'. When this was not possible due to missing network data because an actor did not fill out the survey (CareLab: 2 actors, Invasive Species: 2 actors, Radicalisation: 1 actor), a tie was considered by confirmation from only one respondent.

To determine the interaction *during meetings*, we asked:

- *Which participants in [project name] most frequently elaborated during the meetings of [the arrangement] upon the information and ideas you shared?*

For this question, respondents could indicate the five participants that elaborated most frequently on their contributions inside the meetings. Because CareLab consisted of more actors, the respondents could name up to eight actors in this case to make the networks comparable. That way respondents could name around 50 per cent of the actors in all cases. We decided to pose this question in a way that respondents were not able to name every actor in the collaborative arrangement. As the collaborative arrangements consisted of relatively few actors, we were only interested in the actors who elaborated most on an actor's contributions. The meetings in the cases were set up in a way that all actors engaged in group discussions with each other. By limiting the number of actors, we prevented respondents from naming every actor in the collaborative arrangement.

Actor Importance

Respondents were asked to evaluate how important they perceived the other actors in order for the innovation process to succeed. They were asked to answer the question:

- *Could you please indicate for each of the participating actors whether you considered it 'very important', 'important' or 'not that important' that they were involved in the process.*

We took only the 'very important' answer category into account as respondents were not likely to indicate actors as 'being unimportant for the process'. By only including the 'very important' category, we got a clear view of the actors respondents felt were the most important, as it eliminated the rather neutral 'important' category, and, thus, giving a better representation of the most important actors.

The importance of the individual actors in the networks was determined by calculating the percentage of the times they were labelled as being 'very important' by the other actors. For example, in CareLab, the total number of times an actor was reported to be 'very important' to the process was divided by the total number of actors minus three (as actors cannot indicate themselves as being very important and the presence of two non-respondents in this case).

Network Integration

Multiple measures were used to determine the level of integration of each network. As a basic variable, the density of the networks was checked to see how the actors in the whole network are connected to each other. The density is the number of ties between actors compared to the maximum number of ties (Borgatti et al., 2013:183). Density is used as a measure of network integration, as is common in studies examining network structures (Ngamassi et al., 2014; Provan & Sebastian, 1998).

Next, we examined the different cliques and clique overlap in the networks. As mentioned, a clique is a subset of at least three actors in which every actor is adjacent to every actor in the subset, and it is impossible to add any more actors to this clique without violating this condition (Borgatti et al., 2013:183). As we are interested in the clique formation of interactions, we only looked at reciprocal ties. We excluded cliques of interaction in which, for example, only one actor gives information and the other actors in the clique 'just' receive information. That way, we only took cliques into account in which all actors actively gave information to and received information from all other actors in the clique. This principle was applied to both interaction networks.

The examination of cliques enabled us to identify central actors, and/or whether (groups of) actors are totally isolated. Because the networks are relatively small, we looked for cliques in which all actors of the clique were directly connected to each other. Therefore, methods of analysis that 'loosen' the strict definition of a clique by allowing actors to be not necessarily connected to every other actor in the clique, such as N-clans (Harary et al., 1965) or K-plexes (Seidman & Foster, 1978) were not used. The cliques were identified using the UCINET software. With this software several key measures of network integration were obtained (Kegen, 2015):

- The number of cliques.
- The clique density (the number of actors in at least one clique).
- The average size of cliques.
- The individual and average clique centrality. This is the absolute number of cliques an individual actor is a member of and, at a network level, the average amount of cliques an actor is a member of.
- The integration of clusters of cliques. The cliques were analysed using an average link hierarchical clustering procedure to see how cliques overlap with each other (Borgatti et al., 2013:96). Average linkage hierarchical clustering is a stepwise procedure for determining the clusters in the network based on the average distance from any member of one clique to any member of the other cliques. The algorithm merges the closest pairs of cliques into a cluster. Then, the clique that is closest to this new cluster is, in turn, merged with this cluster, etc. This procedure is repeated until all cliques are merged into a single cluster. As high clique overlap in the network requires less stages of this so-called clustering, the lower the level (stages) of clustering, the higher the extent of clique overlap.

Innovative Outcome Measures

The innovative outcomes of the cases were determined in two ways. First, every respondent was asked to rate the innovative outcomes of the project on a scale ranging from 0 to 10 using four items.[2] Once data were collected, the results of the three cases were pooled and a factor analysis (principal components analysis) was executed to come to one broad measure of innovative outcomes. Second, to overcome a possible bias in the respondents' answers, the phase at which the project ended was determined based on interview data and official documents. The commonly used phases of the innovation cycle – idea generation, idea selection, implementation, and dissemination – were applied to the cases (Sørensen & Torfing, 2011).

RESULTS

Concerning the innovative outcomes of the cases, the factor analysis indicated that items loaded on one factor and the scale was regarded as reliable (Cronbach's alpha = 0.733), the mean factor scores were then calculated to obtain comparable measurements per case (see also Provan & Sebastian, 1998). The results show that CareLab scores substantially lower on innovative outcomes than the other projects, with the negative factor score (−0.34) indicating that the project was ineffective in producing innovative outcomes. The process of the Invasive Species (factor score: 0.20) and Radicalisation case (factor score: 0.46) was much more successful in producing innovative outcomes.

As CareLab did not move past the idea selection phase, it is possible to say that this project was less successful than the other two cases as these reached the implementation phase.

We expect that cases with successful innovative outcomes are characterised by a high degree of clique overlap in terms of the most important actors being included in multiple cliques, both during and outside meetings. The remainder of this section presents the two types of networks separately. The networks are complementary to each other, but it makes more sense to look at each network separately as the interactions in the networks are different in nature. During meetings, actors build upon each other's ideas to deepen discussions and to come to a synergetic process. Outside meetings, actors can elaborate on the things discussed during official meetings and work out the details in smaller groups. By comparing the networks separately, it is easier to notice the differences between the cases per type of interaction network and therefore what the characteristics of a successful case are compared to a less successful case and how it is different per type of interaction network. Moreover, the networks are measured in different ways, which makes a separate presentation more suitable.

Interaction Network 1: Interaction Outside Meetings

Table 11.1 shows the integration of the 'interaction outside meetings' networks. Comparing the interaction outside meetings network across the three cases, CareLab shows the lowest density, followed by the Invasive Species case, and Radicalisation has the highest network density. This can partly be explained as the relative measure of density typically decreases when network size increases (Jansen, 2006:194). An actor is only able to have a direct tie with a limited number of other actors so when the network size increases, the relative number of linkages decreases. Larger network size is generally associated with a higher number of cliques, because there are simply more actors to connect to. This is visible in the network data as CareLab has one clique more than the successful Invasive Species and Radicalisation networks. However, the clique density of the CareLab network can be considered quite low as just a little over half of the actors (10 out 18 actors) is integrated in at least one clique.

Clique density is a measure that indicates how many actors are a member of at least one clique. The clique density is lowest in the CareLab network, and higher in the smaller Invasive Species and Radicalisation networks. This is in line with the argument that smaller networks have a higher clique density as isolated actors are spotted more easily and are consequently sooner squeezed into a clique (Kegen, 2015). Furthermore, the cliques in the CareLab network all contain the minimum number of three actors, while the other networks tend to have some cliques containing four actors, which gives these networks a higher average clique size pointing to a higher extent of integration.

Clique Overlap

The clique centralities were obtained to spot indications of clique overlap. The clique centrality indicates the number of cliques an actor is a member of. Moreover, a hierarchical clustering procedure was executed to see to what extent cliques are integrated with each other. The average clique centrality of CareLab is 1, indicating that on average every actor is a member of one clique. However, as the clique density indicates, only 55 per cent of the actors are present in at least one clique. The average clique centrality turned out to be especially high because one actor is member of all six cliques, and one is a member of four cliques. This indicates a high extent of clique overlap but given the observation that only 55 per cent of the actors is included in a clique it means that especially a core group is well connected to each other through clique overlap and the other actors are more isolated (eight of them are in no clique at all). In this network it indicates a strong centralisation towards a core group that is closely tied together, while other actors are more isolated.

Actors in the more successful Invasive Species and Radicalisation networks are less isolated. The average clique centralities indicate that actors are on average a member of 1.55 cliques (Invasive Species) and 1.60 cliques (Radicalisation). An interesting observation in the Radicalisation network is that one actor is present in all cliques in the network, indicating strong clique overlap through this central actor, just as in the CareLab network. Not surprisingly, this central actor is the coordinator.

However, although a central coordinator is present with whom actors are directly connected in the Radicalisation network, the observation that a higher percentage of actors in the network are a member of at least one clique (70 per

Table 11.1 Network integration 'interaction outside meetings' network

	CareLab	Invasive Species	Radicalisation
Network density	0.127	0.273	0.311
No. of cliques in network	6	5	5
Average clique size	3	3.4	3.2
Clique density	0.55	0.72	0.70
Average clique centrality	1	1.55	1.60
Individual clique centralities	0 to 6	0 to 3	0 to 5
Complete integration of cliques at level …	2	3	2
Top most important actors* (with individual clique centrality)	1. Local coordinator 1: 93% (clique centrality: 6) 2. Parent 1: 67% (0) 3. Private actor 5: 60% 4. Federal coordinator: 60% (4)	1. Public actor 1 Federal: 50% (0) 2. Public actor 2 Flemish 38% (1) 3. Public actor 2 Walloon: 25% (2) 4. Public actor 1 Brussels: 25% (0)	1. Federal actor 4 (coordinator) 78% (5) 2. Federal actor 1 67% (3) 3. Federal actor 2 67% (2)

Note: * Top three. In case of equal importance more actors are listed in the table.

cent) indicates a high degree of interconnectedness of the other actors as well. Therefore, in this network actors interact frequently with the coordinator, but unlike CareLab, they also interact with the other actors.

In the Invasive Species network, none of the actors are a member of every clique, meaning that no central actor connects all cliques with each other. In this network, 72 per cent of the actors are in either one, two, or three of the five different cliques. Not having a central actor that connects all cliques implies less clique overlap, which is also confirmed by the lowest level of clique integration following the hierarchical clustering procedure. However, as only 28 per cent of actors are in no clique at all and cliques are on average larger, we are able to say that actors are more directly connected to each other than in CareLab where interaction concentrates towards a well-connected core group.

Actor Importance

Then, concerning actor importance, especially the CareLab and Radicalisation cases have actors who are regarded to be very important to the process by the vast majority of the collaborative arrangement. The most important actor in these cases are coordinators and are a member of all cliques in the 'interaction outside meeting' network, indicating that the most important actor in the network is well integrated with the cliques in these 'interactions outside meetings' networks. However, the other most important actors in the CareLab network, not being coordinators, are less well integrated into the network. These important actors are in only one or even none of the cliques. The important actors in the Radicalisation case are in that respect better integrated into the network as they are all a member of multiple cliques. Interestingly, actors in the Invasive Species case tend to qualify other actors in the network less frequently as being very important to the process. The most important actor is only named 'very important' by half of the other actors. Also, the most important actors, in this case, are poorly integrated into cliques. Especially less important actors are well integrated into the clique structure of the network.

Following from these findings we can conclude that the CareLab network has the lowest level of integration on the whole network level with a core group of actors that interact with each other, while other actors, including some of the most important ones, are in the periphery of the network and hardly share information with each other outside meetings. The cliques overlap to a high extent, but only a few actors are present in these cliques, making the actors who are a member of a clique well connected with each other, but poorly with the rest of the (sometimes highly important regarded) actors. This points to a very important regarded 'in-group' that mainly shares information with each other, while the other less important actors hardly interact with each other.

Clique overlap is lower in the Invasive Species network, but as more actors are present in at least one clique, the integration of the whole network of Invasive Species is higher. Also, important actors are more dispersed throughout the network; none of the important actors are present in all cliques, which means that the important actors have a less prominent role in this network.

The Radicalisation network shows a high level of integration as a majority of actors are included in a clique and this network has a high level of clique overlap. Because a vast majority of actors are a member of a clique and cliques overlap to a high extent, the whole network is tightly connected. Especially the most important actors are well integrated in the network having a membership of multiple cliques, which means that important actors are at the core of the network, yet they are better connected to the others in the network unlike what we see in the CareLab network.

Interaction Network 2: Interaction During Meetings

The 'interaction during meetings' networks shows more extreme results between the different cases. As presented in Table 11.2, the unsuccessful

CareLab case has a very low overall density, meaning that actors are to a low extent connected to each other. Especially actors in the Invasive Species case tend to elaborate on each other's ideas as almost half of the actors are directly connected to each other.

Clique Overlap

Especially the actors in the Invasive Species network are highly integrated as everyone is part of at least one clique in the network, meaning that every respondent is part of a group of a minimum of three actors who frequently elaborate upon each other's ideas. We must stress, however, that the two non-respondents, in this case, were not taken into account.[3]

Whereas in the Invasive Species network, every actor is a member of at least one of the five different cliques making this a well-integrated network, the other networks contain fewer cliques and only a small percentage of the actors are members of at least one clique. In the Radicalisation network, only three actors form a clique together, and in the CareLab network just four actors.

This means that in both a successful and an unsuccessful case only a small core group of actors elaborated upon each other's ideas. The Invasive Species network consists of substantially larger cliques than the other networks with an average size of 4.6 compared to the minimum amount of three actors in the other cases, indicating strong integration of actors in this network. The high average clique centrality indicates that actors are on average a member of 2.54 cliques, which is considerably higher than in the other cases.

The individual clique centrality shows that, again, no actor in the Invasive Species case is a member of all five cliques. However, multiple actors have an individual clique centrality of four, indicating membership of four cliques and a strong level of clique overlap. In CareLab, a larger amount of clique overlap is present, as the results of the hierarchical clustering procedure show, but as only four actors are a member of a clique this only implies a strong core group of four actors, but poor integration on the whole network level. As the Radicalisation network only consists of one clique, obviously no clique overlap occurs in that network. Thus, the Invasive Species case has the strongest integrated network in which all actors actively elaborate upon each other's ideas. Everyone's idea is built upon by at least two other actors given that every actor is a member of a clique.

Actor Importance

Concerning actor importance, we found in the CareLab network that the members of a clique are among the most important actors of the network. Still,

Table 11.2 Network integration 'interaction during meetings' network

	CareLab	Invasive Spcies	Radicalisation
Network density	0.085	0.455	0.156
No. of cliques in network	2	5	1
Average clique size	3	4.6	3
Clique density	0.13	1	0.33
Average clique centrality	0.33	2.56	0.33
Individual clique centralities	0 to 2	1 to 4	0 to 1
Complete integration of cliques at level: (hierarchical clustering of cliques)	2	4	Not applicable, as only one clique is observed in this network
Top important actors (with individual clique centrality)	Local coordinator 1: 93% (clique centrality: 2) Parent 1: 67% (0) Private actor 5: 60% (2) Federal coordinator: 60% (1)	Public actor 2 Flemish: 38% (1) Public actor 2 Walloon: 25% (1) Public actor 1 Brussels: 25% (1)	Federal actor 4 (coordinator) 78% (1) Federal actor 1.67% (0) Federal actor 2.67% (0)

some actors who are regarded as being very important to the process are not included in any clique.

The most important actors in the Invasive Species case are only to some extent a member of a clique. They are only part of one clique, while less important actors are a member of up to four different cliques. We argue that the most important actors are to some extent well integrated in the network, but the network is centralised towards less important actors. In other words, the most important actors do not function as brokers in this network. However, as clique density is high, they are tightly connected to most other actors in the network through clique overlap.

In the successful Radicalisation network, only one clique is observed. The most important actor is present in this clique, however, as no other cliques are present in this network the overall integration of the network is poor. Especially a group of three actors elaborated upon each other's ideas, while only one of these actors was frequently named as very important to the process.

Following these results we see that the Invasive Species case has more or less the same network structure and clique formation in both networks, whereas a clear difference between the networks in the CareLab and Radicalisation cases is observable in terms of clique formation and inclusion of the most important actors. The clique overlap in these latter two cases depends on the type of network, while this is to a lesser extent observable in the Invasive Species case.

DISCUSSION

The goal of this study was to examine how innovative outcomes of collaborative public sector innovation projects can be explained by the network integration of its most important actors. Following from the work on clique overlap and information ties (e.g., Hu et al., 2022; Provan and Sebastian, 1998), collaborative innovation (e.g., Ansell and Torfing, 2014:11) and actor importance (e.g., Cristofoli et al., 2021; Stevens, 2018) we hypothesised that cases with successful innovative outcomes are characterised by a high degree of clique overlap in terms of the most important actors being included in multiple cliques, both during and outside meetings.

We can only confirm our hypothesis for the 'interaction outside meetings' network. Our findings are in line with the argument that clique overlap is related to positive network outcomes. We found that the cases with higher innovative outcomes have a higher integrated network concerning sharing information outside meetings (Cristofoli & Markovic, 2016; Raab et al., 2015). Being a member of multiple cliques in the successful Radicalisation case indicates that the most important actors are in close contact with less important actors and thus act as brokers that connect the different actors with each other. In contract, the few actors in cliques of the less successful CareLab case are among the most important actors, which points to a very important regarded 'in-group' that mainly shares information with each other, while the other less important actors hardly interact with each other. The Invasive Species case shows a high amount of clique density and overlap, however, in this case, the most important actors are less well integrated as they are in fewer cliques.

We expected the same type of integration to be present in the 'interaction during meetings' networks. We expected successful cases to have a higher level of clique density, higher clique centrality of the most important actors, and clique overlap. This is confirmed to some extent as the relatively successful Invasive Species case has a higher level of clique density and more actors are a member of a clique than the CareLab network. However, the successful Radicalisation case follows the pattern of the less successful CareLab case in the 'interaction inside meetings' network: limited cliques, with little involvement of most actors, including the most important ones. We therefore cannot fully confirm our hypothesis for the 'interaction during meetings' network.

CONCLUSION

With this study, we wanted to answer how innovative outcomes of collaborative public sector innovation projects can be explained by the network integration of its most important actors.

Unlike what theory suggests, we have to conclude that successful innovative outcomes are only to some extent explained by the way the most important actors are integrated through clique overlap and depend on the type of network. A well-integrated network (with important actors connected through clique overlap) is not necessarily always a crucial driver for the development of collaborative innovation as the successful Radicalisation case shows poor network integration during meetings. In that sense, the findings refine the argument that information flow is crucial to the development of innovative outcomes (Koliba et al., 2017), as the findings show that a well-connected network is not necessarily always needed. This may indicate that successful cases spend less time on deep discussions and idea generation during broad general meetings and actors in successful cases are more inclined to connect with each other outside meetings to work out details with the relevant actors without the inclusion of non-essential actors. Still, the results also indicate that a certain amount of dispersion of important actors throughout the network seems needed (see also Yi, 2018) as we find that the less successful CareLab case is characterised by an important in-group that does not connect with other actors in the network.

This study builds upon the milestone study concerning clique overlap as the most effective way for information flow in collaborative arrangements (Provan & Sebastian, 1998). Moreover, it was the first to examine clique overlap in combination with the position of the most important actors in the network and to make the distinction between interaction inside and outside meetings. Furthermore, this study is one of the first to examine clique overlap in relation to (digital) public sector innovation. To date, the role of the integration of the most important actors in the networks was only studied to a limited extent, while research suggests that, on the one hand, the network position of certain main actors (such as the coordinators) leads to more effective outcomes (Cristofoli et al., 2021; Raab et al., 2015) and, on the other hand, that actor importance is associated with innovative outcomes (Stevens, 2018). No study had examined the combination of clique overlap as a way of network integration in combination with actor importance. Moreover, usually, no distinction between the complementary networks concerning information sharing inside official meetings and outside official meetings is made.

Our findings suggest that collaborative innovation networks do not necessarily always have to be well integrated through clique overlap both inside and outside official meetings when developing an innovation. The findings are therefore a refinement to the classic studies (e.g., Provan & Sebastian, 1998) that argue that clique overlap is an important driver for positive network outcomes. Clique overlap seems to be of lesser importance for building upon each other's ideas inside meetings and important actors do not necessarily have to engage in interactions in order to achieve successful innovative outcomes.

We do have to acknowledge that the nature of the cases was different. The successful Radicalisation case was working towards a clear end goal, and thus formal meetings were less characterised by idea generation and building upon each other's ideas. Instead, actors interacted with each other outside formal meetings for the arrangement of more practical resources and 'to get things done', which might point to a strong commitment towards innovation and formal meetings were not necessary to let actors interact with each other. In other words, there was no real need to build upon each other's ideas as the end goal and the way to reach it was more or less known already.

In contrast, CareLab was very much in the idea generation phase, so interaction within meetings was necessary to create a process of synergy that enabled the collaborative arrangement to formulate innovative ideas. However, no proper ideas that included all perspectives and that could count on actual support were developed due to poor network integration. Interaction mainly focused on an important 'in-group' and other actors did not interact with each other, thus reducing the process of collective idea generation. For that reason, the phase of the innovation process might explain why poor integration of the network led to a lack of innovative outcomes in CareLab, while this was not an issue in the Radicalisation case. The Invasive Species case shows in that respect a mixture between the two projects. This case was also largely implementation-oriented, however, as some ideas still needed to be decided upon, building upon each other's ideas in formal meetings was still very much necessary. This might be a reason why actors, in this case, are tightly connected both inside and outside meetings, but that lack of active involvement of the most important actors explains why this case does not have the highest innovative outcomes. Practitioners or coordinators of innovation projects should therefore be aware of the phase of the innovation project. They have to determine to what extent integration through clique overlap is needed and when, during or outside meetings, the most important actors should interact more with each other and/or the other actors.

Besides the difference in cases, this study has some other limitations. The data stem from one survey in which respondents were asked to evaluate their own projects. Hence, their opinion on the innovative outcomes might be biased by their experiences in the project. Moreover, it is hard to determine whether importance leads to better integration, or if better integration has led to higher importance. Tsai (2001) and Zhao (2022) argue that central actors are more likely to access useful knowledge from others. Hence, better-integrated actors might be considered more important. In contrast, the resource dependency theory (Hillman et al., 2009) argues that the resources of an actor determine its importance. This study did not examine why certain actors are regarded as being more important, so this is an interesting topic for future research.

Future research should also examine what the ideal network structure is for different types (idea generation-oriented or implementation-oriented) of innovation processes and to what extent our findings are generalisable to other innovation projects. Moreover, the findings indicate that collaborative arrangements aimed at innovation should be aware of the interconnectedness of all actors in the network through clique formation in such a way that important actors are well connected with the others; especially outside official meetings. This study did not examine why actors are more likely to interact with others and thus why certain cliques are formed. Future research should examine what drives interactions in the networks in order to determine how clique formation can be achieved.

NOTES

1. Data were collected in the period March 2017–June 2018.
2. The four items were: (1) No innovative ideas are developed [in this process] … Many innovative ideas are developed [in this project]; (2) The innovative character of [the process] is lower than my initial expectations … The innovative character of the [the process] exceeds my initial expectations; (3) The innovative ideas that are developed in [project name] are not feasible at all … The innovative ideas that are developed in [project name] are very feasible; and (4) The [solutions that have been developed] do not deal with the problems at hand at all … The [solutions that have been developed] truly deal with the problems at hand.
3. Due to a different way of measurement, no network data of non-respondents were available, hence non-respondents in all three cases were excluded from the analysis of the ‘elaboration upon other’s ideas’ network.

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