Inter-organisational teams working at the boundary:

How collaboration objects influence boundary work

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Abstract

Organisations are forming inter-organisational teams with the goal to stimulate transfer of knowledge and innovation. Professionals with different roles and who come from different organisations are working within the same team. The combination of professionals from differing organisations leads to a greater diversity in backgrounds, cultures, understandings, routines and processes which means that many boundaries are encountered within these inter-organisational teams. These team members thus engage in boundary work, either to stress their differences or to minimise them and reach collaboration. However, not only does human agency influence boundaries, they can also be influenced by different collaboration objects, which are categorised as material artefacts, boundary objects and epistemic objects. This qualitative, ethnographic-inspired cross case research studied how inter-organisational teams and team members engage in competitive and collaborative boundary work and what role collaboration objects have on the accomplishment of effective boundary work. The two teams that were studied engaged in collaborative and competitive boundary work and lay their focus mostly on collaboration. To structure their interactions and translate their differences, team members used collaboration objects. Collaboration objects used by the teams included examples, pre-existing visuals, comparisons and descriptions of routines. Examples were the most used type of collaboration objects and other types of objects were found to be elastic in their use. The elasticity of objects became visible when team members used one model either to stress differences or to minimise them.

Keywords: Boundary work, collaboration objects, inter-organisational teams

Inter-organisational teams working at the boundary: How collaboration objects influence boundary work

Organisations are forming inter-organisational teams in an attempt to keep up with the rapidly evolving innovations. These organisations aim to generate a competitive advantage as well as enhance knowledge and innovative capabilities, which is why they engage in collaboration projects and form inter-organisational teams (Easterby-Smith, Lyles, & Tsang, 2008). The newly formed, inter-organisational teams are created with a main goal to innovate (Edmondson & Harvey, 2018). The sharing of knowledge across organisations leads to a combination of knowledge from different contexts. Moreover, the heterogeneity of knowledge in those teams generates performance benefits (Van Knippenberg & Schippers, 2007) and leads to creativity and innovation (Edmondson & Harvey, 2018; Mannix & Neale, 2005).

However, innovation is not always achieved, often due to the unique complexity of inter-organisational teamwork. Within an inter-organisational team, there are heterogeneous team members engaging in a collaboration, which means that multiple experts from different professional cultures and contexts are represented in one team (Akkerman & Bakker, 2011; Edmondson & Harvey, 2018). These differences in cultures and contexts can be seen as boundaries, where different capabilities, knowledge bases and ways of communicating and engaging with one another are being encountered (Wenger, 2000). Since there is a diversity of knowledge and capabilities at those boundaries, they carry significant potential for learning (Engeström, 1987). On the other hand, boundaries may stimulate separation when striving for innovation. The challenge of boundaries is therefore to combine different social and cultural practices, within and across organisations in order to enable collaboration (Akkerman & Bakker, 2011). Therefore, inter-organisational teams need to work actively on boundaries if they want to be successful in achieving innovation.

The boundaries found within and around inter-organisational teams can be influenced. Boundary work is the active individual and collective effort to treat boundaries either as barriers and allow them to reinforce separation or to treat boundaries as junctures and let them enable collaboration (Quick & Feldman, 2014). Boundary work can either promote separation or enable connection (Quick & Feldman, 2014), which means that collaboration can either be helped or hindered. Moreover, boundary work provides a lens on organisational phenomena (Langley et al., 2019). Boundary work can influence how people look at "difference, conflict, collaboration and integration" (Langley et al., 2019, p. 4) within an organisation. However, we are lacking research that zooms in on actual interactions to understand how team members either help or hinder collaboration in their interaction. The lens of boundary work could help to understand these interactions in a novel way (Langley et al., 2019). Two distinct, yet inter-related forms of boundary work are specified in

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literature: competitive boundary work and collaborative boundary work (Langley et al., 2019). When teams try to differentiate themselves from others, they are in business of doing competitive boundary work. In opposition, collaborative boundary work is the act of minimising differences to enable teamwork. In order to see how inter-organisational teams work at the boundary, we need more insights in how they engage in effective collaborative and competitive boundary work.

In order to gain a holistic view on the teamwork processes happening within teams engaging in boundary work, one could take the team members' use of collaboration objects into account. Collaboration objects can be used to translate meaning from one team member to another. These objects can be abstract or physical artefacts (Huvila, Anderson, Jansen, McKenzie, & Worrall, 2017), used at boundaries to aid individuals in their boundary work. Additionally, collaboration objects are able to shed light on how groups cooperate (Nicolini, Mengis, & Swan, 2012) and stimulate communication across boundaries (Sapsed & Salter, 2004; Huvila et al., 2017). However, we lack insights on how collaboration objects can be used when teams and individual team members engage in boundary work. The purpose of this research therefore is to find out how inter-organisational teams and team members engage in competitive and collaborative boundary work and what role collaboration objects (i.e. material artefacts, boundary objects and epistemic objects) have on the accomplishment of effective boundary work.

To find an answer to this research question two inter-organisational teams who are part of a Dutch collaboration initiative were studied. There were many differences and thus boundaries encountered within the teams, due to differences in organisational contexts, job roles and functions, to name just a few. The aim of this in-depth analysis of the two teams was to unravel what characterises the different types of boundary work for inter-organisational teams, what forms they most naturally engage in and how one type of boundary work differs from another. Additionally, the aim is to discover what the influence of collaboration objects is on boundary work and how these collaboration objects might help or hinder team members in their attempt to work at the boundaries.

Theoretical framework

Inter-organisational teams: Where boundaries are ubiquitous

Organisations that are striving for innovation can accomplish this through the sharing of knowledge across organisations (Easterby-Smith et al., 2008). Innovative organisations therefore create inter-organisational teams, where professionals from different organisations, often with different job roles or functions, are collaborating and aiming for innovation. Transferring information in inter-organisational teams can be complex, since the combination of professionals from different backgrounds leads to a combination of expertise and perspectives within one team (Easterby-Smith et

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al., 2008). The differences of team members can lead to advantages such as innovation, but they can also lead to increased conflict, slow response and compromised performance (Bunderson & Sutcliffe, 2002). The advantages of inter-organisational collaboration are assigned to the fact that professionals are in contact with other professionals, which enables them to reflect on their own ideas and consider alternative approaches (Akkerman, Admiraal, Simons, & Niessen, 2006). On the other hand, these teams are confronted with many differences within and around the team, which could have negative implications for collaboration (Bunderson & Sutcliffe, 2002). These differences are seen as boundaries, which can either enable or hinder collaboration in inter-organisational teams.

Inter-organisational teams experience boundaries within and across their practices. The boundaries within the teams can arise due to practical orientations (for example a development team versus a sales team), professional commitment (technology designers versus the professionals using it), different levels of knowledge and so forth (Fox, 2011). The boundaries that are encountered in these teams could lead to discontinuities in actions and interactions (Akkerman & Bruining, 2016). Boundaries within and around inter-organisational teams are dynamic, emergent, relational and active (Quick & Feldman, 2014) which means that the boundaries can shift due to a changing environment or active attempts from a team. Discontinuities can therefore be overcome by human agency.

Previous research has identified different types of boundaries (Hernes, 2004; Comeau-Vallée & Langley, 2019): physical or structural boundaries, social boundaries and symbolic boundaries. Physical or structural boundaries are material and formed by regulations and rules that govern action and interaction (Hernes, 2004). These boundaries are constructed for instrumental purposes, for example rules and regulations that are specific to market an organisation's service. Another example of a physical boundary could be a team member who does not have access to files that the team uses, because of security measures. Social boundaries emerge through social bonding between individuals and enable production and reproduction. These social boundaries relate to the identity of the group or organisation and they are reflected in, for example, loyalty, trust and norms. A social boundary might be encountered when a person changes jobs and moves from a very traditional and hierarchical organisation to a modern and innovative one. Finally, symbolic boundaries relate to mechanisms, which can be beliefs, ideas, and understandings which guide organised actions (Hernes, 2004). Boundaries are not all similarly tangible or visible, for example material boundaries are far more explicit than symbolic boundaries. A symbolic boundary can be the belief that some kind of question needs to be answered, which leads to a team being formed and working on that idea. Notwithstanding, all boundaries have an effect on how inter-organisational teams operate and these encountered boundaries can be influenced by boundary work.

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Boundary work

The notion of boundary work is built on the premise that boundaries are not fixed but are subject to human agency and can thus be shaped (Bucher, Chreim, Langley, & Reay, 2016; Langley et al., 2019). Boundary work is the active attempt of teams and team members to try to uphold or minimise boundaries that are encountered within and around the team. Recent research has focused on a more processual view on organisation and organising and expresses with this a desire for more dynamic ways of understanding organisational phenomena (Langley & Tsoukas, 2016). Boundary work allows to account for this more processual character. When individuals and teams put in effort to influence boundaries, they are engaging in boundary work (Langley et al., 2019). Purposeful action is used to impact collaboration, inclusion and exclusion. This means that boundary work enables boundaries to be shifted or maintained (Lindberg et al., 2017). Moreover, boundary work provides a view on boundaries where these boundaries can be seen as barriers which strengthen separation or as possible junctures with the potential to be joined and to enable diverse connections (Quick & Feldman, 2014). They can either help or hinder the collaboration of professionals.

Three different forms of boundary work are distinguished: competitive, collaborative and configurational boundary work (Langley et al., 2019). Competitive boundary work is the attempt of teams and individual team members to distinguish themselves through defending, extending or maintaining boundaries. Through collaborative boundary work the opposite is achieved: teams and individuals pursue collaboration and build connections through negotiating, blurring and realigning boundaries. A third form of boundary work also exists, namely configurational boundary work. This type focuses on how people from outside the boundaries design, organise and influence boundaries to influence others' behaviours. This last form of boundary work is not researched in this study, because the focus lay only on interactions within teams and external influences were not taken into account.

Competitive boundary work to distinguish individuals and organisations

The first form, competitive boundary work is the attempt of teams and individual team members to distinguish themselves from others. Teams and team members can actively shape situations to their own benefit, to defend or contest boundaries (Bucher et al., 2016). Competitive boundary work often involves demarcation of boundaries, through which the boundaries around and within the teams are influenced (Langley et al., 2019). Langley et al. (2019) identified three categories of competitive boundary work: defending, contesting and creating boundaries.

In *defending boundary work,* teams and team members looking at one side of the boundary find themselves significantly different. These teams are trying to discern their superiority and are

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discursively trying to defend or repair boundaries. Defending often concerns a dichotomy, for example scientists and non-scientists, or nursing work and other hospital staff (Allen, 2000; Garud, Gehman, & Karunakaran, 2014). This means that people on one side of the boundary construct themselves to be disparate and superior on essential elements (Langley et al., 2019).

In *contesting boundary work,* a team or a team member looks at both sides of the boundary, to understand why and how boundary work tactics and teams or individuals may differ. The team and team members are looking at two or more parties who handle the boundaries differently. For example, Bach, Kessler and Heron (2012) show that both nurses and healthcare assistants look at their collaboration dissimilarly. Nurses underscore the role of the assistants in comparison to their own; they find that these assistants do not have a holistic judgement to provide the best care. In comparison, the healthcare assistants actually blur the boundaries with the nurses and emphasise similarities. Contesting boundaries therefore reveals some of the friction generated by boundary work of teams and individual team members who interact with one another (Langley et al., 2019).

Finally, in *creating boundary work* teams and team members consider how a new group can distinguish itself and seek unique places where they can operate (Langley et al., 2019). An example of teams creating boundaries is found in the study of Reay, Golden-Biddle, and Germann (2006), where nurse practitioners developed their legitimacy through fitting their roles into a complex system, whilst trying to prove their value, which enabled them to position themselves in the health care terrain.

Collaborative boundary work to work on a shared goal

On the other hand, collaborative boundary work is the attempt of teams and team members to engage in collaboration and to minimise the differences found within the team or between teams. Boundaries that are encountered are discussed, aligned and minimised in order to get work done and to achieve collective goals (Langley et al., 2019). Collaborative boundary work focuses more on enabling intra-team collaboration and cooperation. There are also three categories of collaborative boundary work: negotiating, embodying and downplaying boundaries (Langley et al., 2019).

Negotiating boundary work enables collaboration through the process of negotiation. Boundaries are socially constructed and together the team members formulate their collective objective. For example, health care professionals negotiate boundaries through stepping in and doing each other's work or separating roles when needed (Liberati, 2017). Negotiation shows how boundary work is accomplished in interactions and happens through ongoing give and take of actions and interactions (Langley et al., 2019).

Embodying boundary work involves people embodying boundaries by taking on specific positions, roles or actions. Middle managers can take on the role of boundary objects as they are used

as enablers of communication and cooperation (Azambuja & Islam, 2019). When individuals are embodying, they become both boundary objects and boundary subjects: sometimes individuals absorb the boundaries and sometimes they actively mobilise differences to enable collaborative boundary work (Langley et al., 2019).

Downplaying boundary work involves the active building of a shared team identity (Langley et al., 2019) or the deliberate ignorance of differences (Quick & Feldman, 2014) to enable collaboration. An example of boundaries being downplayed is the joking of teams to build feelings of belonging and solidarity (Pouthier, 2017). The team members purposefully put the boundaries to the background, in order to be able to engage in collaboration.

To summarise, when engaging in boundary work, inter-organisational teams try to minimise the boundaries found within a team to enable constructive collaboration. On the other hand, teams and team members try to stress their differences to generate an advantage over others or show their superiority. Boundary work is almost never wholly competitive or collaborative (Langley et al., 2019). It can be argued that both competitive and collaborative boundary work is supported through the use of objects in the interaction within and between teams. Imagine an inter-organisational team that works together on achieving a joint goal. These team members are trying to bridge the boundaries found within the team and in order to do so, they bring printed examples of how they work within their own companies. These examples structure the conversation and enable the team members to distinguish what exactly is handled differently in the different organisations. By distinguishing what is different and what is the same, the team members can find a way in which they can collaborate. Through the printed examples they can communicate effectively, which shows that not only people have an effect on boundary work, but that non-human factors can also influence boundaries. The influence of non-human factors on boundary work is shown in many studies on collaboration objects and boundary objects (Akkerman & Bakker, 2011; Ewenstein & Whyte, 2009; Nicolini et al., 2012; Star, 2010).

Collaboration objects

Boundary work is not only subject to human agency; objects can also participate in boundary work. The processual view on organisational phenomena incorporates the fact that organising is bound up with the objects and spaces through which teams interact (Orlikowski, 2007). Nicolini, Mengis and Swan (2012) argue that more research is needed to understand and trace the shifting roles of objects in collaboration. Collaboration objects perform a brokering role in translating, coordinating and aligning the different perspectives found at boundaries (Fominykh, Prasolova-Førland, Divitini, &

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Petersen, 2016). These objects help inter-organisational teams to structure and mediate interaction, so that people from different backgrounds can work together (Nicolini et al., 2012). Objects are entangled with interaction (Nicolini et al., 2012; Orlikowski, 2007) and are something that people act towards and act with (Star, 2010). They can be material or symbolic and can enable heterogeneous and cooperative collaboration (Ewenstein & Whyte, 2009; Nicolini et al., 2012). For example: a theory can be a collaboration object, which becomes specific through people acting upon it (Swan, Bresnen, Newell, & Robertson, 2007).

Collaboration objects support inter-organisational teams engaging in boundary work. These objects aid the accomplishment of collaboration within inter-organisational teams where there are boundaries around and within the team. Nicolini, Mengis and Swan (2012) argue that collaboration objects can have three different roles in enabling inter-organisational collaboration: there are material objects, boundary objects and epistemic objects. Material objects constitute the basic infrastructure to sustain collaboration. These material objects can for example be meeting rooms, documents or communication systems; without these collaboration or boundary work would be impossible (Nicolini et al., 2012). A more abstract form of collaboration objects are boundary objects. Boundary objects can be either material or symbolic representations (Fox, 2011) that should serve to bridge different types of boundaries (Fominykh et al., 2016; Nicolini et al., 2012). Boundary objects can be shaped in an array of forms such as standardised forms, prototypes, methods and processes (Carlile, 2002; Swan et al., 2007). How boundary objects enable interaction can differ, sometimes as a shared language, sometimes as learning tools (Carlile, 2002). Finally, epistemic objects are the most abstract of objects, since they aim to enable the unknown and organise aims, objectives, and desires (Nicolini et al., 2012). This lack of completeness generates energy and emotional investment from individuals and teams to collaborate. Examples of epistemic objects are problems, questions or the promises of a new solution, which all fuel collaboration and create mutual dependencies (Nicolini et al., 2012). On the whole, material, boundary and epistemic objects are not fixed in their role, and due to the teams' efforts, an object can become more specific or abstract over time (Nicolini et al., 2012). Where a problem in a process is first abstract, as a solution is being developed, the end product becomes more specific and may become a job-aid for people in that process.

The present study

The aim of this study is to shed light on trends that either help or hinder collaboration in inter-organisational teams by combining boundary work and collaboration objects. The findings should give a more in-depth understanding of the role that boundary work and collaboration objects play in inter-organisational collaboration. This means that not the motives of individuals engaging in boundary work are researched, but rather the role of collaboration objects on boundary work. This study aims to find

answers to the following main research question: how do inter-organisational teams and team members engage in competitive and collaborative boundary work and what role do collaboration objects (i.e. material artefacts, boundary objects and epistemic objects) have on the accomplishment of effective boundary work?

Setting and method

Context

The data for this study was collected within a collaboration initiative in the Netherlands, which was formed by more than twenty organisations engaging in inter-organisational collaboration to take the industry to a higher level. This initiative brings together professionals from different organisations and different contexts into inter-organisational teams that are collectively aiming for innovation. These teams purposefully develop, test and implement solutions for the Dutch industry. The goals of this initiative are to reach new and more efficient ways of collaboration, to experiment with these ways of collaboration and to convert the results into new practical insights in order to create national technological and economic advantages.

For this ethnographic-inspired cross case study, two inter-organisational teams were studied over time and in their real-life environment. These two teams were selected for a number of reasons, the first being that all team members consented to be followed and studied using video observations. Secondly, both teams had members from at least three different organisations, thus avoiding that just two organisations would be collaborating on a project, which is a more usual setting. The organisations that were represented in the teams differ in size, maturity and market. These differences gave sufficient reason to assume that both teams indeed encountered and had to work on boundaries. Thirdly, team members had different work functions, stretching across junior and senior as well as technical and processual roles, to name just a few. Finally, these two teams could be followed from early on in their collaboration. The first stages of a teams' collaboration are characterised by individuals looking for ways to reduce uncertainty and by conflict, which in turn leads to clarity concerning roles, identity and structure (Wheelan, 2005). This is even more the case for inter-organisational teams, where professionals are joined together for a reason, but first need to get to know one another and the expectations other members have. Since the first stages are so important for enabling and sustaining collaboration in inter-organisational teams, the initial meetings of both teams were studied. The team members would have to get acquainted in these first meetings, which would mean that they needed to engage in boundary work and to work around the boundaries that were found within the teams. Thus, the first meetings were expected to be saturated with boundary work.

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Data collection

The collaboration of the two teams was studied over time, through observations and video recordings of their formal meetings. The consent from the team members to record their meetings via video was gathered before the first video-recording. The data was collected by another researcher, who was present during all meetings as a non-participating observer and took field notes. These field notes contained factual information about the meeting, for example who was present and where everyone was seated. Field notes also contained notes on the content of the meeting, the atmosphere and some initial reflections. In total, 611 minutes of video data and 10 pages of field notes were collected and used for this study.

These meetings were recorded using a 360-degree video camera. This camera is a very unobtrusive method to record the meetings since this small black device can easily be placed be on top of the table, drawing little attention from team members. After the meetings the 360-degree images were transformed into split screen videos for analysis of the data.

Table 1. Data collection from two teams

Team Apple	Team Banana
Goal: servitisation	Goal: documentation and product configurators
6 members	4 members
Members from three different organisations	Members from three different organisations
7 hours of data, of which the spread over three sessions was 2 hours, 1.5 hours and 3.5 hours	5 hours of data, of which the spread over three sessions was 1.5 hours, 2 hours and 1.5 hours

Data analysis

For the data analysis, both video observations and fieldnotes were used. The field notes were used to get a quick feeling of the meeting, the atmosphere and content. The video observations were coded in two rounds using Atlas.ti; in the first-round coding for boundary work and in the second-round coding for collaboration objects.

Coding boundary work

In the first round of coding all the data, every segment that concerned a boundary work activity was coded based on a codebook (see appendix 1.). The codebook for boundary work was based on the work of Langley et al. (2019) and consisted of six codes, which were refined by coding the data collaboratively. The boundary work was coded into two overarching categories, *collaborative* and *competitive boundary work*. The third category *configurational boundary work* (Langley et al., 2019)

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was found not to be interesting for this study, since external influences were not incorporated in the scope of this research. Collaborative and competitive boundary work both had three different subcategories. *Collaborative boundary work* could involve *negotiating*, *embodying* and *downplaying boundaries*, and for *competitive boundary work* these were *defending*, *contesting* and *creating boundaries*. In order to gain a complete understanding of strategies used to deploy teamwork, both categories contained a fourth subcategory: other, for strategies that were different than the specified ones. An example of a definition used to find the different subcategories is the definition of contesting: *'a team or team member analyses both sides of a boundary in order to understand why and how tactics and strategies may differ while boundaries are upheld. Teams or team members on one side may try to discern themselves, while a team or a team member on the other side may try to blur the boundary. In short: different teams or team members deploying different strategies.'* (for the full codebook see Appendix 1.).

The codebook on boundary work drew special attention to the different kinds of boundaries that can be encountered within inter-organisational teams. The boundaries were structural boundaries, social boundaries and symbolic boundaries (Hernes, 2004). The purpose of this was to create comprehension and identify where boundary work was taking place within the team meetings.

Coding collaboration objects

The data was coded a second time, reviewing the boundary work segments in light of the collaboration objects the teams used. The data was coded with a codebook which was split into two sections: the *type* of objects and the *function* the objects had (see appendix 2.). First, the different types of objects were derived from an extensive review of literature and during the initial pilot observations the list with types of objects was prolonged with objects that were encountered. For example, key words were added in these initial pilot observations. During initial coding, 22 types of objects were spotted, and these were, amongst others: examples, metaphors, pre-existing visuals and prototypes. Secondly, an object was assigned a *function*, which were based on the work of Nicolini, Mengis and Swan (2012). The function that the objects could have were *material infrastructures*, *boundary objects* and *epistemic objects*.

Trustworthiness

Trustworthiness of the study was established in multiple ways during the data analysis. The data was coded collaboratively by two researchers; one who was immersed in the project and was present during all the sessions. The other was new to the study and thus more an outsider to this project. The combination of these researchers with different degrees of engagement to the study led to new

insights for them both. The immersed researcher was able to provide additional information on the two teams, while the other researcher looked at the data from a more objective point of view. The collaborative research that was performed when analysing and coding the data can be defined as being a critical friendship. Within a critical friendship there is a trusted person who asks provocative questions, offers alternative lenses and critique as a friend (Costa & Kallick, 1993). The relationship of such an insider and outsider to the situation is even seen as a strength (Colby & Appleby, 1995), where an appropriate balance is found between challenge and support (Baskerville & Goldblatt, 2009). That is why this collaborative research contributes to the trustworthiness of the study.

Within the first round of coding, the researchers looked individually at the data and noted interactions that stood out within the team, to see if their interaction could be coded as either collaborative or competitive boundary work. After this, they discussed their notes and findings from their own perspective. They often observed interactions that started as competitive boundary work, drawing attention to the differences of the organisations. However, through an intervention and reaction of another team member this interaction could end as collaborative boundary work. Through discussion both researchers decided that the reaction of the team should be taken into account when coding the data and that such interactions should be coded as collaborative boundary work, since the teamwork and its interaction was of importance.

The coded data was looked at a second time, checking whether the first codes were still thought of in the same way, and, more importantly, the data was coded for collaboration objects that were used in the interaction in the team. This round of coding was also discussed by looking at one meeting of the teams, and both researchers elaborated on which codes they applied and why. The discussions between the two researchers also helped to refine the codebooks, which led to the adding of the specification of boundaries and refining the descriptions for the codes. Both codebooks incorporated explanations and examples of the codes to illustrate how the code could be applied.

Finally, the findings from the data are portrayed using vignettes. Vignettes are characterised by 'show and tell', where a description is provided with evidence and examples (Reay et al., 2019). These vignettes make the readers feel like they were there and gives them a rich overview of the studied meetings. This attributes to trustworthiness, since a reader now sees the data and can recognise the patterns that are discerned throughout the analysis.
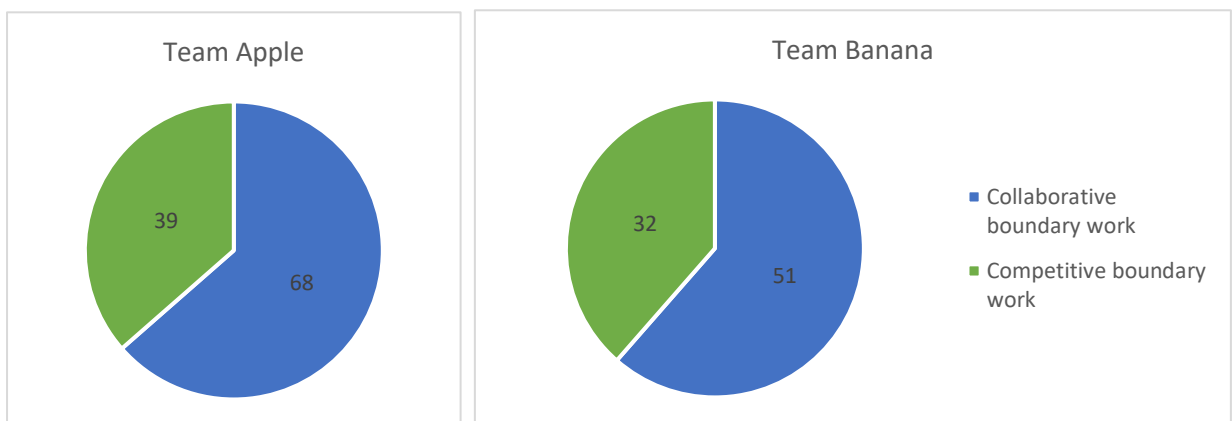
Findings

The findings of this research will be portrayed in two parts. Part one shows the patterns observed when teams and team members engaged in boundary work, first by looking at collaborative boundary work and then at competitive boundary work. The patterns observed for collaborative boundary work were, amongst others, the frequent use of negotiating strategies and also a newly discovered strategy,

namely clarifying. For competitive boundary work teams recurrently used defending strategies. The second part of the findings shows how teams and team members used collaboration objects to support their boundary work. Here four main patterns were seen: the frequent use of examples when engaging in boundary work, the elasticity of pre-existing models to bridge boundaries, that metaphors were used to negotiate and downplay and, finally, how case descriptions were the basic means of inter-organisational collaboration.

Part I: Teams engaged more in collaborative than in competitive boundary work

When looking at how two inter-organisational teams and their team members engaged in collaborative and competitive boundary work, both teams had a similar distribution of engaging in boundary work. It was found with both these teams that in two-thirds of the instances they engaged in collaborative boundary work and in one-third of the instances in competitive boundary work. Team members focussed on teamwork despite many differences and boundaries being present. This collaborative boundary work led to a mutual understanding and they worked towards the same goal. In some of the instances team members engaged in collaborative and competitive boundary work at the same time, for example by focussing on the differences and making a joke about how difficult their boundaries were. Overall, team members were able to translate their boundaries to others, in an attempt to clarify their situations to one another. However, there was one person who found his own organisation different from the others, since this organisation sold another product, to another market and had different strategies. He continually used jargon to convey his point of view, thereby focusing on the differences. The team leaders tried to translate his input as a benefit for the whole team, which only worked in some of the cases. In conclusion, collaborative boundary work was more present in the interaction of inter-organisational teams and was sometimes combined with competitive boundary work. Table 2 shows the different types of boundary work with excerpts.

**Figure 1.** All coded segments where both teams engaged in boundary work

Table 2. How the team members engaged in the different types of boundary work

Type	Example
Collaborative boundary work	
Negotiating	*'But if you are already paying for a product and you can make an improvement to that 'Then you are working from a preventive point of view' 'Well in this model they are actually already providing software as a service. In the middle of the model, in red, is product as a service displayed, and your software is actually a service.' 'Yes' 'So for the customer you are working on business optimisation' 'Yeah, in that direction.'*
Embodying	*'That could be possible, but then part of the interaction that is present in 3D and not in 2D has to be accounted for' 'But actually…' 'Let's try to make the switch to options and variance at this point. So, you have the choice 2D or 3D and what is the link, is there a link with options and variance?'*
Downplaying	*'It starts with a business plan, what do you want to accomplish in the markets you operate in? From there you get your business case and do a development launch where some research is done. At some point you move into development. And then you can tell sales that it is time to start… 'That sounds really easy right?'* [Laughing]
Clarifying	*'What has the biggest impact on the bid-process? For example you have somewhere a product and I see here* ((points to screen)) *customer bid and project X' 'Well, the bid-cycle is introduced here* ((points to screen))*, it is possible that your product manager is not completely finished, that it's still in development, but that you are already going to bid it' 'Yeah, okay in essence is your bid-process somewhat similar' 'Yes, yes, yes, what you saw was the current BID-process' 'Oh it was?' 'Yeah, but we used to only have something similar' 'Aha and now you have added this?' 'Yes'*
Competitive boundary work	
Defending	*'Let's continue the brainstorm and see how everybody can connect to this.' 'Good idea' 'I have to say that within our organisation we don't have these processes' 'No?' 'We are only four years old, 25 people, we are too small, and our product model is only focused on customer requests. And Product X is something we develop with a customer which will become a SaaS solution, which you can subscribe to, which is an online solution for which we need many building blocks.'*
Contesting	*'I just said that we are doing that, but I was thinking about our development, but do we do this for service as well?' 'No, not the risk-based approach' 'And when I saw your sheets, I saw that you are doing this here, and that there, but I was wondering who your product owner is and how did you arrange things like that? And you are at risk of doing things too fast' 'What I showed you was our bid-process, but there are certainly processes surrounding our bid-process'*
Creating	*'Good to see how we can progress. You drew a product configurator and an arrow to quotation' 'Yeah, I think that we have to pick a couple of topics and see what they mean, what are the key-parts that' 'Maybe we have to change quotation to a wish list to make it generally applicable.' 'We are now mainly working on getting that wish list right.'*

The team members of both inter-organisational teams engaged in collaborative boundary work the most, of which the form most used was negotiating, closely followed by downplaying. Three subcategories were formulated in the codebook, with room for other strategies for collaboration, which lead to the discovering of another strategy that was found to be used significantly by both teams, namely clarifying. The teams clarified situations to one another, making something clear or easier to understand by giving more details or an explanation. Other strategies of collaborative boundary work were also found, such as aligning, giving advice and asking input, however they were not significantly applied. The only strategy which was used significantly was clarifying.

Figure 2. The distribution of the engagement of the different forms of collaborative boundary work in the observed teams
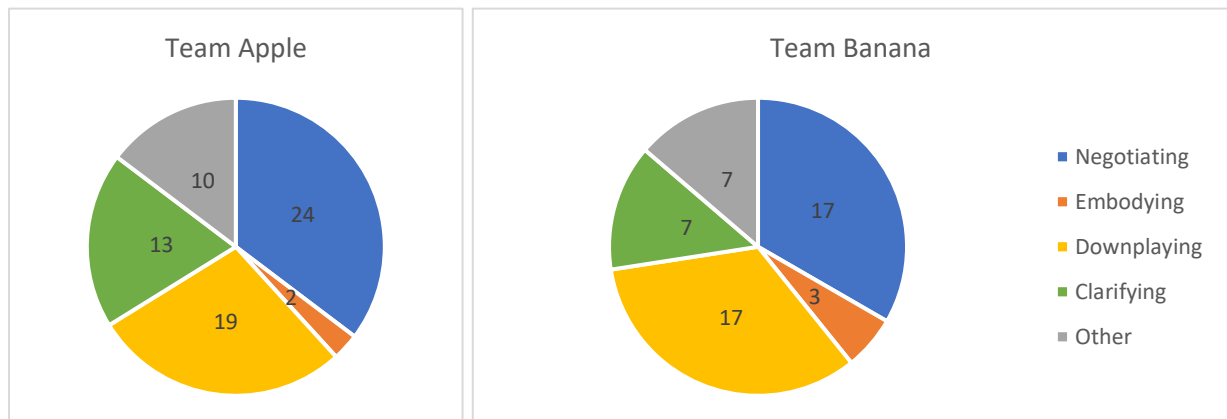
Negotiating was the most used form by both inter-organisational teams. In all sessions there were forms of negotiation seen between team members. Team Apple engaged in this form of boundary work by, for example, discussing what a generic model should look like and how all the companies present within the team would benefit from this generic model. Team Banana conducted a brainstorm over some form of a product. All team members gave input and together they defined the basic requirements for this product. What characterised this form of collaborative boundary work, was that the boundaries were discussed and actively shaped for the benefit of the team.

When team members deliberately ignored the boundaries between team members, they were *downplaying* the boundaries. A form of downplaying, for example, was used when a team member of Team Banana joked about how some kind of guideline was even more elaborate than their own. The ignorance of boundaries is of importance: they were working on a shared goal and did not pay attention to their differences. What stood out was that in almost two-thirds of the times downplaying was observed, there was also another form of boundary work present, either being collaborative or

competitive. This means that downplaying is often used to support other forms of boundary work to treat boundaries either as barriers or as junctures. Downplaying was not often used as a standalone strategy for teamwork by both teams.

Embodying was found less often in collaboration efforts than the two other forms of collaborative boundary work. Team members had to take into account both their own goals and the goals of the team. Team leaders were most often the ones who were able to embody the boundaries. In Team Banana, one of the team members was elaborating on their complex context and which boundaries were encountered. Here the team leader summarised their situation and started a discussion that proved to be valuable to all the organisations present. What is seen here is that a team member has to work actively across boundaries, giving room to the boundaries which are encountered and at the same time keeping the team's objective in mind and working towards the accomplishment of the collective goal.

During the coding of all sessions, it was found that certain efforts of the team to enable collaboration did not fit into the existing categories of collaborative boundary work. The teams often engaged in *clarifying*: they used it to understand each other's companies and products better. In Team Apple, one member explained how their organisation marketed one of their products and provided it with service. The other members did not really understand their situation and asked that member to indicate where they thought their organisation's service was located on an existing model. This model on servitisation guided their collaboration efforts and allowed them to see where all three organisations were positioned. After the team member indicated where their service was located, he elaborated and clarified their service even more. Clarifying is different from negotiating, embodying and downplaying, since each team member has their own frame of reference from which they are operating in the team, which may inhibit collaboration. However, through proper explanation and clarification of the situation, team members might understand one another and speak the same language. In this way, their collaboration and advises are more elaborately explained to one another and one's understanding of what the other has got to offer is made clearer.

Defending boundaries was the most often used form of competitive boundary work

Teams engaged less often in competitive boundary work than in collaborative boundary work. Defending was the most used form of competitive boundary work. The teams also engaged in contesting and creating boundary work, both of which were used to the same extent. New subcategories besides the pre-existing forms of defining, contesting and creating were not discovered during analysis, as was the case with collaborative boundary work.

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Figure 3. Defending was the most used form of competitive boundary work
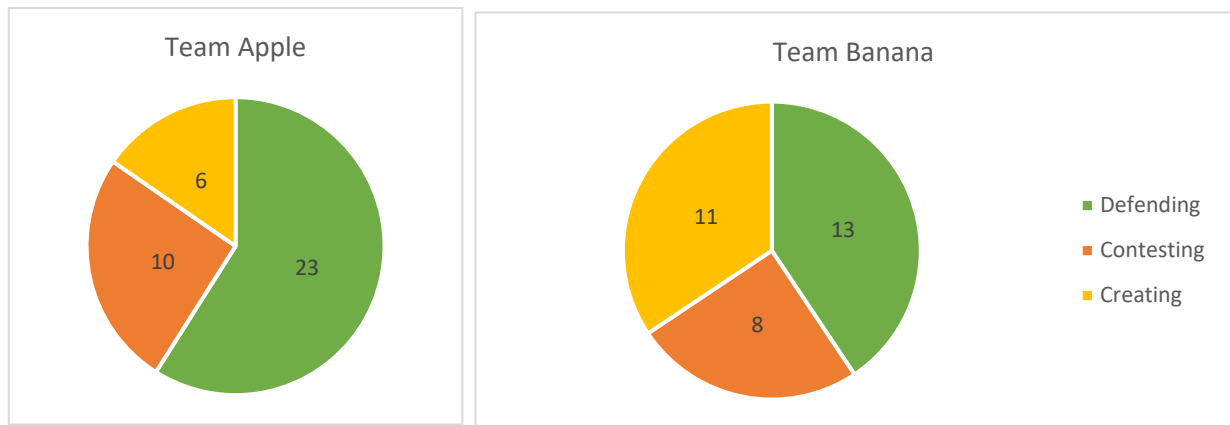
When individual team members engaged in *defending,* they elaborated on why their service is good, more complex or in some other way superior. In both teams, two of the three organisations were alike and similar in their way of operating. The third organisation in each team had a different service and strategy, compared to the first two. This led to the fact that in both teams, this member, being the outsider, continually dwelt on why they were so different. Other team members sometimes tried to find a connection, but this team member chose to distance himself from the others. As is typical with defending, there was little or no connection between team members and their organisations. To elaborate, they placed emphasis on their differences.

With *contesting,* team members analysed both sides of the boundary, with the analysis leading to an understanding of why tactics and strategies may differ while upholding the boundaries. Team members did not try to come to terms but explained how different strategies were chosen, regarding the different boundaries each organization faces. In Team Banana, two team members from different organisations discussed how much they differed. They had certain aspects and processes in which they were alike, but their delivery of different products to different types of customers led to different strategies. The comparison of two kinds of tactics or strategies was characteristic to contesting.

Teams did not only emphasize the boundaries within the team, they were also *creating* boundaries around the team. Both teams had only recently been formed when the researcher started video-recording their meetings, so they had to shape the boundaries actively around the team. The teams distinguished themselves from other teams, found their unique form and added to the bigger context. For example, one team member of Team Apple started the creation of a generic model on maturing in servitisation as an organisation. The team started to brainstorm about the requirements, and, in this way, they shaped and created new boundaries. What is central to creating boundary work is that the team discerns its work from what already exists, and the members are actively shaping boundaries around the team for such a space to be created.

Boundary work may now seem like it is wholly competitive or collaborative from the examples shown above. However, team members and their interactions influenced which form of boundary work would be shown. A team member could start with, for example, defending competitive boundary work, and the team leader then would respond to it in a more negotiating style, to involve all the team members in that conversation. This means that within one segment showing that teams engage in boundary work, multiple forms of boundary work could be present. Of all coded segments, 14,5% were teams engaging in both collaborative and competitive boundary work. Moreover, there were also segments with multiple codes from collaborative (17,6%) or competitive boundary work (3,1%). In the next segment the team was at first *negotiating* on what their organisation should do, but in the end that specific team member starts *defending* the complexity of their organisation's context:

> A. 'For you it's easy to calculate the amount of terabytes, but for a customer it would be very difficult. Because you can pass that on to where you are leasing your servers.' B. 'But then we have to… Let's see' C. 'The hardest part is, I think, that they want to be flexible for their customers, so they don't want to lease tons of terabytes, but instantly scale that which they want to sell. And then create your own cost variables and link them to whatever you're selling.' A. 'But then with practical examples saying: this is a customer that uses a few terabytes and it looked like this, and that customer wanted the premium package and that looked like this, I think that's fancy' [laughing] C. 'But it doesn't mean that fancy brings the most money.' A. 'True' B. 'Here, a terabyte is mainly for storage of projects, like these ((shows a list on screen)) which we can combine with examples, like a house uses an x-amount of MB's.' C. 'I think you should do it like D. just said. That you don't talk about MB's, but that you offer a client a package, and then' D. 'Then they ((pointing to B.)) might have to change their functionalities' B. 'Yeah, I have to think about that, because texture is a solution to show the same quality model with less polygons and therefore it is less heavy. But also, to lift it, because a texture is made of high-resolution polygons: a lot of detail, from which you can get a lot of information, which you can layer by using 2D-folders. To make this clear, think of colours, you've got red, yellow and green, and if you take one layer of an image and see the red values, it is actually a black-and-white image...'' [team member B continues this monologue for over 1,5 minutes]

This example shows how teams collaborated, made recognisable jokes, but also that the organisational contexts were very specific. This lead to the fact that team member B became consumed by all the complexities concerning their product and started a monologue. During this

monologue, other team members distanced themselves from the conversation. The team member defended boundaries that made their product so complex. Right after this monologue, someone else utilised the short pause to immediately change the subject. In this example it became evident that a collaboration effort can be hijacked when an individual chooses to focus on boundaries specific to only his organisation, thereby silencing the input of the rest of the team.

Part II: How collaboration objects are used to influence boundary work
The teams used many different objects to enable collaboration. Some objects were very specific and present in every situation, like a meeting room with a screen for a presentation. These material artefacts were only coded when they significantly impacted the teams' interactions. The function of most objects was being a boundary object: they used different types of objects to translate the boundaries. There was no specific subcategory of boundary work related to boundary objects. Only a few objects were found to be epistemic objects, directing teamwork to something yet unknown. Epistemic objects were often combined with creating boundary work. Some objects were only used by one team, like stories by Team Apple and project proposals by Team Banana. The collaboration objects (across function) that were most used by both teams were examples, processes, pre-existing visuals, situations and comparisons.

Figure 4. Collaboration objects most often have the function of a boundary object
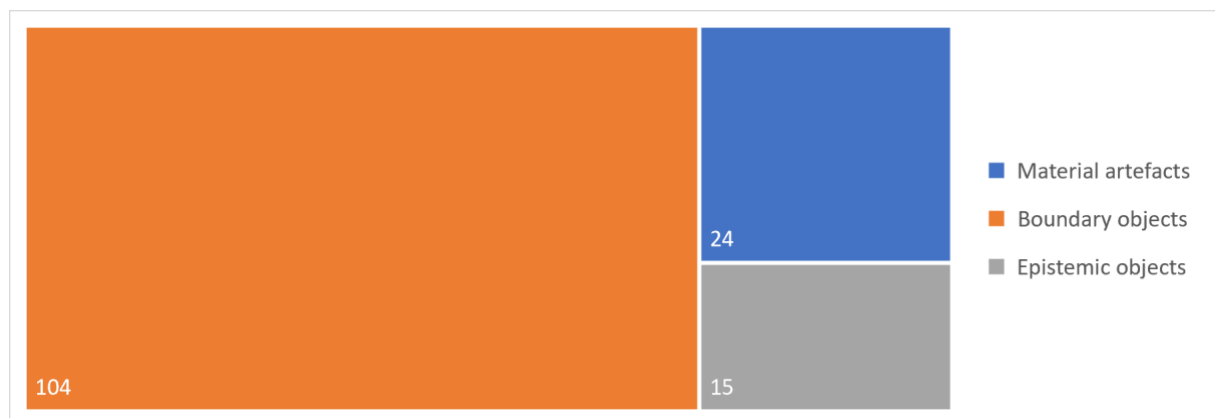
Figure 5. Teams deploying different types of objects in their meetings
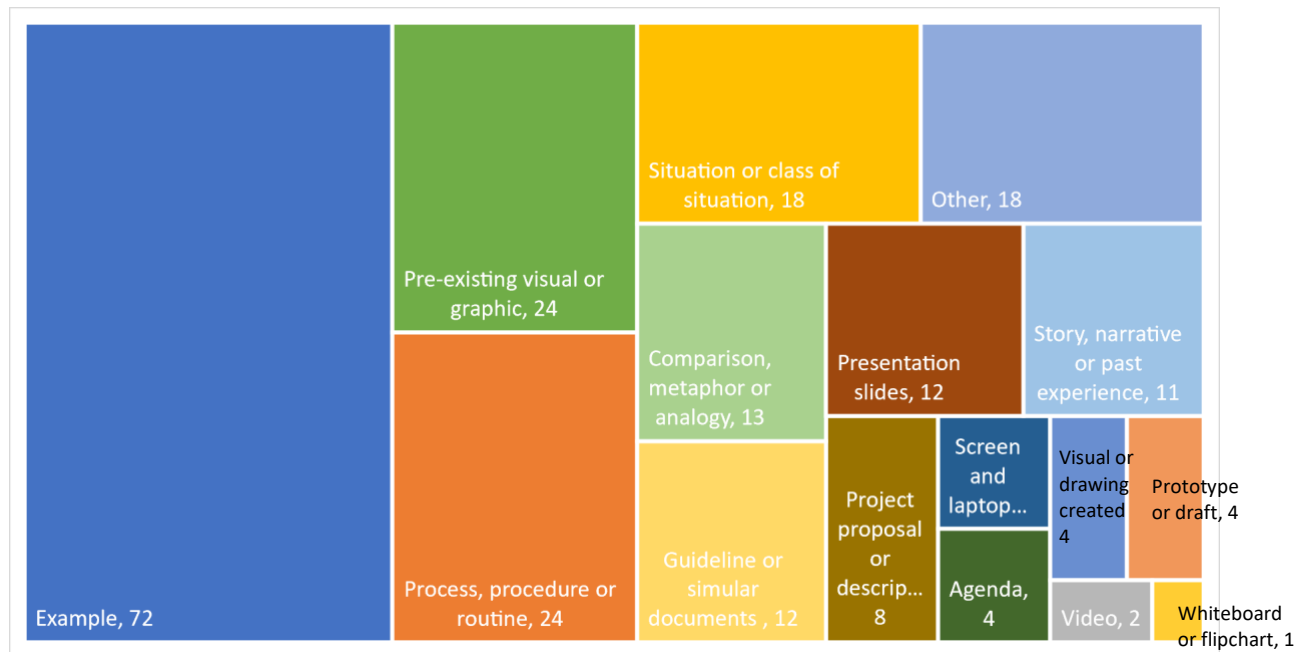
Table 3. Teams deploying different types of objects in their meetings

Type of object	Amount of times used	Percentage	Team Apple	Team Banana
Examples	72	31%	32	40
Pre-existing visual or graphic	24	10%	20	4
Process, procedure or routine	24	10%	12	12
Situation or class of situation	18	8%	6	12
Other	18	8%	10	8
Comparison, metaphor or analogy	13	6%	7	6
Guideline or similar documents	12	5%	2	10
Presentation slides	12	5%	8	4
Story, narrative or past experience	11	5%	11	0
Project proposal or description	8	3%	0	8
Screen and laptop connection	4	2%	2	2
Agenda	4	2%	1	3
Visual or drawing created during meetings	4	2%	1	3
Prototype or draft	4	2%	2	2
Video	2	1%	2	0
Whiteboard of flipchart	1	0,4%	0	1

Examples are boundary objects which support both collaborative and competitive boundary work

Both teams used *examples* most often as collaboration objects when engaging in boundary work. The teams used examples for collaborative and competitive boundary work alike. By deploying an example, a team member gave a specific and characteristic verbal illustration of something that he or she was trying to explain. A pattern that was seen when looking at examples was that every time a team member engaged in embodying boundary work, an example was used to be able to embody the boundary. This means that for a team member to be able to embody a boundary, they needed examples to be able to do so. Examples made visible the differences or similarities that the different organisations faced. This is seen in Team Apple, were one team member, when engaging in defending boundary work, used an example and described their strategies concerning clients:

> *'We have segmented our customers into three groups: basic, average and advanced. This depends on the percentage of the gross national product a country spends on their defence and what kind of service attitude they have. For example: The United Arab Emirates are spending a lot of money on their defence, but their service attitude is relatively low. They buy a very appealing [product X], but the preventive maintenance, making sure that the object is deployed well, that is still a bit shaky. And if you are looking at the UK navy, the royal navy, or the Dutch marine, they are more advanced. Their gross national product is within the advanced part, they are spending more than enough on Ministry of Defence and their service attitude is very high.'*

Here, this team member was defending why segmenting their customers was such a good decision. In order to illustrate why they made this choice he used an example of why different countries fit in a certain segment. If this member had just told the other team members that their segments were beneficial for their company, they might not have understood it. However, by deploying an example their choice was made visible and the team members got an even better picture of their situation.

The elasticity of existing visuals to bridge boundaries and their ability to be used for different functions

Pre-existing visuals, graphics or drawings were also often used as boundary objects by both teams, which were shown via a PowerPoint presentation on a screen. Teams who used pre-existing visuals most often used them in the process of negotiating or defending, but this was closely followed by teams engaging in downplaying or other collaborative work. Pre-existing visuals were used two times more often when engaging in collaborative boundary work than competitive boundary work. Furthermore, one pre-existing visual was found to be elastic, since it had different functions.

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Sometimes it would be used as a boundary object and at other times it was an epistemic object. This elastic visual was a model used by Team Apple, which was central to their goal and had a specific curve, going up and to the right at the same time. The team used the pre-existing visual for multiple purposes and it structured many of their conversations and collaborations:

> Team leader: '*And then I identified an assignment: imagine having a service desk; how should they develop along the model* ((pointing towards the screen, where a model on servitisation is shown))*. We are now in the warranty phase: what should a service desk be able to do? Moving towards an availability phase: which abilities should a service desk have in this phase and which changes should be incorporated? And he will be working on that (…).*' Another member joins the conversation '*And is the idea that this will be a generic model, which you can deploy for these steps* ((pointing towards the screen, where a model on servitisation is shown))*, not regarding a specific organisation?*' The team leader continues '*I really want to keep this generic; I want him to develop a model in which some elements will be named, and you will rank these. And depending on the score, you will be able to determine if you are mature enough to make the next step.*'

The team here is talking about a generic model being developed by one of the organisations. The scene evolves with the team discussing which generic elements such a model should have and how this model would be workable for all teams and organisations. This happened in the first meeting and in the following meeting the team had a new team member elaborating on the process to develop such a model. The object for this part was found to be an epistemic object. The team was negotiating what they did not yet know and on how this idea should be brought into reality. This pre-existing model on servitisation was often times used as a boundary object, but in this case it became an epistemic object, since it guided a question the team had, but was not yet able to answer: what a generic model on servitisation should look like and how it could guide organisations to mature into new steps.

What stood out was the fact that Team Apple was able to let this visual become elastic in form. Over time, the team members of Apple no longer had to show the visual on the screen when they discussed the model. The model became so embedded in the team culture that a simple hand gesture, which mimicked the curve that the model has, was enough for the team to know that the model was being referred to. This could be translated into a paradox; where on the one hand the model became less tangible in the conversations of the team and on the other hand become more specific and embedded in their team culture.

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Comparisons, metaphors and analogies help teams to negotiate and downplay boundaries

Comparisons, metaphors and analogies were easily spotted in the interactions within both teams. When using a comparison, metaphor or analogy, the notion of a similar object or situation was mobilised. Through the use of recognisable comparisons, metaphors or analogies, a difficult notion can be explained or illustrated, so that team members might understand it. What stood out was that in all segments where teams deployed a comparison, they were engaging in collaborative boundary work: negotiating and downplaying. One could say that comparisons and metaphors lead teamwork to being collaborative rather than competitive. Team Banana often deployed the notion of a car to illustrate the common ground between the different organisations:

> Team leader explains the goal to a new team member: *'The subject is impact, options and variance and you should think about a product configurator, which you know from cars. Seat for example. You can develop a car with all kinds of options and variances: with or without navigation, in a certain colour or another etc. etc. etc. Which is really nice for customers, because they can choose what they specifically want, but a one-size-fits-all principle is easier for a manufacturer, which is applied by Ford. To meet the customers' needs and wishes, and at the same time not to get caught up in the complexity of all the wishes [...].'* New member responds because the comparison is relatable: *'This is exactly the same with our [product Y], where we have a number of options and do not have 200 possible variances anymore.'*

The use of comparisons, metaphors and analogies leads to recognition by team members. They remember similar situations or can imagine what such a product would look like. The use of a comparison was often accompanied with an example. When trying to explain something a team member often gave a specific characteristic for what he was trying to explain, which was preceded or followed by a comparison. Both an example and comparison help when trying to explain something clearly.

Case descriptions are an essential artefact for inter-organisational collaboration

Within the "other" category for collaboration objects the *case descriptions* were dominant. The teams and team members used these case descriptions to guide their teamwork. Unlike any other type of object, the usage of case descriptions was stimulated by the Dutch collaboration initiative. All organisations present within the teams contributed with a case, which was some kind of problem or question they encountered within their organisations and which was related to the team's goal. The case descriptions were not seen as epistemic objects, despite the fact that they represented something

that was yet unknown, because these case descriptions were the basic means of teamwork for both teams. These case descriptions were the basic means of teamwork and were therefore found to be material infrastructures. In Team Banana, team members also structured the meetings with the cases:

'Let's start with the background, so the goal which we have formulated in the project plan. We have recalled the example of the product configurator a couple of times now. So, for example Ford's website on which you can compile your product through various combinations. Naturally, this leads to complexity in your product development cycle on various points. Among other things at the very beginning where you still have to get a green light on the product to be made, but also in the development process itself, in the development stages and later stages like maintenance and within this making and keeping documentation consistently. Within this process we have now specified three cases, which focus on different points within this product life cycle. So, one is at the very beginning: development planning. Another is a bit further in the cycle, let's say product development, the moment in which you are realising the product architecture, which is our case three modular architecture, industrial systems and vision. And another, which begins a little further and ends much further in the process: the part where you start realising maintenance- and educational-information and keep it up to date.'

Case descriptions guided both Team Apple and Team Banana in their formal team meetings. In the meetings they brainstormed on what things should look like, how their own organisation approached certain questions and gave one another advice. Outside the meetings they worked on their cases, searched for new findings and more. The case descriptions helped the inter-organisational teams in their collaboration efforts. Without the case descriptions teamwork would be much harder: now the teams had specific questions related to a subject instead of some general questions which they faced.

Conclusion and discussion

In this paper we investigated how inter-organisational teams and team members engage in competitive and collaborative boundary work and what role collaboration objects (i.e. material artefacts, boundary objects and epistemic objects) have on the accomplishment of effective boundary work. These two concepts were combined by analysing two inter-organisational teams, focussing on their teamwork at boundaries in combination with their usage of collaboration objects, to be able to speak the same language and produce new insights on the one hand and stress their differences on the other hand. We found that teams and team members actively engaged in boundary work and used collaboration objects to shape their meetings, to translate boundaries and to emphasise them.

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The research question was answered firstly by researching how inter-organisational teams and team members engage in boundary work. Team members either tried to see differences as possibilities and used collaborative boundary work strategies, or they stressed their differences and thereby engaged in competitive boundary work strategies. The most used form of boundary work was collaborative boundary work with its negotiating strategy. Also, a new strategy was discovered, namely clarifying, where team members explained the situation, which contributed to the teams' ability to speak the same language. Competitive boundary work was found to be used in one-third of the cases, where teams used defending the most. An individual member could start an interaction as being competitive or collaborative, but the response of the rest of the team determined whether the interaction would remain as such.

Secondly, the role of collaboration objects on boundary work was studied. Overall, the most used function of objects was that of boundary objects. Most material objects did not actively influence an interaction of the team and the teams did not use that many epistemic objects. Moreover, the type of objects was also studied: examples were used the most. Collaboration objects were found to be subject to the situation at hand; a collaboration object is used with a different function in accordance to that situation. This means that the same object can be used in different forms (specific or abstract) and for different purposes.

Scientific and practical relevance

Part 1. Boundary work as an active attempt to work at the boundary

Boundary work provides a lens on organising teamwork that focuses on "how the formal lines that divide and channel activity, are at the same time worked for, at and through by the agency of individuals and groups" (Langley et al., 2019, p. 66). This lens has not been used much to explain organisational phenomena. Therefore, by using boundary work to shed light on collaboration in inter-organisational teams, old and new organisational phenomena are observed in a novel way.

The studied teams and its team members differed on several facets and this led to the fact that the teams encountered many different boundaries in their work environment. They had to work amidst physical, social and symbolic boundaries (Hernes, 2004; Comeau-Vallee & Langley, 2019). The teams worked the boundaries actively and tried either to maintain or shift the conceptions of boundaries in order for them to be able to collaborate (as explained by Lindberg, et al. 2017). The attempt to overcome boundaries was, for example, seen in Team Apple where they tried to combine all differences to find a generic model on how to advance in providing service to customers.

Boundary work was found to have two distinct forms: the teams either tried to overcome boundaries or tried to emphasise them, which is in line with what Langley et al. (2019) found. These

categories were collaborative boundary work, where differences and boundaries were treated as junctures, and competitive boundary work, which looked at boundaries as barriers to collaboration. Teams engaged in collaborative boundary work two-thirds of the time and one-thirds in competitive boundary work. Team members were also able to convert an interaction that started as being competitive into a collaboration effort.

Existing literature formed three categories on collaborative boundary work (Langley et al., 2019). However, this research showed that next to negotiating, embodying and downplaying there is a fourth form of collaborative boundary work, that is to say clarifying. Team members clarified the situations which were central to their organisation to one another, in order to be able to speak about the same issues and understand why organisations apply a certain strategy or approach. Clarifying was characterised by team members discerning differences and boundaries in a way that bridged those differences. The outcome of clarifying boundary work was collaboration. Nevertheless, this might be a form of collaborative boundary work which is only seen in inter-organisational teamwork. Individual team members are less accustomed to the specifics of another organisation. Therefore, further research into collaborative boundary work is needed and specifically into clarifying.

The forms of competitive boundary work were discovered in accordance to the existing literature. Teams and team members defended boundaries, as well as contested and created them to emphasise differences or to construct their own new spaces in which they could operate.

Part 2. Collaboration objects are naturally used to support boundary work

It is affirmed that boundaries are not only subject to human agency, but that objects also play a part in maintaining and transforming boundaries. Fominykh et al. (2016) argue that objects support translation and coordination at the boundary. This is in line with the results of this research, where collaboration objects were used often by team members in situations where boundaries were encountered. For instance, collaboration objects in the form of examples helped team members explain similarities or differences of a company, which led the team's understanding of the different contexts.

The role and function that collaboration objects have in a team's interaction may change. Nicolini et al. (2012) even argue that collaboration objects are becoming increasingly specific over time. However, this research found specificity of an object was not always time related. The function of a collaboration object was chosen based on the situation at hand, not structurally evolving into a more specific version. For example, Team Apple used a pre-existing model to structure their conceptualisation of servitisation. This model was used most often by the team as a boundary object to align team members on the phases of servitisation. However, as their collaboration progressed, the

object was also used as an epistemic object to create a generalised model. Depending on the situation at hand, the object had a different function and was deployed in a different manner. This means that, based on their interaction, a team member would decide ad hoc which function such an object should have. Nevertheless, this research only focussed on the first stages of inter-organisational teamwork: the team's goal was not seen come into realisation. The generalised model was not finished. However, if the team was able to complete it, that might be a collaboration object which would become more specific over time. Therefore, inter-organisational teams and their final products should be subject to more research in order to be able to say that time is of no influence on the specificity of collaboration objects.

Not only the function of collaboration objects can change within the team's interaction, the object itself may also transform. The elasticity of objects becomes visible through the pre-existing model which Team Apple used. At first, this model had to be visible on the screen for team members to talk about the phases of servitisation. Then they started mimicking the curve whilst showing the model on screen. Later on, the team members did not request the model when they talked about it, but they used a hand gesture to refer to and mirror the model. This means that the same object may become gradually more abstract due to the team's familiarity with this object. The practical implication of this could be that teams may benefit from embedding existing models and visuals into their team culture. This helps the team to translate differences and to guide the team in their collaboration. This paradox of an object becoming more specifically embedded in the team's culture and at the same time being less tangible in their conversation is new ground and therefore should be subject to more research.

Limitations & future research

A limitation of this research was that the study was relatively small, one could study more teams to see if patterns are recurring. Additionally, only the first phases of collaboration were studied, because of the assumption that these contained the most boundary work. Future research could study the full lifespan of a team or only focus on the middle and final stages to see whether inter-organisational teams still need to engage in boundary work when they are collaborating for a longer period of time. What might also be seen is how the nature of the boundary work changes when teams move onto new phases of teamwork. Moreover, one could observe the effects and use of collaboration objects over time. A trend that might be observed is how the use of objects might decrease when team members become more familiar with one another. When engaging in such research one should be aware of and sensitive to all the different boundaries that are encountered within these teams.

What stood out during the analysis of the function of collaboration objects, is that most objects were boundary objects. This might be the result of the fact that only the segments with boundary work were reviewed in the second round of coding for collaboration objects. What is expected is that when the complete dataset would be coded for collaboration objects, other functions might be seen more often. However, a conscious choice was made to code the boundary work segments, since understanding the influence of collaboration objects specifically on boundary work was the goal of this research.

Concludingly, one could say that both teams and their team members actively worked at the boundaries and thereby engaged in both collaborative and competitive boundary work. These boundaries were not only influenced by human agency, but also by the use of collaboration objects. The use of collaboration objects was not stimulated, but team members applied these objects out of natural habit to be able to engage in teamwork. The effects of using collaboration objects as interventions for teams participating in boundary work, might be interesting for future research. This could prove that collaboration objects do not only stimulate communication but are able to be the 'glue' that enables teamwork.

References

Abdallah, C., Lusiani, M. & Langley, A. (2019). Performing process research, In B. Boyd, T.R. Crook, J. Lê & A.D. Smith (Eds.), *Standing on the Shoulders of Giants: Traditions and Innovations in Research Methodology*, 91-113, Bingley, UK: Emerald.

Akkerman, S., Admiraal, W., Simons, R. J., & Niessen, T. (2006). Considering diversity: Multivoicedness in international academic collaboration. *Culture & Psychology, 12*, 461-485

Akkerman, S. F., & Bakker, A. (2011). Boundary Crossing and boundary Objects. *Review of Educational Research, 81*, 132-169.

Akkerman, S., & Bruining, T. (2016). Multilevel boundary crossing in a professional development school partnership. *Journal of Learning Sciences, 25*, 240-284.

Allen, D. (2000). Doing occupational demarcation: The "boundary-work" of nurse managers in a district general hospital. *Journal of Contemporary Ethnography, 29*, 326-356.

Alvesson, M. (1996). *Communication, power and organization*. Walter de Gruyter, Berlin.

Azambuja, R., & Islam, G. (2019). Working at boundaries: Middle managerial work as a source of emancipation and alienation. *Human Relations, 72*, 534-564.

Bach, S., Kessler, I., & Heron, P. (2012). Nursing a grievance? The role of healthcare assistants in a modernized national health service. *Gender, Work & Organization, 19*, 205-224.

Baskerville, D., & Goldblatt, H. (2009). Learning to be a critical friend: From professional indifference through challenge to unguarded conversations. *Cambridge Journal of Education, 39*, 205-221.

Bucher, S., Chreim, S., Langley, A., & Reay, T. (2016). Contestation about collaboration: Discursive boundary work among professions. *Organization Studies, 37*, 497-522.

Bunderson, J. S., & Sutcliffe, K. M. (2002). Comparing alternative conceptualizations of functional diversity in management teams: Process and performance effects. *The Academy of Management Journal, 45*. 875-893.

Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science, 13*, 442-455.

Comeau-Vallée, M., & Langley, A. (2019). The interplay of inter- and intraprofessional boundary work in multidisciplinary teams. *Organization Studies, 41,* 1-24.

Colby, M. & Appleby, R. 1995. Reflective practice through critical friendship: Some possibilities. *Cambridge Journal of Education*, 25(2): 149–160.

Costa, A. & Kallick, B. 1993. Through the lens of a critical friend. *Educational Leadership*, 51(2): 49–51.

Easterby-Smith M., Lyles, M. A., & Tsang, E. W. K. (2008). Inter-organizational knowledge Transfer: Current themes and future prospects. *Journal of Management Studies, 45*, 677-690.

Edmondson, A. C., & Harvey, J. (2018). Crossing-boundary teaming for innovation: Integrating research on teams and knowledge in organizations. *Human Resource Management Review, 28*, 347-360.

Engeström, Y. (1987). Learning by expanding: An activity theoretical approach to developmental research. Helsinki: Orienta-Konsultit Oy.

29

Ewenstein, B., & Whyte, J. (2009). Knowing practices in design: The role of visual representations as 'epistemic objects'. *Organization Studies, 30*, 7-30.

Fominykh, M., Prasolova-Førland, E., Divitini, M., & Petersen, S. A. (2016). Boundary objects in collaborative work. *Information Systems Frontiers, 18*, 85-102.

Fox, N. J. (2011). Boundary objects, social meanings and the success of new technologies. *Sociology, 45*(1), 70-85.

Garud, R., Gehman, J., & Karunakaran, A. (2014). Boundaries, breaches, and bridges: The case of Climategate. *Research Policy, 43*(1), 60-73.

Hernes, T. (2004). Studying composite boundaries: A framework of analysis. *Human Relations, 57*, 9-29.

Huvila, I., Anderson, T. D., Jansen, E. H., McKenzie, P., & Worrall, A. (2017). Boundary objects in Information Science. *Journal of the Association for Information Science and Technology, 68*, 1807-1822.

van Knippenberg, D., & Schippers, M. C. (2007). Work group diversity. *Annual Review of Psychology, 58*, 515–541.

Langley, A., Lindberg, K., Mørk, B. E., Nicolini, D., Raviola, E., & Walter, L. (2019). Boundary work among groups, occupations and organization: From cartography to process. *Academy of Management Annals, 13*, 703-736.

Langley A., & Tsoukas, H. (2016). Introduction: Process thinking, process theorizing and process researching. In A. Langley & H. Tsoukas (Eds.), *The SAGE Handbook of Process Organization Studies* (pp. 1-25). London, England: SAGE Publications Ltd.

Liberati, E. G. (2017). Separating, replacing, intersecting: The influence of context on the construction of the medical-nursing boundary. *Social Science & Medicine, 172*, 135-143.

Lindberg, K., Walter, L., & Raviola, E. (2017). Performing boundary work: the emergence of a new practice in a hybrid operating room. *Social Science & Medicine, 182,* 81-88

Mannix, E., & Neale, M. A. (2005). What differences make a difference? The promise and reality of diverse teams in organizations. *Psychological Science in the Public Interest, 6*, 31–55.

Nicolini, D., Mengis, J., & Swan, J. (2012). Understanding the role of objects in cross-disciplinary collaboration. *Organization Science, 23*, 612-629.

Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. *Organization Studies, 28*, 1435–1448.

Pouthier, V. (2017). Griping and joking as identification rituals and tools for engagement in cross-boundary team meetings. *Organization Studies, 38*, 753-774.

Quick, K. S., & Feldman, M. S. (2014). Boundaries as junctures: Collaborative boundary work for building efficient resilience. *Journal of Public Administration Research and Theory, 24*, 673-695.

Reay, T., Golden-Biddle, K., & Germann, K. (2006). Legitimizing a new role: Small wins and microprocesses of change. *Academy of Management Journal, 49*, 977-998.

Reay, T., Zafar, A., Monteiro, P., & Glaser, V. (2019). Presenting findings from qualitative research: One size does not fit all! In T. Zilber, J. Amis, & J. Mair (Eds.), *The production of managerial knowledge and organization theory: New approaches to writing, producing and consuming theory,* Research in the sociology of organizations (Vol. 59, 201-216). Bingley, UK: Emerald.

Sapsed, J., & Salter, A. (2004). Postcards from the edge: Local communities, global programs and boundary objects*. Organization Studies, 25*, 1515-1534.

Star, S. L. (2010). This is not a boundary object: Reflections on the origin of a concept. *Science, Technology & Human Values, 35*, 601-617.

Swan, J., Bresnen, M., Newell, S., & Robertson, M. (2007). The object of knowledge: The role of objects in biomedical innovation. *Human Relations, 60*, 1809–1837.

Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, 7, 225–246.

Wheelan, S. A. (2005). *Group processes: A developmental perspective (2nd ed.).* Boston, MA: Pearson Education.

Appendixes

Appendix 1. Codebook: Boundary work

We are open to all types of boundaries that can be encountered within the inter-organisational teams. The following types were most prominently discerned in literature and therefore serve as main orientation anchors (Comeau-Vallee & Langley, 2019; Hernes, 2004; Paulsen, 2003):

- Physical boundaries are related to formal rules and physical structures. For example, people working at different sites of the office often collaborate less. These boundaries are constructed for instrumental purposes and regulate action and interaction in teams and organisations. Another example of a physical boundary is a team member who does not have access to all documents or required knowledge; such a boundary prescribes the outer limits of what can and what cannot be done. Physical boundaries are so material and obvious that teams and team members can hardly deny their existence or work around them.

- Social boundaries relate to the cultural part of teams and organisations. They are formed through the relations between members and enable production and reproduction. Based on cultural aspects and thus the identity an organisation or team has, they draft norms of behaviour. This could lead to teams' distinction at a social level, because they decide to do things differently than other teams do, which is maintained through social bonding as this leads to norms of behaviour. While physical rules hold for everyone, are very formal and written down, group norms and social boundaries are worked out by specific group members, they are more fluid and flexible and subject to constant change. Loyalty, trust, identity and group norms are products of social boundaries. Within an organisation, both marketing and product development need to communicate to satisfy their customers' requests, yet they have very different roles and tasks to complete.

- Symbolic/cognitive boundaries relate to the core concepts and ideas that exist within the team members, team or organisation and are central and particular to it. These symbolic boundaries are mechanisms in forms of beliefs, ideas and understanding which guide organised actions. This would mean that a team can work from a certain theory which leads to the fact that this team has monthly meetings with the organisation who has ordered a product, to make sure that they are on the right track, instead of delivering a product after eight months of hard work. Another example is a team member who keeps on speaking and talking from their own frame of reference, their own ideas infer with the teamwork, due to a lack of openness to others' point of view.

Kind of BW	Type of BW	Description	Example
Competitive boundary work	Defending	A team or team member is discerning itself as significantly different and superior on elements that distinguish the team from other teams or the member from other members. It usually concerns a dichotomy, for example scientific teams who create ethical spaces to maintain their credibility and position, in comparison to other practices which are constructed as more questionable.	*'Volgens mij is dat nog niet helemaal duidelijk, behalve dan dat we hebben geconstateerd dat Organisatie X, Organisatie Y en Organisatie Z in het blauwe veld zitten op dit moment zeker nog, en dat dat jullie, als jullie een positie weten te vinden, dat die al in het rode veld zit.' 'ja dat klopt.' 'dat jullie service al jullie product is'*
	Contesting	A team or team member analyses both sides of a boundary in order to understand why and how tactics and strategies may differ while boundaries are upheld. Teams or team members on one side may try to discern themselves, while a team or a team member on the other side may try to blur the boundary. In short: different teams or team members deploying different strategies.	*'Een sprekend voorbeeld van wat er nu gaat gebeuren, dat dus Defensie heeft nu dus een tweetal radars.' 'Ja' 'Eén in Wierden, één in (onverstaanbaar gemompel), die worden onderhouden door Defensie zelf. En nu zie je dus dat de volgende generatie, daar zegt Defensie gewoon van het onderhoud is niet meer hun corebusiness, wij gaan het anders doen.' 'Ze gaan terug naar hun bestaan, waarom bestaat Defensie optreden en veiligheid, en al die dingen daaromheen willen ze eigenlijk vanaf, ze willen alleen maar daar mee bezig zijn.' 'En dan zijn dit er maar twee, binnen de hele familie van SS die de luchtmacht heeft, eigenlijk zijn de vliegtuigen nog veel meer een risico. Dus dat betekent dat zij op die manier besluiten met het onderhoud, wij gaan onze organisatie niet opnieuw inrichten. Organisatie X gaan jullie maar mooi jullie onderhoudsorganisatie opnieuw inrichten en ga het onderhoud maar voor ons doen. En dat is heel kenmerkend van deze journey, van de servitisation journey. Eigenlijk blijft het werk nog hetzelfde, alleen wordt het overgedragen naar andere partijen.'*

	Creating	A team or team member creates an own space, in which they prove their value to a wider domain and/or try to market their services. These teams are often new or weaker, which means that the existing boundaries are actively shaped, and territory is expanded or demarcated for the benefit of the team/team member. In the end a distinction to the other is created.	*Doelstelling voor vandaag is om nog eens te kijken naar die drie cases zoals ik ze net noemde, dus eh die drie cases, om nou eens te kijken van kunnen we die doelstelling in ieder geval van case 1 en 2 e:h meer als een geheel smeden, waardoor we denken van hee hierdoor kunnen we daar perfect in samenwerken en is het niet meer zozeer van: de een doet deze en de ander doet die en we werken grotendeels naast elkaar, maar je werkt echt samen waardoor er hopelijk ook een betere uitkomst uit kan komen.*
	Other competitive BW	A team or team member is creating and highlighting differences, they have different goals and use different strategies. Work that is performed is not aligned with what other teams/team members are doing, they are interacting in an oppositional way.	
Collaborative boundary work	Negotiating	A team or team member is enabling collaboration through the negotiation of physical, social and/or symbolic boundaries. For example, different roles, expectations and understandings are discussed in order to reach an agreement on the project approach.	*'Het grappige vind ik wel dat je eh eh je begint met een definitie van voor, maar je doet meteen eh zeggen van eh en zo eh eh gaan we het ook persen zou ik maar zeggen. Dus zeg maar je acceptatiecriteria eh leg je ook meteen op tafel.' 'Ja dat doen wij inderdaad ook' 'Dat is gewoon het v-model' 'dat is gewoon het v-model, maar dan agile toegepast eh eh zeg maar' 'ja, wij hebben het vaak over een minimum viable product, eh' 'ja' 'waarbij je primair op de markt op de markt wil komen' 'ja' 'en om je kosten en tijdslijnen te reduceren en vervolgens wel kennis en validatie te doen in de markt eh ik denk dat dat wel een beetje overeenkomt eh met die minimale set aan doelstellingen die je hebt. En als je dan eh binnen de tijd die je hebt gespect van dan en tot de markt, nog extra*

		ruimte hebt dan kan je er nog wat features aan toevoegen. Dus op zich komt dat wel overeen.'
Embodying	A team or team member takes on a specific role where they embody boundaries within their activities. They both negotiate differences between groups and also cope with their own identity tensions. *For example: Japanese expats in the U.S. who mediate between the two countries, without explaining what they do to the counterparts but smooth over their relations.*	*'Dat zijn heel andere uitgangspunten eh, maar wel net zo relevant voor Organisatie Y, want dat zien we ook' 'jajaja' 'nee maar kijk' 'en misschien dat deze nog wel vaker voorkomt, nee deze komt vaker voor. Dan dan eh eh' 'Tis niet, het is niet dat ik e:::h, jullie beslissen daar zelf, want jullie kennen de omstandigheden, maar uit het werk wat wij met 1.3. gedaan hebben aan die product X-case, waar we met name ook gekeken hebben naar, tussen de relatie naar tussen de eh eh gebruiker van product X en Organisatie Y, plus het feit dat we daar eh ook aandacht besteden hebben aan de flows, maar vooral ook de discussies die Daan inbracht, ten aanzien van e::h KPI's, hoe ga je met KPI's om? E:h e::h had ik de indruk dat eh van eh dat is wel een hele mooie case omdat dan het element met KPI's ook invloeit in zeg maar een servitisation of een BBL-achtige roadmap'*
Downplaying	A team or a team member deliberately ignores or jokes about the differences between the team members. Also, a shared goal can be directly discussed, ignoring differences.	*Daar hebben we nog een mooie uitdaging. Iedereen denkt dat wij bij Organisatie X het goed voor elkaar hebben, maar wij worstelen ook nog wel met de nodige uitdagingen hoor [gelach]*
Other collaborative BW	A team or team member is working at the boundary, they are collaborating in order to get work done. Patterns of collaboration and coordination are developed and sustained.	

Appendix 2. Codebook: Collaboration objects/figures

Level	**Type** of object/figure	Description	Example
1	Communication system	The team or a team member uses or refers to a type of communication system that the team uses to communicate or share and store information outside of their meetings.	
	Meeting room	The team sits in a typical meeting room.	
	Screen and laptop connection	A team member connects her laptop to a screen or beamer in order to show something to the group.	
	Whiteboard or flipchart	A team member uses a whiteboard or flipchart to draw or write down something.	
	Cup or glass	A team member uses a cup or glass for purposes other than drinking.	
	Paper	A team member uses a paper to draw or write down something.	
	Pen	A team member uses a pen for purposes other than drawing or writing down something.	
	Project proposal or description	A team shows, describes, or refers to the team's project proposal or description; for example, to work on it and refine the	

team's goals and plans or to remind the team of these.

Agenda	A team member shows and/or refers to the agenda of the meeting; for example, to give an overview of the meeting's action points or to structure the meeting and remind the group of what is up now or next.	*Ja (.) eh, even kort de agenda, even waar we zijn en wat we allemaal eh e:::h verder nog willen gaan doen. Dat is heel kort e:::h eh de agenda van vandaag.*
Story, narrative or, or past experience	A team member tells a story about an event that she has experienced or heard of or shares some of her experiences that she has made in the past. This can, for example, include stories about management's behaviour in a specific situation or about problems and challenges encountered in the past. It can also include a past experience a person has had with a customer or a co-worker.	*Op gegeven moment kwamen we e:::h kwam de vraag e:::h (0.5) of we tijdens de user days een interactieve::: sessie kunnen organiseren? En toen hebben we de methodiek van e:::h value proposition design hebben we gebruikt.* *Ik weet bijvoorbeeld van van een project wat we opgeleverd hebben voor een klant, waarbij we wel de discussie hebben gehad en gezegd hebben van Okay jullie willen dus NO service, jullie willen daar absoluut niet over praten- Ne, ne, was niet nodig […] We zijn twee jaar verder, en dan komt er gewoon zo'n zo'n handig inkoper en zegt van Ja maar hoe zit dat dan met jullie verantwoordelijkheid, want daar zitten gewoon fouten in.*
Comparison, metaphor, or analogy	A team member describes or explains something by mobilizing the notion of a similar object, process, image, or symbol.	*Dan trek ik even een een parellel naar wat daar gebeurd is met e:::h de koffie machines. In verleden hadden de bedrijven allemaal koffiemachines en en kochten ze bonen in, and so forth. Dat klopt*

inmiddels in geen van de bedrijven meer zo. Je hebt nu iets van een firma die daarvoor zorgt dat de koffiemachines bij mij in bedrijf staan en dat het loopt. De uitdaging is om die ontwikkelingen, dat model, ook te implementeren als businessmodel voor Product X in relatie tot ziekenhuis.

Nee maar goed, trek even een parallel aan als jij:::, jij koopt een nieuwe auto en dan heb je 24 manden garantie, of zoveel draaiuren wat week ik hoeveel, en nou, tot in die tijd wordt alles meet heel veel coulance wordt opgelost door je dealer. En dan ben je daar voorbij en dan gaat er toch eigenlijk in die context gaat er iets stuk, wat dan? (1.0) Dan krijg je altijd een discussie over hoe werkt het dan. Is het nog steeds de verantwoordelijkheid in in in de context van de afspraken die je in het begin hebt gemaakt, of juist helemaal niet?

Example	A team member gives a specific and characteristic example of something that she is trying to explain; for instance, to make an abstract group, category, process, or idea easier to understand.	*Met betrekking tot preventive maintenance, e:::h (0.5) is het een beetje, naja, omdat de regulaties per land verschillen in hoe vaak je een system moet laten kalibreren. Duitsland is bijvoorbeeld heel streng en die moeten gewoon elk jaar hun medisch apparaten laten kalibreren e:::h Nederlands is volgens mij een keer in twee jaar, en zo verschilt dat per land.*
Pre-existing visual, graphic, or drawing	A team member explains or describes something by using and showing pre-	*Daar vind ik ook de kracht van deze deze::: afbelding. Het gaat om de aspecten type of relation, business*

	existing visual aids, such as an image or a graphic.	*model en value proposition en die zijn onlassmatig met elkaar verbonden. En als je meer na rechts wilt, dan moet je op elk van deze moet je een stapje maken en dat vind ik een mooie, een mooie van hoe ze dat hier in beeld gebracht hebben.*
Visual, graphic, or drawing created to during meeting	A team member explains or describes something by creating an own sketch or drawing during the meeting (on a piece of paper, a whiteboard, etc.) that she shows to the rest of her team.	
Guideline or similar documents	A team member explains or describes something by using and maybe showing pre-existing textual aids, such as product guides or other documents.	
Keywords	A team member writes down important words (on a piece of paper, a whiteboard, etc.) while explaining or describing an idea, thought, or insight.	
Process, procedure, or routine	A team member explains or describes her organization's typical or standard ways of working to clarify something for the rest of her team. Most often, this takes the form of steps of actions that follow upon each other.	*Wat een werk! Bij ons, bij de marine, daar schrijven ze het in rood bij en de volgende keer dan doen ze dat op die manier.*

Situation or class of situation	A team member explains or describes specific or typical circumstances and what she or her organization would do in these.	*Als je een nieuw product bijvoorbeeld maakt (.) als je nog helemaal niet, zoals ik Harry even begrepen heb, hoe kun je dan hele concrete dingen afspreken?*
Prototype or draft	A team member explains, describes, or shows a prototype or draft of, for example, a new product, a new website, a new document, etc.	
Presentation slides	A team member shows or refers to (a) presentation slide(s) to her team and elaborates on these.	*E:::h ja, laten we even kijken naar deze slide.* *De tweede punt e:::h tweede bullet is inderdaad opzicht ook ontzettend interessant (.) waar zit je in de waardeketen?*
Video	A team member shows a video to the team or refers to a video that she, or maybe the entire team, have seen before.	*Hetzelfde hadden we in het filmpje eigenlijk, met dat verlichting van Phillips, met dat je dan zeg maar jullie moeten eh gewoon voor licht zorgen, en dat Phillips dan ook al die dingen een beetje anders gaat bouwen.*
Other	This code will be used for objects and figures that are not yet part of the coding scheme. Objects and figures coded under 'Other' will be re-analysed in the final phases of the data analysis to see whether there are any additional prominent objects and/or figures in the data that we did not capture in our initial coding scheme.	

Level	**Function** of object/figure (Nicolini et al., 2012)	Description	*Example*
2	Material infrastructure	An object that provides the basic and mundane infrastructural support of collaboration, such as a meeting room or a communication system. This type of object is mostly taken for granted and remains very invisibly, performing a background function. However, it can become very visible when it no longer performs its required function, e.g. when a meeting room is blocked or when communication systems fail.	
	Boundary object	An object that facilitates work, communication, and understanding across team members' differences in professions, trainings, values, and other background characteristics.	
	Epistemic object	An object that embodies something that team members do not yet know but want to find out. This can be questions, a solution to a problem that is not yet solved, or team members' goals. Such an object often also provides a sense of direction and motivation for team members.	