Building resilience through collective learning in project-oriented organizations in infrastructure planning

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Abstract: The performance of existing main transport infrastructure networks in The Netherlands is currently being challenged by for example climate change, new mobility technologies, ageing infrastructure and energy transition. These challenges call for an adaptive approach towards existing and new infrastructure. One way is to make physical infrastructure itself more resilient, another way is to create organizational resilience. Literature describes learning as a key element in organizational resilience. Most infrastructure network agencies are organized in a project-oriented way and consist of multiple projects and a parent organization. However, how do projects learn from each other and how does the whole organization learn from projects? This paper aims to enhance the understanding of collective learning and resilience of project-oriented organizations within the domain of infrastructure planning at three distinctive levels: within a single project, between multiple projects, and between projects and their parent organization. Findings are based on an in-depth case study at Rijkswaterstaat - the executive agency of the Ministry of Infrastructure and Water Management in The Netherlands. The study uses Social Network Analysis to analyse the observed network. Based on this study, it seems that collective learning in project-oriented organizations still remains limited despite the urgency of it.

Keywords: organizational resilience; collective learning; project-oriented organization; infrastructure planning

1. Introduction

The performance of existing main transport infrastructure networks in The Netherlands is currently being challenged by for example climate change, new mobility technologies, ageing infrastructure and energy transition. Infrastructure network agencies need to build resilience to be able to adapt to these continuously changing circumstances. These agencies fulfil societal functions through a combination of social and technical aspects and therefore can be considered to be socio-technical systems (Geels, 2004). By focussing on technical aspects, an infrastructure network agency can make the physical infrastructure itself more resilient. However, it is also important for infrastructure network agencies to act resiliently as an organization (Brown *et al.*, 2017).

In order to efficiently build, change and improve infrastructure facilities, infrastructure network agencies often manage by projects (Gareis, 1991). They organize themselves as project-oriented organizations (Gemünden *et al.*, 2018). Project-oriented organizations consist of multiple project organizations – projects – and a parent organization. Organizational resilience has been subject of

research in various types of organizations. However, previous studies have dealt little with project-oriented organizations. It is still largely unknown how the resilience of projects and their parent organization relate to each other. Research on this relationship is relevant because parent organizations expect projects to contribute to the organization's goals. If there is need for a project-oriented organization as a whole to adapt to changes in the environment, projects should support this change in interaction with their parent organization. However, projects are initiated to realize specific goals within a fixed budget and a fixed amount of time. These limitations may put constraints on the absorptive and adaptive capacity of projects and consequently on the project-oriented organization.

People in organizations interact with each other and create social networks that can cover projects and their parent organization. Barasa *et al*. (2018) and Lee *et al*. (2013) argue that information and knowledge, that flows through these networks, contributes to the resilience of organizations. In addition, de Kraker (2017, p. 101) states that "in resilience thinking, learning is given a central role in the adaptive cycle". Despite these insights into information, knowledge and the relevance of networks that facilitate knowledge sharing and knowledge creation in organizations, little is known about how collective learning contributes to organizational resilience. How do projects learn from each other and how does the organization as a whole learn from projects? This paper intends to enhance the understanding of how collective learning takes place in project-oriented organizations in the domain of infrastructure planning at three distinctive levels: within a single project, between multiple projects, and between projects and their parent organization. The findings are based on an in-depth case study at Rijkswaterstaat – the executive agency of the Ministry of Infrastructure and Water Management in The Netherlands. Rijkswaterstaat is a major project-oriented infrastructure network agency that is faced with challenges, the need to become more resilient, and enhancing collective learning. Social Network Analysis is used as a method to analyse the observed network. Based on this study, it seems that collective learning in project-oriented organizations still remains limited despite the urgency of it.

2. Background

2.1. Organizational resilience

Organizational resilience can be defined as "a system's ability to continue to perform and meet its objectives in the face of challenges" (Barasa *et al.*, 2018, p. 496). Some researchers would define resilience as a process our an outcome, but increasingly authors, such as (Barasa *et al.*, 2018), define resilience as an ability or a property. This retains to the definition of resilience by Holling (1973, p. 17): "In this definition resilience is the property of the system and persistence or probability of extinction is the result." In this research, resilience is viewed as an ability or property of a project-oriented organization.

Various authors distinguish two perspectives regarding organizational resilience (Lee *et al.*, 2013; Lengnick-Hall *et al.*, 2011): first, *absorptive capacity* of an organization that insures an organization to bounce back to business as usual in the case of unwanted events; second, *adaptive capacity* of an organization that enables an organization to respond to emergent situations and thrive amidst changes in the environment. Absorptive capacities are linked with short-term interventions and adaptive capacities are linked with longer-term interventions (Berman *et al.*, 2012). It is a combination of absorbing the challenges faced, and adapting and transforming so as to continue to thrive in the face of challenges that makes it possible to achieve organizational resilience (Burnard & Bhamra, 2011).

Research in the past twenty years has brought much insight into organizational resilience. Two studies that summarize the essentials of organizational resilience are especially worth noticing. First, Barasa *et al.* (2018) identified factors that influence the resilience of organizations, like leadership practices, information management, and preparedness and planning. Second, Lee *et al.* (2013) have made an explicit distinction between indicators for *planning capacity* – which we call absorptive capacity – and *adaptive capacity* – as shown in Table 1.

Indicators for absorptive capacity	Indicators for adaptive capacity
Planning strategies	Minimization of silos
Participation in exercises	Internal resources
Proactive posture	Staff engagement and involvement
External resources	Information and knowledge
Recovery priorities	Leadership
	Innovation and creativity
	Decision making
	Situation monitoring and reporting

Table 1 Indicators for absorptive and adaptive capacity (Lee et al., 2013)

2.2. Project-oriented organizations in infrastructure planning

In order to efficiently build, change and improve infrastructure facilities, infrastructure network agencies often manage by projects (Gareis, 1991). Infrastructure network agencies often organize themselves as project-oriented organizations (Gemünden *et al.*, 2018). They have a responsibility to provide and maintain adequate infrastructure facilities. As such, they use projects to realize necessary changes in the existing infrastructure facilities. Therefore, realizing projects is not the main activity in a project-oriented organization, but it is a way to fulfil responsibilities.

Projects operate within set conditions to deliver a predefined result. This causes projects to operate relatively autonomous from the parent organization. While an efficient management of resources calls for structure, "adaptive responses resist the pull to order and capitalize on the collective intelligence of groups and networks" (Uhl-Bien & Arena, 2017, p. 10). Furthermore, Weichhart and Stary (2017) argue that for the evolution and improvement of the organization it would be beneficial to learn across multiple projects. Learning across projects and organizational levels enables organizations to deal with challenges more appropriately by increasing the diversity of response options (Folke *et al.*, 2005). Projects and their parent organization are part of a network, through which knowledge flows and learning can take place.

2.3. Collective learning

Learning is described as a key type of adaptation (Armitage *et al.*, 2011) and is therefore a key element when it comes to building organizational resilience. Organizations need to learn as fast as the environment changes in order to survive. They can learn by both formal and informal learning practices. According to Marsick and Watkins (2001, p. 25), "formal learning is typically institutionally sponsored, classroom-based, and highly structured", whereas control of informal learning primarily rests in the hands of the learner and may occur anywhere and at any time in institutions. The interesting thing about informal learning is that it can be deliberately encouraged, but it can also take place even if an organization takes no deliberate action to encourage learning (Marsick & Watkins, 2001). This means that informal learning can take place under any circumstance. What makes collective learning interesting in the context of our study is the fact that it is concerned with learning as an accumulation of individuals rather than learning by a single individual. Backström (2004, p. 471)

defines collective learning as "… rather enduring changes in a collective as a result of interaction between the collective and its context. In simpler terms, it is the ability of the collective to learn from experiences drawn by members of the collective while working." This can take place in both formal and informal ways.

The predominant resource regarding learning is knowledge. Knowledge differs from data and information. Although there are various definitions of these concepts, we interpret *data* as symbols that represent properties of objects or events, *information* as data that is processed to make it useful (know-what), and *knowledge* as what is needed for the application of information and data (know-how) (Rowley, 2007). In general, there is a distinction made between tacit and explicit knowledge. Tacit knowledge is based on personal experience and embedded in individuals, whereas explicit knowledge is articulated in formal language, stored in documents, databases, et cetera. In literature, four modes of knowledge conversion are distinguished (Nonaka, 1994): *socialization*, from tacit to tacit knowledge through interaction between individuals or shared experience, *combination*, from explicit to explicit knowledge through the sorting, adding, recategorizing and recontextualizing of explicit knowledge, *externalization*, from tacit to explicit knowledge through articulating into metaphors, analogies, models, hypotheses and theories, and *internalization*, from explicit to tacit knowledge through action, practice and reflection. Collective learning in project-oriented organizations might predominantly involve combination, because people from various projects and departments directly interact to transfer knowledge between each other. However, knowledge can also be transferred between individuals through documents. Knowledge is then externalized by one individual and subsequently internalized by another individual. The possibility to interact is gone and a part of the richness of the knowledge is lost, but this is still a useful way to transfer knowledge from one project to another across time and space.

3. Methods

3.1. Multiple-case study

One of the major infrastructure network agencies in The Netherlands is Rijkswaterstaat – the executive agency of the Ministry of Infrastructure and Water Management. Rijkswaterstaat initiates projects in order to fulfil its responsibility for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands, including the main road network, waterway network and water systems (Rijkswaterstaat, 2018). Changes in the external environment put challenging demands on Rijkswaterstaat as an organization and on its infrastructure facilities. For this reason, Rijkswaterstaat was selected for an in-depth case study. To collect data on collective learning within a single project, between multiple projects and between projects and their parent organization, a multiple-case study has been conducted within Rijkswaterstaat.

A set of criteria was established to select relevant cases. The cases should support the possibility to draw general conclusions so homogeneity is necessary. The selection criteria were type of contract (DBFM: Design, Build, Finance, Maintain), challenging environment, project phase (realization), type of infrastructure (highways), and realization in different periods in time.

In selecting the cases, first, the cases should support the possibility to draw general conclusions so homogeneity is necessary. Second, the selection criteria included: type of contract (DBFM: Design, Build, Finance, Maintain), challenging environment, project phase (realization), type of infrastructure

(highways), and realization in different periods in time. For collective learning in relation to organizational resilience, cases that contain an above average amount of uncertainty, surprises and changes are particularly interesting. DBFM, as a type of contract, was selected because this is a relatively new and complicated type of contract, introducing uncertainty for both client and contractor with respect to their collaboration and changes in responsibilities from what they were used to. Next, cases were selected based on a challenging environment, with many stakeholders close by. The realization phase was selected, because of the large amount of different activities and time pressure.

In relation to multiple case studies, Eisenhardt (1989) recommends to four to ten cases. Projects with DBFM contracts in challenging environments are numerous in The Netherlands, especially regarding highways. In this study, six cases were selected clustered in two metropolitan regions: Amsterdam and Rotterdam. Infrastructure projects in these regions are challenging and appeal to the resilience of organizations that realize these projects. With a relatively new type of contract and complex context, one would expect projects to learn from other projects that are realized at the same time or earlier. To be able to analyse whether this happened or not, the realization phase of the selected cases started in the period between 2010 and 2018 with an interval of one to two years.

Since collective learning involves people interacting with each other, in-depth semi-structured interviews (Mann, 2016) are considered an appropriate way to study this phenomenon. The key questions for the interviews focused on learning and interaction. The indicators of Table 1 were used in the analysis of the interviews to identify which ones seemed to be relevant for learning. In order to strengthen construct validity and to corroborate findings based on the interviews, also documents were analysed (Yin, 2003), such as the project management plans, which describes the way a project is organized and carried out, and reports of peer consultancy or evaluation trajectories.

3.2. Social Network Analysis (SNA)

Considering the importance of social networks to collective learning (see Section 2.3), subsequently a Social Network Analysis (SNA) has been carried out to understand more about learning through a network. Scott (2017, p. 2) states that SNA "comprises a broad approach to sociological analysis and a set of methodological techniques that aim to describe and explore patterns apparent in the social relationships that individuals and groups form with each other". A social network consists of *nodes*, representing actors such as individuals, departments, and projects, and *ties* (Robins, 2015), which are relationships between the nodes that represent the flow of knowledge or other resources, either material or nonmaterial (Wasserman & Faust, 1994).

This research concerns collective learning in a social network as a whole. Therefore, a whole network view (Scott, 2017) is adopted. There are two ways to set the boundaries of a network: the normalist and realist approach (Pryke, 2012). In the *normalist approach*, the researcher defines the boundaries beforehand, whereas in the realist approach, the actors in the network define the boundaries themselves. The *realist approach* begins with some relevant actors. By asking these actors with whom they link up, the network starts to unfold. This way of letting the network unfold is also called snowball sampling (Robins, 2015). This research used the realist approach as: it is impossible to determine beforehand who interacts with whom; by setting the boundaries beforehand, possible relevant actors might be excluded from the research; besides the departments in the functional organization, there might be other hallways (Dixon, 1999), or events (Robins, 2015), where actors form a link between projects and the parent organization. Since this qualitative research seeks to understand how processes of collective learning unfold, snowball sampling is considered an adequate

approach. Snowball sampling began in the projects by interviewing two key actors for each project: the project manager and the stakeholder manager. Together, they have an overview of most of the relationships within a project and between a project and its environment. In the next phase of our research, we will expand to other parts of Rijkswaterstaat based on the references that were made by the participants.

In SNA, various centrality measures are relevant, particularly to collective learning. First, *degree centrality*, which is about the popularity or activity of a node (Robins, 2015). Directed networks, like in this research, comprise in- and out-degree centralities. *In-degree centrality* is the number of ties directed towards a node and, therefore, indicates the popularity of a node. *Out-degree centrality* is the number of ties directed away from the node and, therefore, indicates the activity of a node. In- and out-degree centrality indicate the available channels for knowledge flow to and from nodes. Second, *betweenness centrality*, which is a measure of the importance of a node in connecting other nodes through short paths (Robins, 2015). Nodes with a high betweenness centrality serve as bridges between parts of the network. Last, *eigenvector centrality*, which indicates the centrality of a node's network partners. Nodes with high eigenvector may have low degree centrality or betweenness centrality, but have relatively easy access to much knowledge, because they are connected to well-connected nodes. The data was processed with Gephi (Gephi, 2019).

4. Results

4.1. Network visualization

Figure 1 provides the main results of our study. The nodes in this visualization represent the projects from the multiple-case study (navy blue nodes with a capital letter A to F), the projects that were mentioned by participants (lavender nodes with small letters), the departments that were mentioned by participants (light blue nodes with a capital D and a number), other relevant platforms like communities of practice (yellow nodes with a capital O and a number), and relevant entities external to Rijkswaterstaat (green nodes with a capital E and a number). The size of the nodes represents the degree centrality of that node.

The arrows, or *edges* as called in SNA, in this visualization represent knowledge transfer. The direction of the edges shows in which direction knowledge was transferred. The weight (thickness) of the edges represents the strength of the relationship between a pair of nodes based on how many participants mentioned this relationship for each type of knowledge conversion. The colour of the edge represents the type of knowledge conversion:

- combination (green edges);
- externalization (orange edges);
- internalization (blue edges);
- individuals moving and taking their own knowledge from one project to another (black edges).

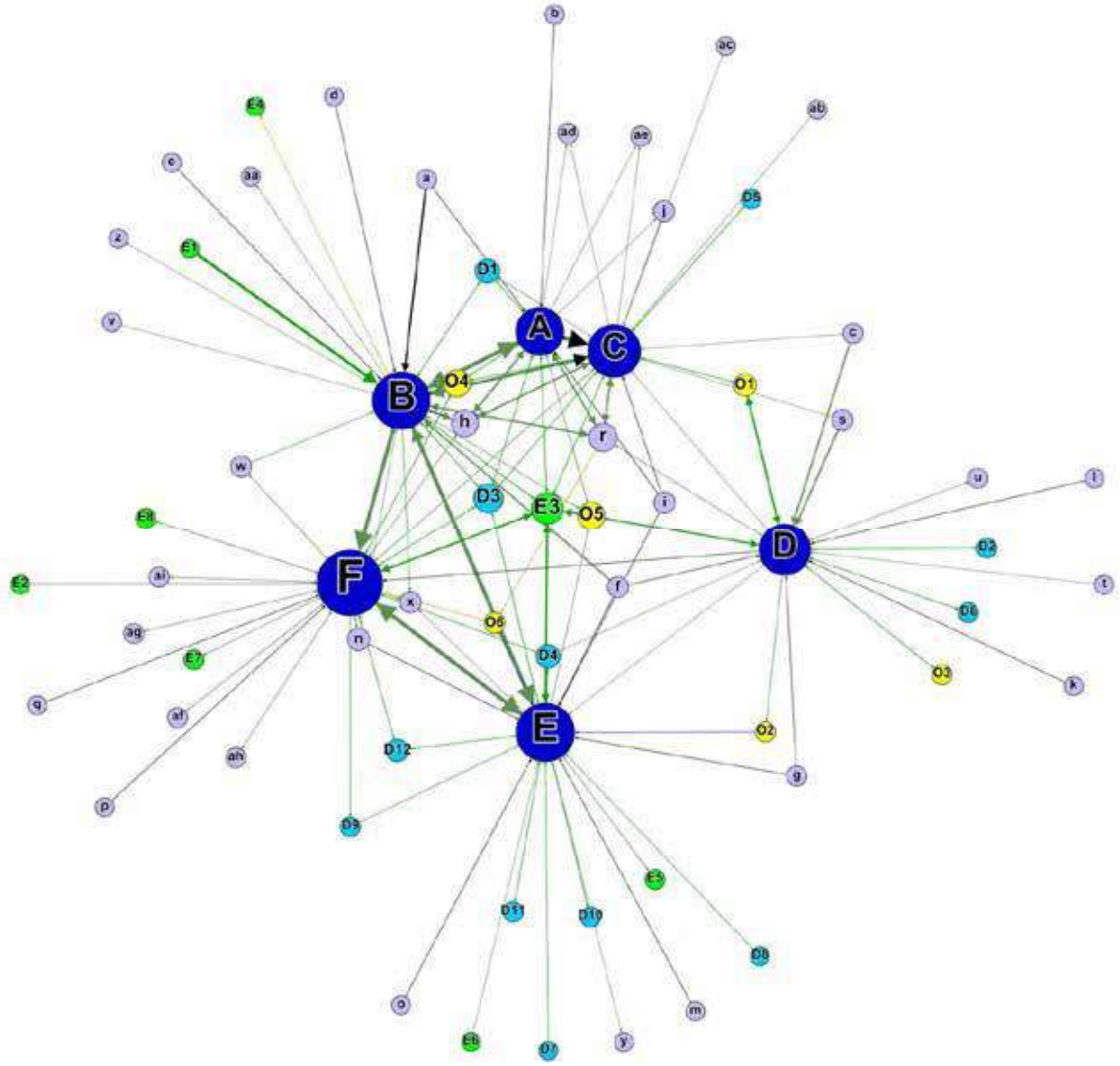

Figure 1 *Network visualization of interactions in the cases studied*

4.2. Learning within a single project

As Figure 1 shows, projects have their own collection of past projects (see the lavender coloured nodes with small letters) from which project members bring their knowledge and experience. When they are brought together in a new team to realize a new project, project members use their own knowledge and experience to give meaning to events. Changes or unexpected events and their effects on individual project members were often considered deliberately to collectively make sense of what was happening and how to proceed with the project. Participants indicated that it was important to do so to prevent miscommunication and to be able to proceed as a team.

The project management teams generally consisted of five members who represented various specialisms in a project: project manager, stakeholder manager, technical manager, contract manager, and manager project control (Rijkswaterstaat, 2019). They met each other regularly and discussed issues that they could not solve within their own specialism. Other than that, most of the interaction between project members took place within the boundaries of their own specialism. Although

participants indicated that this worked well for them, some participants indicated that problems arose at a later stage because their specialism was not considered at an earlier stage. A stakeholder manager interviewed said: *"Driving piles during the night is no cause for concern for a technical manager, as long as it happens safely and in accordance with rules and regulations. It becomes an issue once we have to inform the neighbourhood. For them it obviously is a problem."*

Interviewees suggested that as a project proceeds, uncertainty reduces. They indicated that the frequency of interaction and knowledge transfer decreased during the realization of a project. There were less issues that needed to be solved, which allowed for less interaction. However, interviewees indicated that they were sometimes surprised by issues resulting from project members not being as well informed as others assumed. Furthermore, participants addressed knowledge loss due to project members leaving without transferring their knowledge to a successor as an issue. In contrast, knowledge transfer to future successors, i.e. apprentices, through socialization was mentioned by a few interviewees.

4.3. Learning between multiple projects

Like the frequency of interaction within a single project changes over time, also the interaction between multiple projects changes over time. The realization phase starts with preparing a contract and finding a contractor that realizes the physical infrastructure. Participants indicated that much knowledge was transferred from other projects during this phase. Projects want to learn how contracts from other projects worked out and they want to prevent themselves from making the same mistakes as other projects. Once this has been taken care of and the contractor has started, a project seems to go to a primarily internal focus. Often, many issues arise and project members need all of their time and attention to solve these issues. As the end of the realization phase approaches and issues are solved, projects start to open up and become willing to share their knowledge and experiences more proactively.

Nevertheless, participants indicated that they did also transfer knowledge during busy periods. Urgency seems to be dominant for engaging in knowledge exchange with other projects or experts. Participants mentioned three aspects that made knowledge exchange urgent:

1. infrastructure interfaces (e.g. projects having a physical interface due to parts of the infrastructure network directly connecting to each other, and projects having to align project activities in order to minimize effects on infrastructure availability on a regional level);
2. connections with the same stakeholders (e.g. clients, local governments, authorities, companies, and citizens);
3. similar issues (e.g. the same type of contract, the same project phase, the same period in time, and a similar project environment).

The aforementioned urgency aspects are recognizable in the network visualization. Projects A, B, and C were realized in the same region (Amsterdam), shared many stakeholders and had to deal with similar issues. Furthermore, these project teams were located in the same building. This physical proximity urged, and was beneficial to, knowledge transfer between the projects according to the participants. These aspects also hold true for projects E and F, although these projects were realized in another region (Rotterdam) than projects A, B, and C. Project D was realized also in the Rotterdam region like projects E and F, but was realized a few years earlier.

Projects A, B, and C were realized in a programme structure. This might explain why these nodes are closer to each other than the other nodes in the network visualization. Participants mentioned frequent knowledge transfer and learning activities between these projects. Apart from sharing documents and having frequent meetings, project members also switched between these projects. The programme board actively encouraged learning activities and tried to keep project members within the programme in order to retain a high knowledge level.

The interviewees indicated that project members engage in different networks depending on their specialism. These networks are predominantly communities of practice and functional networks in the parent organization. In projects, various specialisms interact, but the interaction between projects primarily takes place within a certain specialism. Furthermore, knowledge transfer is primarily initiated based on questions that need to be answered or problems that need to be solved. For all projects in this study, the weighted in-degree was higher than the weighted out-degree. This implies more knowledge transfer from another project than knowledge transfer to another project.

Participants mentioned the importance of considering the specific characteristics of each project, especially when experiences are externalized, e.g. in best practices and evaluation reports. When experiences are conversed through socialization or combination, it is possible to interact and, for example, talk about differences in project characteristics that may cause certain measures to be less effective or even counterproductive. Another way to transfer knowledge from one project to another and ensure that it is applied in a way that fits with the specific characteristics of a project is to move individuals with their knowledge from one project to another. This happens often as participants indicated. However, this can become problematic for individuals, especially when they have to serve multiple projects. An interviewee (stakeholder manager) said: *"... when the problem is big enough, they create facilities that allow me to get involved in the three biggest projects in my region, although this is somewhat difficult for me, because I have to continuously switch between the projects and also between the various roles that I have."* This interviewee adds to this that the knowledge remains personal knowledge. In other words, collective learning is absent: *"So, they do create facilities, but there is a lot to gain when it comes to how you actually transfer knowledge to people who are the future of our organization."*

4.4. Learning between projects and their parent organization

The network visualization in Figure 1 shows that learning platforms, such as communities of practice, are more centrally positioned than departments. Participants mention the relevance of these learning platforms for their work in projects. For example, node O5 represents a learning platform for stakeholder managers within Rijkswaterstaat. People from all over the country meet each other monthly to discuss issues in their field. This also lowers the threshold to interact with colleagues in the same field elsewhere in the parent organization at other times. In contrast, nodes O3 and O4, which represent similar learning platforms for project managers, are separated from each other based on organizational departments. Strikingly, the most central learning platform (node E3) is an external learning platform, namely Neerlands Diep. Nearly all participants mentioned this specific learning platform and its importance for learning within their project and between their project and other projects. This node also ranks highest for betweenness centrality, weighted degree centrality, and eigenvector centrality, behind the nodes that represent the investigated projects. This supports the interviewees' perceived importance of this external learning platform to learning between projects.

Interviewees mentioned a lack of interaction with the parent organization. Half of the participants mentioned that there was little or no knowledge transfer to departments at all. Some participants felt no need to interact with their department, because of the physical proximity of colleagues from other project teams who have a similar specialism. Others experienced a distance to their departments, rather physical, psychological or social, which prevented them from transferring knowledge. When knowledge is transferred, it is important for the richness of the transferred knowledge that project members experience social safety and trust. This holds true especially when people have to show their vulnerability as they tell others which mistakes they have made. As an interviewee said: *"To share that knowledge is very difficult, because it gets close to you as an individual. ... you actually do that once you have a lot of trust in each other."*

Interviewees mentioned that a programme functions as buffer. Relatively small changes, both positive and negative, are absorbed at programme level. However beneficial this might be for the projects within such a programme structure, a programme structure was also considered to be disadvantageous for learning between projects and the parent organization. Interviewees experienced isolation from their parent organization. For example, an interviewee mentioned managers in the parent organization explicitly stating that the programme stood apart from the parent organization, as if those projects were not realized by Rijkswaterstaat, and experiencing a form of competition between the programme board and management from the parent organization.

5. Discussion

5.1. Collective learning in project-oriented organizations

The *network structure* resulting from this study (Figure 1) can be considered as decentralized. There are many ties, often weak, which allow for knowledge transfer from various directions and varying in content. This network structure makes sense for project-oriented organizations, because projects come across many and varying issues. To solve these issues, they depend on knowledge from outside the project. However, as Hansen (1999) argues, the transfer of complex knowledge through these weak ties may be problematic. This is why in practice people engage in combination, for example by intensifying interaction through frequent phone calls or face-to-face meetings. Furthermore, this retains to the social safety and trust that people need to feel when they engage in the transfer of complex knowledge.

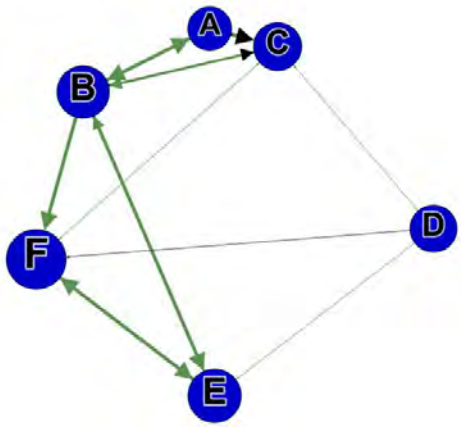

Figure 2 Network between projects

In Figure 2, the network between the projects in the case study is retrieved from the entire network and has a more distributed structure. A distributed network is beneficial to sharing tacit knowledge in an environment where people need to experience trust and safety (Smedlund, 2008). Not only the network structure, but also the weight of the ties shows generally strong connections between projects.

Figure 1 shows that each project has its own *satellites*. These satellites are knowledge sources. Some ties with satellites represent individuals moving from one project to another and, thus, the displacement of knowledge. Other ties with satellites represent the transfer of knowledge, mainly through combination. The knowledge from these satellites and the various specialisms within a project result in a multiplicity of perspectives. Dixon (1999) argues that the occurrence of multiple perspectives is one of the critical elements that fosters collective learning. Differences in knowledge enable learning. Therefore, projects need satellites, various specialisms and a decentralized network to reach and exploit as much knowledge as necessary to maximize response options in case of changes or unexpected events.

When we examine the relationships in Figure 1 more closely, we can see that many relationships are "homophilous", which means that people have relationships with people who are socially similar or physically close (Rogers, 2003). This makes sense, because social similarity makes it easy for individuals to understand each other and physical proximity makes these relationships less time consuming. Furthermore, it is easier to assess if someone similar to you is able to help with an issue than someone you do not know. The research of Borgatti and Cross (2003) shows that it is important to know what another individual knows and to have access to that knowledge. It is a challenge for project-oriented organizations to stimulate heterophilous relationships to enable a higher level of collective learning.

Rijkswaterstaat regularly combines similar projects in multi-project *programmes*. Figure 1 clearly shows that projects A, B, and C, which are part of a programme, are closer to each other than the other nodes in the network. However, the only difference seems to be the frequency of interaction between the projects. This raises the question how collective learning within programme structures actually differs from other collective learning between separate projects. Furthermore, since participants experienced isolation from the parent organization due to the presence of a programme structure, one might wonder whether the advantages of a programme structure for the projects outweigh the disadvantages in the relationships between these projects and the parent organization. This needs further research.

Next to direct interaction between projects, learning between projects takes place trough *learning platforms*, such as the so-called *communities of practice*. Figure 1 shows that such learning platforms have a central position in the network within a project-oriented organization like Rijkswaterstaat. These communities are somewhere in between the projects and their parent organization, but what is their actual function? Nonaka (1994) describes the importance of this kind of communities of practice for socialization and its contribution to the overall organizational knowledge creation process. However, based on the indications from interviewees about explicit knowledge, combination seems to be supported through these communities as well. Furthermore, the external learning platforms offer the benefits of multiple perspectives (Dixon, 1999) due to the participation of other organizations, but the knowledge that is transferred or created through these platforms only remains within the projects that were already engaged. There seems to be no diffusion to other organizational units.

Strikingly, the interviewees indicated an absence of relationships with *departments of the parent organization*. Departments are considered to be relevant for human resources management. In other words, according to projects, departments have to make sure that there are enough employees for each specialism and that they are equipped to perform at the right level. Considering that collective learning, also within specialisms, prominently takes place through learning platforms, raises the question whether departments should have more central positions in the network of a project-oriented organization or not.

5.2. Absorptive and adaptive capacity of project-oriented organizations

Many interviewees indicated that they proactively interacted with the environment. Projects interact with their environment to understand the context in which they operate and to identify changes to which they have to adapt. Doing so prevented them from surprises or crises and allowed them to adapt to changes in a controlled manner. This means that the indicator *proactive posture* (Table 1 in section 2.1) was clearly present. Other indicators for absorptive capacity were not clearly present. This might be because projects exist temporarily and have a specific objective to accomplish. If the business case of a project is no longer justified, for example due to changes in the context or a crisis that occurred, then that project simply ends.

Regarding adaptive capacity, interviewees indicated that the indicators *minimization of silos, internal resources, information and knowledge,* and *situation monitoring and reporting* received the most attention. A large project-oriented organization like Rijkswaterstaat consists of numerous departments, projects and specialisms, each making up a silo. Although people experience these silos and indicate that there is room for improvement, the aforementioned learning platforms do noticeably contribute to *minimization of silos*.

As Burch (2010) argues, it can be concluded that it is not a lack of capacity or *resources* that limits the building of organizational adaptive capacity, rather it is often a lack of facilitating the effective use of existing resources. This study shows that lack of time is a major issue in project-oriented organizations. Although all participants view learning as important, they often consider investing time in activities that might have benefits on the long term and are more abstract less urgent than spending time to solve concrete problems in short term. However, some participants indicated that they planned events or participated in externally organized learning trajectories to ensure that they kept investing time in preventive learning instead of only spending time on corrective learning.

With respect to *information and knowledge* we have observed fluctuations in learning between projects. Whereas adaptive capacity has a longer-term focus (Berman *et al.*, 2012), the aforementioned urgency in projects shows that learning is merely an adaptive response to find an instant solution for unexpected events. Furthermore, learning between projects occurs prominently at specific transition stages, i.e. right before writing a contract specification – knowledge transfer from other projects – and at the end of the realization phase – knowledge transfer to other projects. In the intermediate period, projects primarily maintain an internal focus. This makes the organizational knowledge-base (Nonaka, 1994) out-dated, fragmented and inaccessible to the entire organization. Further research is needed about what the implications are for the adaptivity of project-oriented organizations.

One of the prominent aspects of organizational resilience is to maintain an external orientation (Weick & Sutcliffe, 2007). How should a project adapt to changes in the environment? This external orientation is covered by the indicator *situation monitoring and reporting* and is mentioned by many participants. Projects depend on stakeholders in the environment for the acceptance of the project and, thus, the project success. How do the external orientation of projects and their parent organization differ from or complement each other? This needs further research.

6. Conclusions

This paper discussed the way collective learning takes place at three distinctive levels: within a single project, between multiple projects, and between projects and their parent organization. The findings indicate the following:

- A project-oriented organization like Rijkswaterstaat seems to consists of decentralized networks, which enable much knowledge transfer due to the presence of many weak ties. Projects interacting with each other do so in a more distributed network, which allows for sharing tacit knowledge in an environment where people need to experience trust and safety, and mainly through direct interaction with combination as the predominant mode of knowledge conversion.
- Learning within projects and through external learning platforms benefits from multiple perspectives in contrast to learning between projects and through internal learning platforms, where individuals generally engage in homophilous relationships.
- Programme structures and learning platforms enable learning between projects. However, they seem to hinder learning between projects and their parent organization.
- Learning between projects and between projects and their parent organization is hindered by a lack of time (internal resources). Next to solving acute problems, learning is urgent when projects share (1) infrastructure interfaces, (2) stakeholders, and (3) similar issues.
- Learning between projects occurs prominently at specific transition stages, i.e. right before writing a contract specification – knowledge transfer from other projects – and at the end of the realization phase – knowledge transfer to other projects.

7. Further research

This study is the first part of a research project on the contribution of collective learning to the resilience of project-oriented organizations. In subsequent stages, the research will expand from projects to the parent organization's perspective. The observations that were made so far will be further examined. Among others, further research is needed to identify (1) the advantages and disadvantages of programme structures for collective learning between projects and between projects and their parent organization, (2) the implications of an outdated and fragmented organizational knowledge-base for the adaptivity of project-oriented organizations, (3) the position of departments as opposed to learning platforms in project-oriented organizations, and (4) how the external orientation of projects and their parent organization differ from or complement each other.

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