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Reasearch paper

Boundary objects in network interactions☆

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ABSTRACT

The purpose of this paper is to investigate the mediating role of boundary objects in interaction processes within business networks. From a single case study in the grocery retail industry, we find that such objects are used within interaction processes for collaboration, but are also used extensively for handling conflict, facilitating economic negotiations, and power execution. As such, network-level boundary objects do not require broad consensus by all the involved actors, but instead narrow consensus in a particular interaction process.

1. Introduction

The purpose of this paper is to investigate the mediating role of boundary objects in interaction processes within business networks. We adopt the concept of boundary objects from organization studies and use it to show how such objects are used to interact, facilitate co-operation, handle conflict, and achieve narrow consensus in interaction processes. Such objects can be considered as a form of "inter-cognitive representation" in business networks (Mouzas & Henneberg, 2015). They can be defined as "*…both plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across sites*" (Star & Griesmer, 1989:393).

In studies of inter-organisational networks, interaction is seen as the activities performed across firms at multiple levels to co-ordinate and to create value by combining resources from multiple actors (cf. Håkansson, 1982; Håkansson & Snehota, 1995). It involves all the industrial marketing and purchasing activities that are performed on a day-to-day basis (Håkansson & Waluszewski, 2013) including both ongoing and future potential business solutions.

In a business network setting, relationship interactions are characterized by both cooperation and conflict (Ellegaard & Andersen, 2015; Ford, 1980). A central issue is how to achieve collaboration among diverse and partly competing actors in networks (e.g. Bengtsson & Kock, 2000; Tidström, 2015) when both individual interests and collective purposes are present (Medlin, 2004; Munksgaard, Johnsen, & Patterson, 2015; Wilkinson & Young, 2002). Boundary objects provide a lens to investigate how cooperation and conflict are handled within specific interaction processes. As such, our research question is; '*how are boundary objects used in business network interactions?*'

The empirical setting in this paper is that of the supplier-retailer network context. While power is an inherent part of relational interaction in business networks (e.g., Baraldi & Nadin, 2006; Kutschker, 1982; Meehan & Wright, 2012; Welch & Wilkinson, 2005; Wilkinson, 1973; Wilkinson & Young, 2002), supplier-retailer network contexts are typically concentrated networks, in which there are asymmetrical relationships based on powerful retailer actors (Hingley, 2001; Hingley & Hollingsworth, 2003; Sutton-Brady, Kamvounias, & Taylor, 2015). In other words, the power dimension inherent in all interactions comes to the fore (Authors, Rindt & Mouzas, 2015; Maglaras, Bourlakis, & Fotopoulos, 2015).

The in-depth single case study reported below is based on a two-month period of intensive interaction across retailers and suppliers in the Norwegian grocery retail industry. Negotiations take place every autumn in the sector, known as the "Autumn Hunt". The negotiations which form the basis of the case occurred against the backdrop of Lidl as a new market entrant. The threat of a new discount chain intensified the interactions, already laden with cooperation, conflict, power and influence. As a result of the contracts agreed at the end of the negotiation process, the Norwegian Competition Authority took the major dairy supplier Tine to court for anti-competitive behaviour. The case study is based on the material from three court cases between Tine and the Norwegian Competition Authority.

The paper proceeds as follows. In the next section below we briefly discuss inter-organisational networks in terms of cooperation, collaboration and control. We then outline the characteristics of boundary objects, and relate these to network interactions. Sections three and four describe the research methodology and provide some background to the case study. Next, we describe a chronology of network

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interactions over a two-month period, which is followed by an analysis of the characteristics of boundary objects operating at the network level.

In our case material we uncover how a constellation of boundary objects (cf. Cacciatori, 2012) – price surveys, planograms and financial spreadsheets - are used across inter-organisational boundaries. We find that the multiple boundary objects mediating network interactions have four characteristics in common. Three of the characteristics relate to coordination; boundary objects 'facilitate present interaction', 'simulate future interaction patterns and roles', and aid 'calculating and visualising'. A fourth characteristic is that of 'shaping, using and re-arranging power relations'. That is, the use of boundary objects as a means for control/power. Taken together, these four characteristics make the boundary objects influential in shaping networked interaction processes, where rivalry, negotiation, coordination and collaboration play out across the actors.

In the final section of the paper we argue that network-level boundary objects do not require broad consensus by all the actors involved. Instead, narrow consensus in a particular interaction process is sufficient. Boundary objects mediating network interactions facilitate narrow consensus in a particular interaction process – such as the autumn hunt – in which some actors improve their network position and other relationships are terminated. More specifically, (i) economic targets are essential to the use of network-level boundary objects; (ii) their use tends to reflect the existing distribution of power within the network; and (iii) orchestration across linked boundary objects allows for the amplification of influence.

Our findings both challenge the bias towards consensus-based coordination and collaboration in current boundary objects research (e.g. Lainer-Vos, 2013), and provide another lens for investigating how cooperation and conflict is handled in business networks, specifically with the attainment of narrow consensus.

2. Network interactions: Co-ordination, collaboration and control

Network interaction can take many forms and shapes (Håkansson & Waluszewski, 2002a,b) ranging from pure exchange – or thin interaction (Swedberg, 1994) – with no effects on products, facilities, business units and relationships to networking – or thick interaction (Håkansson & Waluszewski, 2013). In this paper, we specifically emphasize the networking interaction type, or "network interactions". Such "networking" is "neither neutral or fair" (Håkansson & Waluszewski, 2013, p 447).

Through network interaction actors, resources and activities in networks are co-ordinated across firm boundaries. Obtaining increased efficiency and effectiveness from inter-organisational interaction is said to require mutuality of goals (Håkansson, 1982; Park, 1996), adaptations (Brennan, Turnbull, & Wilson, 2003), trust (Blois, 1999; Huemer, 2004), and commitment (Anderson & Weitz, 1992), which enables resource interaction (Håkansson & Waluszewski, 2002a, 2002b), and cost rationalizations (Dubois, 2003).

There are episodes of consensus and agreement in business networks, but obviously also episodes of non-consensus, based on conflict and discord (Ford, 1980; Munksgaard et al., 2015; Tidström, 2015). Thus some network interactions are beneficial to some actors while detrimental to other actors. This gives rise to non-consensual network interactions due to ambitions of control and influence on behalf of some powerful actors. Non-consensual network interactions exist because, fundamentally, network interactions are not inherently neutral (Håkansson & Waluszewski, 2013), and both individual actor interests and collective purposes are in play in business networks (Medlin, 2004; Munksgaard & Medlin, 2004; Wilkinson & Young, 2002).

The next section below outlines the characteristics of boundary objects; after which we link such objects to business network interactions.

2.1. What are boundary objects?

Boundary objects were defined above in the Introduction section. Studies of boundary objects need to take into account how they facilitate interaction, their interpretive flexibility, how they aid information and work processes, and how they enable both tailored (internal) and more ill structured (across actors/inter-disciplinary) use (Star & Griesmer, 1989). More specifically, they enable coordination, collaboration, and mediate change, across boundaries.

Boundary objects in different forms can facilitate co-ordination. Various artefacts can fill this role, e.g. prototypes (Bechky, 2003a; Carlile, 2002), engineering sketches (Henderson, 1991), standardized reporting forms (Star & Griesmer, 1989) and use scenarios (Bødker, 2000). What a boundary object needs to achieve to enable interaction will of course also fluctuate; sometimes it will be shared language, other times learning tools, or shared processes (Carlile, 2002).

Boundary objects are also commonly in use for enabling collaborative problem solving across boundaries. Hsiao, Tsai, and Lee (2011) studied how a number of different objects, from mathematical patterns to tanks and robot arms, were mobilized as boundary objects to facilitate learning and collaboration across organizations in an engineering setting. Multiple boundary objects – "systems of artefacts" – can also be in use for this purpose at a given point in time (e.g. Cacciatori, 2012).

Boundary objects can also mediate change across boundaries. This brings the political aspect to the fore (Mørk, Hoholm, Maaninen-Olsson, & Aanestad, 2012). In the words of Lee (2007: 307), boundary objects can "be used to push boundaries rather than merely sailing across them". Indeed, sometimes actors may impose "interpretive rigidity", i.e. limiting other actors' room for interaction (Klerkx et al., 2012). They are therefore a part of the struggle for status, control and position (Barrett & Oborn, 2010; Hsiao et al., 2011). Boundary objects may hence both facilitate and inhibit knowledge sharing and collaboration (Swan, Bresnen, Newell, & Robertson, 2007).

2.2. Linking boundary objects to network interactions

Connecting boundary objects to business relationship interactions extends the scope of boundary objects to the network level. In business networks boundaries are multiple, provide functions such as bridging and buffering, and imply numerous boundary spanning roles, not only key account managers (e.g. Araujo, Dubois, & Gadde, 2003; Dubois, 1994; Spencer, 2005; Torvatn, 1996). In other words, teams of individuals in the different organizations interact (Ford, 1980; Håkansson, 1982). As "an object is something people act toward and with" and "based in action" (Star, 2010: 603), a boundary object may be part of the ongoing interaction processes involved in connecting resources and managing roles across actors. It can be viewed as an "inter-cognitive representation" underpinning interaction in multiple business relationships (Mouzas & Henneberg, 2015).

Recent research has discussed the role of objects in a variety of ways. This includes their boundary creation and spanning features in market shaping (Finch & Geiger, 2011; Geiger & Finch, 2009), as well as the roles of market devices in various exchange situations (e.g. Callon, Muniesa, & Millo, 2007; Doganova & Eyquem-Renault, 2009), and the impact of accounting devices in inter-organisational settings (Azimont, 2010; Baraldi & Strömsten, 2009; Preda, 2002).

One concern is that every artefact and indeed individual involved in resource utilisation across inter-organisational boundaries is potentially a "boundary object", at least if a literal understanding is applied. Star's (2010) framework provides several useful restrictions here: to be considered as a boundary object operating at the network level, an object must facilitate coordination, including the structuring of work processes and movement between ill structured use (across boundaries) and tailored use (internal to each actor) across multiple business relationships.

Investigating how boundary objects mediate interactions across multiple relationships facilitates in-depth study of network interaction aiming at coordination, against a back-drop of power and control ambitions. In particular, we posit that the role of boundary objects as a means for exercising control and power remains under-investigated, even though one aim in studies of boundary objects is to understand collaboration without consensus (Star, 2010). Systemic power refers to the embedding of power into routines, practices and socio-material relations (Clegg, 1989; Foucault, 1979; Lawrence, 2008). This suggests the need to include objects in the analysis of collaboration and conflict in inter-organisational settings.

We investigate boundary objects "in situ"; in use within current network interaction processes across multiple dyadic relationships. The use of boundary objects within ongoing network interactions across customers and suppliers is a different phenomenon than transforming objects in network settings (e.g. McGivern & Dopson, 2010), or how boundary crossing in supplier networks is facilitated via the use of boundary objects in developing organisational capabilities (Hong & Snell, 2013). The boundary objects under discussion in the empirical sections of this paper (below) mediate how business network interactions take place.

The next section outlines the research design underpinning the paper, and provides some background to both the industry generally and the specific case.

3. Research design: Court cases tracing slices of network interaction

The research methodology used in the paper is a single exploratory case study (Easton, 2010; Stake, 2003). Case studies embed an object in context, and allow depth, detail, and richness of data (Yin, 2014). This type of research design is common for the study of business interactions in networks (Dubois & Araujo, 2004; Dubois & Gadde, 2002, 2014; Halinen & Törnroos, 2005; Morgan & Smircich, 1980).

The selection of the case was based on a combination of ongoing research connections, empirical access and theoretical interests (Dubois & Gadde, 2002, 2014; Eisenhardt & Graebner, 2007). It was initiated by interest in press reports that one of Norway's largest companies – the dairy company Tine - had been fined 3.8 million euro for anti-competitive behaviour towards their competitor Synnøve Finden by the Norwegian Competition Authority (hereafter NCA) during the so-called "Autumn Hunt" (an annual negotiation period) in 2004.

Tine is a dominant actor in the protected Norwegian dairy market. They have a special role as a "market regulator", which means Tine is subjected to particular obligations to not harm the existing level of essentially marginal competition. It implies a rather complex balancing and orchestration of the co-ordinated and competitive elements within the dairy industry.

We frame the case study as centred on the two intensive months of negotiations in the Autumn Hunt of 2004, along with the resulting court case when the NCA fined Tine. The data collection process was to obtain the three publically available legal documents relating to the fine. These are: (i) the decision of the NCA,[1] (ii) the appeal at Oslo City Court, which decided in favour of Tine,[2] and (iii) the decision from the Court of Appeal,[3] which decided partly in favour of the NCA.[4] Several of the analytical case selection decisions were shaped by the legal material, in particular the relevant time boundaries. The data contains detailed descriptions of the business interactions of the involved actors over a six-month period. Our case study focuses on the intensive interactions that occurred within a specific two-month window.

The legal documents are constructed from all the meeting notes and email exchanges across the representatives in the various organizations involved in the Autumn Hunt. In addition, the representatives were subjected to verbal questioning of their actions. The documents therefore provide very detailed accounts of the interactions across the representatives, as well as insights into the internal dialogues of each organization regarding how to relate to their counterparts.

Court case data is a useful way to collect data in case study research, but the quality of the data hinges on the depth of the information provided by the courts (Angrosino, 2005). In order to ensure quality and integrity of the court case data, we validated it across multiple court documents, reflecting diverging interpretations and judgments on behalf of multiple actors. Such data has also been used in other studies of business relationships, most notably in the case of the divorce between the UK retailer Marks and Spencer and its long-standing supplier, William Baird (Harrison, 2004).

Our data analysis was done in two phases. The first phase comprised reading and organising the data in order to gain familiarity. Our readings and discussions of each document were followed by constructing a basic chronology of the events and actions contained within the retrospective but rich material. The ability to critically evaluate the data sources was highlighted by our experience and knowledge of the sector due to a long-standing research interest. Dialogues in the research team around the interaction patterns within the chronological account led to an interest in the emerging theme of how boundary objects were used. In particular, three objects appeared to be central in facilitating interaction across multiple actors: newspaper price surveys, planograms and financial spreadsheets. Our continued analysis seemed to reveal how they trigger, facilitate, close, open, hinder and aid interaction.

A decision was made to focus on these, and in phase two of the analysis, we carefully extracted text about how the different objects influenced interactions across the actors. This was done by multiple discussions of the texts, alongside comparing the extracted examples with the definition of boundary objects provided by the current literature. These dialogues required us to iterate back and forth between the case and the literature as described in the abductive logic approach (Dubois & Gadde, 2002, 2014; Eisenhardt & Graebner, 2007).

Lastly, with an exploratory case study approach, the basis of generalisation beyond the boundaries of the case is to existing theory in order to make analytical or theoretical generalisations (Bonoma, 1985; Mitchell, 1983; Yin, 2014). In the next section we provide some brief background as to why the court case came about.

4. Background

The interactions across seven organizations are central in the case. These are three dairy companies Tine, Synnøve Finden and the Kavli Foundation (owner of the Q-brand), along with the four main grocery retailer chains; Rema, Lidl, Norgesgruppen and ICA. Fig. 1 illustrates the network structure.

Two interlocking events triggered the activities and interactions that resulted in legal action. The first is a repeated trigger for organising: the annual negotiation rounds between the suppliers and retailers. It is known as the "autumn hunt". The purpose of the autumn hunt is to negotiate the coming year's business interactions among the actors. Each actor aims to secure the most profitable contracts. The four retailers "*control more than 99% of the entire food retail turnover…*[5]*the*

[1] http://www.konkurransetilsynet.no/ImageVaultFiles/id_1851/cf_5/Oslo_tingrett_-Avgj-relse_SivilSak_73524816.pdf

[2] https://www.domstol.no/globalassets/upload/obyr/internett/nyheter/tine-dommen.pdf

[3] http://www.konkurransetilsynet.no/imagevaultfiles/id_4567/cf_5/lagmannsrettens_dom_i_tine-saken.pdf

[4] The case was ultimately decided by the Supreme Court, which voted 3-2 in favour of Tine

[5] The number of independent retail organizations is now down from four to three. The Norwegian ICA gave up in January 2012 by merging most of its purchasing with that of the largest retail group Norgesgruppen.

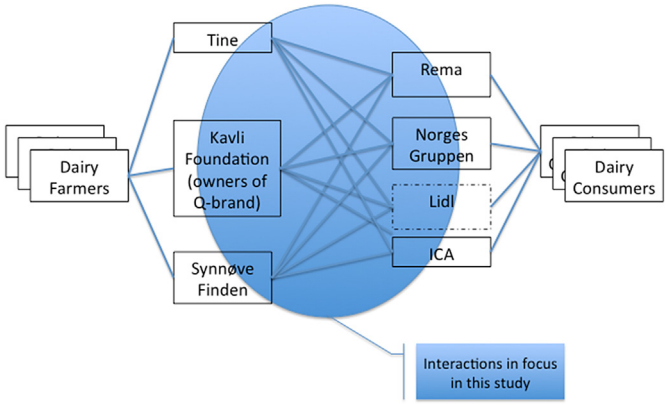

Fig. 1. Network structure

struggle for suppliers is to obtain access to shelf-space" (Borgarting Lagmansrett, 2010, p. 12). One result is that planograms became important during negotiations.[6] The drawing of planograms requires knowledge about consumer behaviour, the display of different products, and logistical issues. The retailers typically devise planograms themselves.

The second event is less regular in character: a decision by the German hard discount grocery brand Lidl to establish itself in the Norwegian market in 2004. The four main grocery retailers – of which Rema was the most price-focused – faced a new competitor with substantial resources. Rema decided to reduce its existing product range in order to focus on the leading brands in the main food categories. One way to achieve this was via supplier concentration.

Rema had established supply relationships for dairy products with Synnøve Finden, Tine and the Kavli Foundation (hereafter Kavli). These suppliers wished to use the autumn hunt in order to increase their current level of co-operation with Rema. While negotiations between Rema-Synnøve Finden, and Rema-Kavli were taking place, Rema's purchasing staff informed Tine that they were willing to discuss a single supplier arrangement for all cheese and milk products. This was based on the assumption that Tine could provide adequate compensation or so-called "market contributions".

The case study (below) starts with the project initiated between Rema and Tine in order to analyse the profitability of Tine's product assortments in cheese and milk. The outcome was a formal agreement between the actors in September 2004; it was later considered by the NCA as a breach of the national competition regulations. Fig. 2 summarises the chronology of the interactions described in the case.

5. Case study

5.1. August

The purpose of the Tine-Rema project initiated in August 2004 was to evaluate the profitability of Tine's cheese and milk product assortment. From Rema's perspective, the issue was how substantial the "market support" contributions from Tine would need to be if Synnøve Finden and/or Kavli were deselected and Tine's role was changed to that of sole supplier.

After a meeting on *August 16th*, Rema's purchaser "*told his boss that Tine already had cost-benefit analyses regarding the benefits of having one instead of two suppliers of milk and cheese*" (Borgarting Lagmansrett, 2010, p. 26). This was partly because several years previously "*Tine had obtained an evaluation from the consultants Genius Retail Management, the so-called 'Genius note'*" (Borgarting Lagmansrett, 2010, p. 23). The cost-benefit analyses were sent to Rema on *August 18th* (Borgarting Lagmansrett, 2010, p. 26). Rema incorporated these into their internal spreadsheets. As a result, Tine was informed that "*we will consider a sole supplier solution if the contributions were increased sufficiently*" (Borgarting Lagmansrett, 2010, p. 27).

In the same time period, Rema also asked Tine to draw new planograms "*...for cheese and milk without Synnøve Finden and the Q-brand [Kavli] … one traditional and one new and crazy alternative*'". The court maintained; "*it contributed to create expectations in Tine that they were to become the sole supplier of cheese to Rema*" (Borgarting Lagmansrett, 2010, p. 64). The person responsible for drawing the new planograms in Tine explained that "*he was surprised by the request to draw planograms without Synnøve Finden...It was fairly 'tough' to remove a product that had around 20% of both sales and shelf space in Rema's stores*" (NCA, 2007, p. 49).

5.2. September

On *September 7th*, Tine staff emailed their counterparts within Rema "*several Excel spreadsheets with revised, detailed calculations of how an eventual change to a sole supplier agreement with Tine would influence Rema's profits*" (NCA, 2007, p. 48). With the new data, Rema again undertook internal cost-benefit analyses based on their own spreadsheets (Borgarting Lagmansrett, 2010, p. 28).

Rema were concerned about being out-competed on low prices due to Lidl's entry. In particular, they wished to be cheaper than Lidl in the key dairy segment as well as on well-known brands. One result from an internal strategy seminar held in September was that Rema's catch phrase was changed from "*only low prices*" to "*only low prices on the brands you know*". In other words, Rema wished to re-position itself as a hard discount but (Norwegian) *'brands you know'* retailer.

A director in Rema stated; "*we could manage without Synnøve Finden and Q [Kavli], if the contributions from Tine were high enough*" (Borgarting Lagmansrett, 2010, p. 31). The activities analysing the impact of Tine becoming the sole supplier took into account financial contributions to Rema's so-called 'Turnip Fund'. After the initial rounds of negotiations, the calculations showed a loss to the Fund.

The Fund was relevant to the price survey published on a regular basis by the prominent national newspaper Verdens Gang (VG). Rema wished to retain their first place ranking in the VG price survey. Journalists generate a comparative pricelist of 80 common grocery items. The survey then ranks the supermarket groups from the cheapest to the most expensive. It affects the retailers by influencing overall price perceptions among consumers, and as such impacts advertising campaigns, competitive positioning, etc. Rema used their 'Turnip Fund'[7] to subsidize/lower the prices of items included in the survey (Borgarting Lagmansrett, 2010, p. 28). The use of the Fund began during the early 2000s (Oslo District Court, 2009, p. 10), underscoring its role in terms of 'price wars' towards rival retailers (Oslo District Court, 2009, p. 10).

Part of the ongoing negotiations therefore revolved around Rema's efforts to increase the level of contributions from Tine (the Fund is based on "*joint marketing*" contributions from all Rema's suppliers).

Tine then sent new planograms, which excluded their competitors, to Rema on *September 15th* (Borgarting Lagmansrett, 2010, p. 29), and followed this by making a new offer on *September 16th*. It contained a 43.5% increase in the financial contributions from Tine (compared to the previous year). By significantly increasing their contributions, Tine did not do "*anything to protect the remaining competition in the market*" (Borgarting Lagmansrett, 2010, p. 71).

The offer was based on the condition that the newly designed planograms were made binding (Borgarting Lagmansrett, 2010, p. 30). In

[6] A planogram is a tool used in merchandising in order to plan and organise shelf space at the retailer site.

[7] The name "Turnip Fund" (translated from the Norwegian *"kålrotfondet"*) was based on a similar fund at a Belgian retailer, the name of which sounded like the Norwegian word *"kålrot"*.

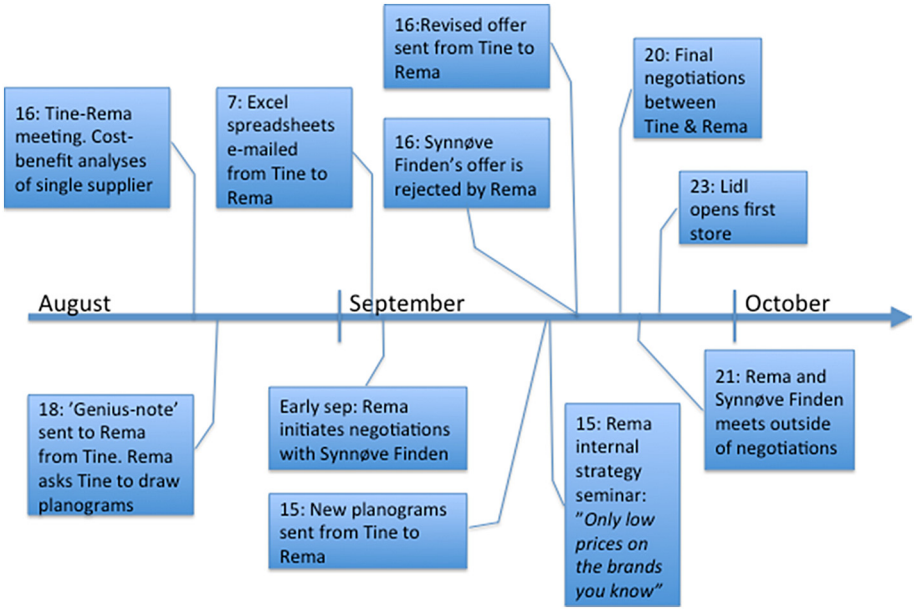

Fig. 2. Chronology of interactions

other words, the economic contribution offered from Tine was directly tied to the cost-benefit analysis being tested in the planograms (Borgarting Lagmansrett, 2010, p. 64). Rema's purchaser concluded that there would be "*clear benefits of having one supplier of cheese and milk*" (Borgarting Lagmansrett, 2010, p. 28). He then sent the planograms to his colleagues for ideas regarding how to save operational costs. Two responded with new calculations on logistics and operations, which would result in additional cost savings of 2.1 MNOK (Borgarting Lagmansrett, 2010, p. 29). Tine's representatives communicated internally "*both Synnøve Finden and Q-brand [Kavli] were 'out' of Rema*" (Borgarting Lagmansrett, 2010, p. 32).

The negotiations between Rema and Tine outlined above took place at the same time as negotiations were held between Rema-Synnøve-Finden and Rema-Kavli. Synnøve Finden's first offer in their negotiations with Rema was rejected. The supplier was allowed two days to produce a better offer. In the second offer, they increased their financial contributions for "*joint marketing*" activities (Borgarting Lagmansrett, 2010, p. 29). As a part of the negotiations, offers and counter-offers, Synnøve Finden (and also Kavli in their parallel discussion) was also given the opportunity to draw new planograms (without excluding their competitors), and thus calculate the economic benefits of various alternative product displays. Discussions regarding changes in the agreements between Rema and their suppliers thus invoked conflicts over the product assortment to be included in the planograms. Nevertheless, the shelves are under the proprietary control of Rema. Ultimately, Rema is able to request alternatives and to decide on the final version or to draw the planograms itself.

The final negotiations between Rema and Tine were conducted on *September 20th*, with an agreement being signed soon afterwards. The relationships between Rema-Synnøve Finden and Rema-Kavli were terminated soon after the agreement between Rema and Tine was in place.

Rema and Synnøve Finden also held meetings on *September 21st* that were directly related to Lidl opening their first store in Norway on *September 23rd*. In order to try to secure a price leader position in the VG survey, Rema wished to collect information from the dairy (and other) suppliers about Lidl in order to gain insight into its planned price levels. Consequently, the price points on various Rema products were adjusted. The result was that Rema retained their number one ranking in VG's first price survey after the opening of the Lidl stores (Borgarting Lagmansrett, 2010, p. 34).

6. Characteristics of boundary objects mediating network interactions

Table 1 provides a summary of the three boundary objects identified in the case study. The boundary objects - spreadsheets, planograms and the VG price survey - are rather different, yet each has a mediating role in the network interactions. The case study exemplifies that each boundary object has three characteristics, which relate to Star's (2010) framework, but assessed in a business network context; (i) to '*facilitate present interaction'*, (ii) aid '*simulating future interaction patterns and roles'*, and (iii) permit '*calculating and visualising*' between business actors.

Star argues that objects need to facilitate existing coordination (without necessarily requiring consensus), including the structuring of work processes and movement between ill structured use (across boundaries) and tailored use (internal to each actor). All three boundary objects in the case *facilitate present interaction* (existing coordination) by shaping the ongoing coordination and negotiations between the actors. For example, the planograms used provide visualisations of the current product assortments provided by the three suppliers. It is therefore a "baseline" at the start of the discussions. The associated economic cost-benefit analyses contained within the various versions of internal organization spreadsheets discussed between the actors involved underpin the planograms. The spreadsheets are shaped as they move across boundaries after internal actor use. The VG Price Survey is also important to the ongoing coordination in the network because it is a focus for price competition across grocery retailers.

The three boundary objects also mediate the network interactions by enabling *simulating future interaction patterns and roles*. They are central in the processes used to discuss propositions of altered supplier roles and the resulting changed activity connections. Interactions via planograms and spreadsheets required a vast amount of activities across Rema, Tine, Kavli and Synnøve Finden in order to identify economic costs and benefits. Propositions regarding adjusted activity scope (in the shape of the proposed assortment expansions underpinning the increases in contributions) went back and forth between the actors. These allowed for simulating the economic effects of various alternatives, and underpinned discussions of possible new roles.

In order to understand the financial implications of the present coordination arrangements and to construct simulations of possible future rules, *calculating and visualising* are performed by the business

Table 1
Case summary

Date	Boundary object	Situation	Interaction facilitation	Data source
August	1. Tine's cost-benefit analysis within Rema's spreadsheets	Evaluating the financial impact of changing Tine's role to sole supplier	Calculating the financial implications of Tine's current role	From BL data pp. 23–27, case text page 16
	2. Versions of planograms	Tine is invited to draw planograms which remove the other 2 suppliers	Simulating a possible future role with Tine as a sole supplier. This would change the current supplier relationships Visualising alternative shelf space designs which underpin spreadsheet calculations	From BL data pp. 49–64, case text page 17
Septem-ber	1. Tine's cost-benefit analysis within Rema's spreadsheets	Multiple versions of offers and calculations are made between Rema and Tine. The final version from Tine contains a substantial increase in contributions	Assessment of how to underpin a future sole supplier role Rema's wish to re-position before Lidl's entry.	From NCA data page 48, and BL data page 28, case text pages 17–18
	2. Kavli and Synnøve Finden's internal spreadsheets used within Rema's spreadsheets	Multiple versions of calculations of financial contributions and economic benefits are produced	Assessment of how to maintain and change the current roles	From BL data page 29, case text page 19
	3. Versions of planograms 4. VG Price Survey	Tine's new drawings exclude both their competitors. They must be binding	Tine calculates economic benefits and requires a new role. They visualise the benefits of a single supplier for Rema	From BL data pages 28, 30, 64, case text page 18
		Kavli and Synnøve Finden are invited to draw alternative product displays. They are not asked to exclude their powerful competitor	Rema initiates the production of multiple versions of possible product displays, some of which exclude suppliers, while others do not	From BL data page 29, case text page 19
		Used to rank all retailers	Rema wish to maintain their current dominant position. Any changes to supplier relationships must support this	From BL data page 28, Oslo District Court data page 10, case text page 19
		Rema evaluate the level of funding available for manipulating the Price Survey from all 3 of the suppliers		

actors using the three boundary objects. For example, financial spreadsheets summarize the results of efforts to improve the economic impacts of potential agreements (e.g. increased "market support" payments). Possibilities for change, improvement or termination are being represented and analysed within the spreadsheets. The exchanging of these Excel documents across boundaries, and their manipulating within organisational boundaries, permits the actors to develop their arguments, their documentation to persuade others, their ability to mobilize support, etc.

Rema requires its suppliers to propose alternative planograms in order to stimulate the development of better options (vis a vis the goal of not being out-competed by Lidl). The actors were playing a "network game" by testing out possible changed roles, sometimes without all of the actors present. The outcome would be that some relationships would be dissolved and others strengthened. The use of the boundary objects in business networks therefore does not require consensus (cf. Star, 2010). The actors in the network do not need to agree or be in harmony; the conflicts inherent in negotiations for improved roles and better agreements become embedded in the ongoing use of the boundary objects. Instead, limited consensus or agreement by some actors is sufficient (e.g. Rema-Tine). The boundary objects can at the same time underpin a lack of agreement – consensus – between other actors in the network (e.g. Rema-Kavli).

We propose '*shaping and re-arranging power relations*' as a fourth characteristic of boundary objects which mediate business network interactions. This is underplayed in the current organisational studies literature, in part because of a bias in empirical studies towards collaboration with consensus (e.g. Lainer-Vos, 2013), notwithstanding Star's (2010) point that consensus is not required. Yet in a business network setting, it is well known that relationship interactions are characterized by both cooperation and conflict (e.g. Ford, 1980; Tidström, 2015; Ellegaard & Andersen, 2015).

In the case reported here, conflict is handled via interacting and negotiating with the three boundary objects. The objects are used by the actors in their attempts to influence others and promote their own agendas. For example, the VG price survey is sufficiently predictive to the retailers to operate as a target for manipulations. As a boundary object it facilitates Rema in making calculations and visualising differing inputs from the 'Turnip Fund'. Here the execution of power concerns mobilizing and persuading others, and formatting their contributions, in order to meet the targets, set by an influential actor.

Hence when multiple boundary objects mediate network interactions they do not require broad consensus by all the involved actors. They coordinate possibilities for different actors to contribute through adaption to the circumstances represented by the others (or invoking differences, as argued by Bechky, 2003b). In other words, it is the facilitation of *narrow consensus* in a particular interaction process – such as the autumn hunt – in which some actors improve their network position (e.g. Tine) and other relationships are terminated (Rema-Synnøve Finden and Rema-Kavli).

Taken together, we find that these four characteristics make the boundary objects influential in shaping networked interaction processes, where rivalry, negotiation, coordination and collaboration play out across the actors. In networked interaction processes laden with economic content, such objects facilitate the structuring of the interactions in time and space, in relation to the economic objectives of the actors. These processes lead to proposed changes in the combining of resources and activities, which are negotiated towards various targets, and later overall agreements between the suppliers and retailers. In the final round of negotiations, an actor may propose combinations and rebalancing between those proposed agreements, before finally signing a contract with each of the suppliers (or rejecting a supplier).

7. Discussion and conclusions

The purpose of this paper was to investigate the mediating role of

boundary objects in interaction processes within business networks. The empirical context was a supplier-retailer network, in which there are asymmetrical relationships in place (Hingley, 2001; Maglaras et al., 2015; Rindt & Mouzas, 2015; Sutton-Brady et al., 2015).

The case reported above exemplifies how the use of the three boundary objects enables the actors to handle cooperation and conflict via interactions and negotiations. Our case suggests that there are four characteristics of the mediating role of boundary objects in business interaction processes. These are; 'facilitate present interaction', 'simulate future interaction patterns and roles', 'calculating and visualising' and 'shaping and re-arranging power relations'. To understand these characteristics of network-level boundary objects requires a focus on their purpose and roles, such as how they are used for both collaboration and conflict in the interactions, which objectives are they supposed to serve, and how they are related. These four characteristics make the three boundary objects significant in mediating networked interaction processes.

Overall, we propose three main findings from the case study reported above: (i) economic targets are essential to the use of boundary objects at the network level; (ii) the use of boundary objects reflects the existing distribution of power within the network; (iii) orchestration across linked boundary objects allows for the amplification of influence by some actors.

First, *economic targets are essential to the use of boundary objects at the network level*. The use of the boundary objects is oriented towards achieving particular targets such as the effective return on shelf space, price perceptions, and supplier contributions to retailer profitability. An actor can create, introduce and develop objects that are formatted to influence the activities of counterparts towards meeting that actor's targets. For example, Rema initiates the drawing of multiple versions of possible product displays, underpinned by their goal to maintain their current dominant position (see Table 1 and case text page 19). The objects get used to measure, evaluate, adjust and re-combine the outcomes of multiple dyadic interactions with respect to the given targets. Boundary objects therefore help coordination efforts, even with differences in interests, in inter-organisational networks.

Secondly, *the use of boundary objects reflects the existing distribution of power within the network*. Our study shows how power is exercised in inter-organisational settings when such objects are used. The three objects discussed above are not neutral in terms of which of the business actors they are there to support, and as such, the interactions are also not neutral (Håkansson & Waluszewski, 2013).

The most powerful actor – Rema – exploits its ability to set the agenda by forcing its targets to the centre of the processes (see Table 1). It is able to do so because of the power asymmetries in place in this supplier-retailer network (e.g. Sutton-Brady et al., 2015). The participation of other actors will typically require a necessary commitment to supporting Rema's targets. Boundary objects are thus a means in the struggle for status, control and position (Barrett & Oborn, 2010; Mørk et al., 2012). All three boundary objects were used by Rema to measure and evaluate the impacts of alternative supplier offerings (see Table 1, case text pages 18–19). Of course, this does not imply that the suppliers were unable to have some other objects in play, or that it would not be possible for them to do so. Yet at the same time an actor needs the ability to move their targets to the centre of the negotiation processes, and to format and upgrade the associated objects, in order to serve their interests.

The focus on the economic targets of particular actors underpinning the use of boundary objects – or an economic dimension to boundary objects - means that narrow consensus in a particular interaction process between a limited number of actors is sufficient (see section 6 above). Some actors are able to improve their network position (e.g. Tine) while other relationships are terminated (Rema-Synnøve Finden and Rema-Kavli). Network-level boundary objects therefore do not require all the actors involved to agree or reach "broad consensus". In a business network this would also be unlikely, given the interplay of collective and individual interests (Medlin, 2004; Munksgaard et al., 2015; Wilkinson & Young, 2002) and the co-existence of cooperation and conflict at any one point in time (Ellegaard & Andersen, 2015; Ford, 1980; Tidström, 2015).

Third, *orchestration across linked boundary objects allows for the amplification of influence by some actors*. The case study exemplifies how the capacity to orchestrate across multiple linked boundary objects allows for some actors to intensify their influence. For example, Rema uses the three boundary objects across multiple business relationships in attempting to reach its goals (see Table 1). As such, our study expands the argument of Cacciatori (2012), in that systems of multiple objects may reinforce patterns of action, not only in intra-organisational problem solving, but also at the inter-organisational level. Certain actors are able to use the objects both to push the boundaries (Lee, 2007), and to limit other actors' room for interaction (Klerkx et al., 2012), facilitate or inhibit knowledge sharing and collaboration (Bechky, 2003a; Carlile, 2002; Swan et al., 2007) and to manage their network roles (Star, 2010).

In sum, boundary objects facilitate interaction because the real content represented by the boundary objects – economic targets and calculations - is the core of the networking activities. In other words, the objects contain the purpose of the interactions. As such, they also specify the targets that are core to the interaction, and provide the collective formats by which to measure and evaluate different potential outcomes for future interaction patterns and roles.

7.1. Suggestions for further research

The research reported here is based on a single case study in the context of the food industry. It is an exploratory study, which is one of the few, at least to the best knowledge of the authors, to investigate the ongoing use of boundary objects in interactions across existing customer-supplier relationships. Moving the debate about boundary objects from organization studies to how such objects mediate interactions in business networks brings with it several challenges.

Business organizations, and the processes in play between them, are often far more complex than what much of the boundary objects literature has included so far. This is not least because of the clear economic content of inter-organisational interactions. While scientists and other professional work groups and their interactions are crucial in many cases, we also need to include management disciplines, such as economics, finance, accounting and marketing, as well as the handling of inter-organisational relationships in the analysis. This will help to level out the present bias in studies of collaboration, and move towards studying interaction with its mixed elements of collaboration, competition, power struggles, economizing, user dialogue, public lobbying, etc. One partial explanation of the bias towards collaboration in the existing literature is that the primary focus is on the socio-material aspects of interactions, where the representation of economic and financial interactions, interests and objectives are only weakly represented (see Lainer-Vos, 2013 for an exception).

We have incorporated an explicit power element in our characterization of boundary objects. In so doing, the economic dimension becomes central. There are few studies in the boundary objects literature that focus on economic governance, or the financial returns on socio-material activities. Network interactions are laden with both conflict and collaboration, and the distribution of gains, losses and profits is not necessarily "friendly".

Further research might investigate the boundary objects concept in multiple network contexts in a variety of industries in order to flesh out their role in networked business interactions. This could include alternative concentrated networks, less concentrated networks, and expanding the scope of the boundary objects to include, for example, digitalisation. Further empirical studies could therefore allow us to flesh out the role of boundary objects as forms of "inter-cognitive representations" in business networks (Mouzas & Henneberg, 2015).

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