Identifying Traces of Boundary Object Properties in Data Hub Development Narratives: Two Cases from Scandinavian Electricity Market

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Abstract

Digital technology enables multi-relational collaborations between parties with different experiences, knowledge, values, and goals. Regarding digital technology triggering enterprise transformation, boundary object as theoretical model for understanding such differences in development is not well understood, especially the ways boundary object emerges in practice. We inquired what traces of boundary object properties can be identified in data hub development narratives. An interpretive approach was chosen for understanding experience-centered narratives that origins from interviews conducted in two separate studies of national development of data hubs for the electricity market in Denmark and Sweden respectively. Through a literature review covering boundary objects, nine prosperities were chosen for the theoretical frame used in the interpretation of the narratives. The conclusion was that boundary object properties were part of the narratives of the data hub developments early on in the in-use taking processes and even before the digital artefact was taken into use.

Keywords

boundary object, data hub, digital technology, narratives, properties

Introduction

Digitalization is an ongoing change process that transforms enterprises and society (Ebert and Duarte, 2018). By utilizing digital technology in an efficient way, enterprises can create value and competitive advantages (Korhonen and Halén, 2017), but new technology also triggers transformation processes that change for example an organization's relationships with its employees, customers, suppliers and governments (Rouse, 2005). In this sense, digital technology enables multi-relational collaborations between parties having different experiences, knowledge, values, and goals (Abraham, Aier, and Winter, 2015).

In information systems research, digital technology positioned in-between collaborating parties with different needs and wants has occasionally been conceptualized as boundary objects. In practice this means that a piece of technology is positioned in-between different parties, enabling collaboration (Star, 2010). The collaborating parties need to have some common view or idea of the technology, but it is still open for interpretation and adaption to the local needs. A very simple example is a database that is used by two

different parties. The parties can agree on that the database is a repository for data, but while the local need of one of the parties is to store data, the local need of the other is to access the same data. For example, engineers and architects have collaborated through digital simulations (Dodgson et al., 2007), IT-developers and users have collaborated through different types of shared systems (Pawlowski and Robey, 2004), and individuals have collaborated through social media (Tim et al., 2013; 2017). Also in the context of enterprise transformation, boundary objects as theoretical concept has been applied, for example in research on ERP-system for enterprise transformation (Koch, 2007), but also for labelling strategies for enterprise transformation (Berghaus and Back, 2016), and in research on Enterprise Architecture Models in enterprise transformation (Abraham, 2013; Abraham, et al., 2015). However, according to Tim et al. (2017) most attention has been given to explain the intrinsic properties of boundary objects, identifying different types of boundary objects, and the different roles they play (See for example Star and Griesemer, 1989; Carlile, 2002; 2004; Abraham, 2013). Much less attention has been given to explore the emergence of boundary objects, e.g. the process of shaping and reshaping (Levina and Vaast, 2005; Tim et al., 2013; 2017). Therefore Tim et al. (2017) argue for more research on boundary object as emerging entities, and especially the ways boundary objects emerge in practice. As a response to the call from Tim et al. (2017) we set out to explore the ways a boundary object emerges in practice, especially the ways digital technology is conceptualized as a boundary object by members participating in its development. We argue that the conceptualization of technology as boundary objects is part of the shaping process and a step towards making a technology a boundary object, e.g. taking it into use and make it usefully incorporated into practice (Levina and Vaast, 2005). We argue that an understanding of the early conceptualization of technology as boundary object can affect the ways enterprise transformation processes and the creation of multi-relational collaborations supported by digital technology are managed, but also the ways new technology is implemented and taken into use.

Our aim is to contribute to the research on boundary objects as emergent entities in enterprise transformation processes by exploring the ways digital technologies are conceptualized as boundary objects by participants in the development. The exploration is conducted by scrutinizing narratives from two data hub development projects related to the electricity market in Denmark and Sweden for properties that can be related to boundary objects. Thus, we inquired what traces of boundary object properties can be identified in data hub development narratives?

Theory

The notion of boundary object was introduced in the late eighties and describes objects that are positioned in-between social worlds (Star and Griesemer, 1989; Akkerman and Bakker, 2011), thus have the potential to enable collaboration**.** According to Akkerman and Bakker (2011) the boundary object can be viewed as a detached entity with its own features and a part of all the social worlds engaged in the collaboration and incorporates features from all of the worlds. Boundary object has also been described as arrangement facilitating collaboration (Star, 2010), being plastic enough to adapt to local needs and robust enough to maintain a common identity across sites, being weakly structured in common use and becoming strongly structured in local use, as well as being either abstract or concrete (Star and Griesemer, 1989). Boundary objects have also been identified of being of different types (Star and Griesemer, 1989; Tim et al., 2013), spanning different types of boundaries (Carlile, 2002; 2004). As Tim et al. (2017) stated a lot of work has been put down to map the properties of boundary objects. One important contribution to this mapping is the summary of properties suggested by Abraham (2013). In this summary no less than 12 different properties were identified. Later, Abraham et al. (2015) tested the different properties and concluded that nine of the properties can be directly related to the boundaries identified by Carlile (2002; 2004). As the research reported on in this article set out to identify properties in the narratives of participants in data hub development projects, the nine properties with clear relation to the boundaries were chosen (See Table 1). But it has also been established that there is no guarantee that a piece of technology having the properties of a boundary object, in fact becomes a boundary object in use. Levina and Vaast (2005) concludes that a piece of technology can be identified to have boundary spanning properties, e.g. having boundary object properties, but still not being taken into use as such.

Property	Definition
Shared syntax	A common schema of information elements is provided, so that local use of information objects is uniform across communities.
Modularity	Communities can attend to specific areas of a boundary object independently of one another, without disturbing or interfering other communities' use.
Concreteness	Specific problems relevant to specific communities are addressed and communities are able to specify their concerns and express their knowledge.
Accessibility	The boundary object is readily accessible for the involved communities. User are informed about the existence of a boundary object and also provided with the right knowledge and tools to access it.
Visualization	Boundary objects do not rely on verbal definitions but possesses a graphical or physical representation.
Annotation	Boundary objects can be enriched with additional information by individual communities in order to provide context for local use.
Participation	Communities are involved in the creation and maintenance of the boundary object.
Malleability	Boundary objects are jointly transformable to support detecting dependencies and negotiating solutions.
Up-to-datedness	The information in the Boundary object is up-to-date. Updates and changes are communicated in a timely fashion to the involved.

Table 1. Properties of a boundary objects (Abraham, Aier, and Winter, 2015)

Methodology

In this study, an interpretive approach (Orlikowski and Baroudi, 1991; Walsham, 2006) was adopted based on the assumption that knowledge of reality is gained through social construction demonstrated through means like language, shared meanings or documents (Orlikowski and Baroudi, 1991; Klein and Myers, 1999). This approach was regarded as suitable for studying context-specific events or processes and for exploring hidden reasons behind complex, interrelated or inter-organizational relationships (Bhattacherjee 2012). A re-analysis of previous collected qualitative data was conducted which according to Corti (2007) allows both for re-interpretations and for new questions to be asked of the data. In this way theory can be advanced, and resources more effectively used when a completely new data collection was not conducted (Wästerfors, Åkerström, and Jacobsson, 2014). This approach is applicable to this case of finding traces of boundary objects in development narratives.

The main source of data is a set of experience-centered narratives. Experienced-centered narratives are defined by Patterson (2008) as *"Texts which bring stories of personal experience into being by means of the first-person oral narration of past, present future or imaginary experience.* (Patterson, 2008, p. 37)". The narratives origins from interviews conducted in two separate studies of national development of data hubs for the electricity market in Denmark and Sweden respectively, where the Danish data hub project had come to take the data hub in to use, while in the Swedish case it was still in the development phase. Twelve interviewees, representing organizations involved in the development of the two data hubs, such as grid companies, electricity suppliers, energy companies and authorities, had been selected based on their role and responsibility in the development process (See Table 2). Interviews had been conducted either in face-to-face meetings or online via Skype for Business meetings. Data had been gathered through audio recording of the interviews on a researcher computer. Interviews in Denmark were done in English, while the interviews in Sweden were in Swedish. All interviews were transcribed. The Swedish interviews were also translated into English.

Role	Responsibility	Organization
Operations officer	Provides billing data for staff in electricity companies through the data hub.	Energy company, Sweden
Operations administrator	No specific role at the moment. Takes special interest in grid and supplier companies' situation in the data hub.	Energy company, Sweden

Member of Expert Group	Involved in business processes and technology issues for the data hub.	Electricity supplier, Sweden
Development engineer	Responsible for collecting and reporting measuring data to the data hub.	Grid company, Sweden
Customer service coordinator	Works with change of supplier, billing, requirement management and customer service. Takes part in the analysis of information, data and of the data hub.	Energy company, Sweden
Swedish Data hub owner 1	Works with change management issues for the hub project. Responsible for dialogue and communication between actors in the electricity market.	Energy authority, Sweden
Swedish Data hub owner 2	Hub product owner. Responsible for systems requirements.	Energy authority, Sweden
Danish Data hub owner	Project manager for the data hub project.	Energy authority, Denmark
Billing manager	Makes sure internal systems are switched to correct suppliers.	Electricity supplier, Denmark
Project & IT development manager	Studies market regulations and the BRS guides for new working process and roles.	Electricity supplier, Denmark
Market data coordinator	Works with price element in the data hub and data consistency.	Grid company, Denmark
Project manager	Monitors communication between company systems and the data hub.	Grid company, Denmark

Table 2. Interviewee role, responsibility and organization in the data hub development.

In order to identify traces of a boundary object property in the narratives, key words and phrases from the boundary object property definitions in the Theory section (Abraham et. al, 2015) were first listed. For instance, information elements; … can attend to specific areas of a boundary object independently and … graphical or physical representation (See Table 1). As the interpretation process of reading, reflecting and comparing theory to practice finding similarities and differences continued the list was kept close. The texts were carefully read, and color coded accordingly. A clear citation from the texts was kept as evidence whenever a trace of a boundary object for a particular property was identified.

Results

Traces of boundary object properties were found in the two data sets analyzed. However, for the modularity and malleability properties no traces could be identified. For each boundary object property, a reference to theory is first made. Then follows the citation as clear evidence of the traces found. The traces are further strengthened by additional findings and finally analyzed.

Shared syntax

According to Abraham (2013) shared syntax concerns the providing of a common schema of information elements. This was described by the Swedish data hub owner 1:

"Certain information, format or attribute needs to be explained, defined and exemplified for everyone to understand. This is how they will reach consensus." Swedish data hub owner 1

The need for a shared syntax was further emphasized by the Member of expert group who said that they had to ensure all partners understood the hub information model. The process would verify information was correct and also contributed to understanding among businesses involved. There were processes developed in the business requirement specification (BRS) guide that explains how to exchange information. Further, they needed a handbook explaining how to retrieve and control data. Everything

should refer to the information model. It was the data hub's information model that all actors would stick to. The Operations officer and the Customer service coordinator both reflected on the need of a common lexicon, glossary or list of words that was regulated and explained meaning, interpretations, the naming of messages etc., for everyone to share. The importance of a shared syntax and ways to create it appears to be important and also an easy property to identify in the narratives.

Modularity
According to Abraham (2013), modularity is when different communities can attend to specific areas of a boundary object independently of one another, without disturbing or interfering other communities' use. However, the modularity property was not found in the narratives. That indicates modularity was not something the narrators prioritized or and something they found important to communicate. Still it is possible that modularity is a feature in the data hubs.

Concreteness
Abraham (2013) defines concreteness to be when specific problems relevant to specific communities are addressed and communities are able to specify their concerns and express their knowledge. The development of the data hubs rested on some very clear problems that the data hubs were supposed to solve. The Member of expert group said that they had a shortage of information, the information was poor and data quality was low. This was echoed by the Billing manager who said sometimes they got the wrong data, sometimes incomplete data and sometimes they didn't get any data. The same thing is communicated by the Operations administrator in this short quote:

We have both lack of competence and lack of information. The difficulty is to get all the staff involved to understand the importance of having the right information." Operations administrator

Other problems were related to correcting data. The Development engineer mentioned that the big challenge was to have correct customer data, and the Danish data hub owner stated that the problem was they had the potential of having several parties changing the same piece of data, so the thing was they needed to have some data control. Finally, the Market data coordinator explained that the problem was when they wanted to change the price elements, they could not do it. They had to contact the data hub owner and ask them to do it. This indicates a lack of modularity in the previous system.

Accessibility
The two main parts of accessibility are according to Abraham (2013), to know that the boundary object exists and having the proper knowledge and training to access it. Making the boundary object known was not explicitly mentioned by the participants interviewed. This might be explained by it being obvious to them that the data hub was going to exist and being accessible, thus not necessary to explicitly talk about. Indirectly however, the communication of the existence of the data hub was done by talking about the training the participants viewed as of great importance. For example, one of the Swedish data hub owner said:

"To understand the model and the process flow, a training package for everyone will be set up that will include a meeting and e-learning." Swedish Data hub owner 1

Further, for example the Operations officer, the Development engineer, the Customer service coordinator, and the Danish data hub owner all mentioned the importance of training. Most elaborated was the Danish data hub owner who concluded that the training activities had to include meetings, phone call, cooperative meetings, eLearning, they made courses by the end of the implementation before they went live. They also had daily phone meetings with more that 100 participants every morning to listen what was going to happen tomorrow the following day. The Operations officer added the importance of learning from trial and errors in other countries. Finally, the Operations administrator who focused on that the training had to come from top management.

All in all, it can be concluded that even though the communication of the boundary objects existence was not explicitly found in the narratives, the accessibility property was still found through the talk about the

importance of training. In relation to this property the interviewer played an important role, as questions related to training was. Training was an explicit question Even though the training aspect was not an explicit part of the interviews, the researchers led the narrators into that discussion. The answers to the questions indicated that the training was a very important part of the project.

Visualization
Visualization is according to Abraham (2013) a boundary object that does not rely on verbal definitions but possesses a graphical or physical representation. The data hub is a such a highly tangible artefact. The Member of the expert group described the data hub as follows:

"The data hub is a machine to machine system. It will almost never be used by users so the need for user graphics is small. Instead it is our systems that will talk to the data hub that need to be built user friendly." Member of expert group

Another illustration was when the Danish data hub owner explained they had a dialog forum for the technical implementation to get input. Besides the above statement, the physical representation of the data hub was expressed by describing for example the way the Development engineer putting in a lot of effort into visualizing and defining every possible situation that could occur in the business. Once the data hub was running there would be data missing. Data hub version 1 needed to be upgraded a number of times before everything got error free. Another indication was related to the testing of the data hub. For example, the Operations administrator was invited to participate in the test pilot. The Customer service coordinator considered testing of systems functions and processes in a testing environment with the help of the IT provider and data hub owner. The respondents from the Swedish data hub owner 1 and 2 explained that a prototype would be developed in close collaboration with the IT vendor as part of the procurement. This mini version of the data hub functionality could be tested by the partners to have their feedback. The data hub can, based on the above, be said to have a physical representation that the respondents are well aware of and been part of developing. Therefore, the property could be said to have been identified.

Annotation
Abraham (2013) defines annotation to be when a boundary object can be enriched with additional information by individual communities in order to provide context for local use. Properties of the data hub that could be related to annotation was hard to find. In fact, in many cases it was quite the opposite. The Swedish data hub owner 1 stated that none-of the partners could upload data that was inconsistent with the others as each partner had their responsibility, illustrated by the following quote:

"If a customer has several electricity suppliers and the same information about the customer must be updated by several partners, then there will be an issue of which partner has the correct information in the data hub. That could be an example of inconsistency." Swedish data hub owner 2

The Member of expert group further emphasize this perspective by declaring that we (here interpreted as the data hub users) had to have as little data as possible in the data hub and only data that was really needed. The Billing manager added that they could call the data hub owner when they needed more information, but the problem was that it often took a lot of system development to get where they wanted to. The Project manager said they talked and helped each other understand what they were supposed to do and how they had to do it.

Participation
Participation is according to Abraham (2013) when communities are involved in the creation and maintenance of the BO. At the point when the studies were conducted the data hubs either had not been implemented yet (Sweden) or just had been taken into use (Denmark). This might be one reason for why participation in maintenance was not an explicit part of the narratives studied. Only one statement could in fact be related to maintenance. It was when the Member of expert group said that different partners had different responsibilities and each partner would be responsible for their data correctness in the hub.

Participation in the creation of the data hub was however more relevant for the narrators. Thus, easier to find in the narratives. The Billing manager described for example how participation in the project evolved over time. In the development of the first version of the data hub they weren't involved in the early part of the project; the data hub owner made all the decisions. But, in version 2 more participants were involved. The Danish data hub owner communicated the same thing, which is summarized in the following quote:

"The success for data hub would be to have everyone onboard when we go live." Danish data hub owner

What happened was that in the first version not everyone was onboard because they didn't understand the magnitude of the project. It was a market project; it was not a single IT system. In the second version, it was made very clear the only way they would succeed was if everyone was onboard. The difficulties were getting them onboard and making them understand that they had to change their business process. Another example was the involvement of the Project and IT development manager and the Billing manager as a supplier trying to understand what the new Danish data hub was about and how to work in the new data hub. The involvement of the suppliers was actually mostly on how to migrate data in the right way, not how the data would work in the future. It was about the current situation not about future situation. The Project manager and Market coordinator said it was the same supplier, but the grid company was involved in a much earlier stage because they had to prepare the data for the data hub. The importance of participation is signaled in several different ways but can be summarized with the importance of getting everyone onboard. Thusly participation as property could be clearly identified. However, just as was the case with training related to accessibility, there was a concrete question related to participation guiding the narrators to this property.

Malleability

Malleability, according to Abraham (2013), is when boundary objects are jointly transformable to support detecting of dependencies and negotiating solutions. The potential for the boundary object to support this cannot be clearly identified in the narratives analyzed. Instead, focus for the narrators were more how to manage the collaboration as such. For example, the Operations officer focused on the importance of meetings and more talk when they didn't understand each other because of different perspectives in different departments. There were also talk about managing the project. The narrators from the Swedish data hub owner 1 and 2 referred to continuous publication lists of concepts, processes should be defined in collaboration with expert groups and talk about the project and provide documentation. The Customer service coordinator also believed in talks with colleagues and data hub owners. The data hub played a central role. They were active and worked together as partners developing the hub, the conceptual model and their own systems. Accordingly, this is not in line with the malleability property.

Up-to-datedness

When it comes to up-to-datedness, Abraham (2013) defines it to be, no surprise, when the information in a boundary object is up-to-date. Updates and changes are communicated in a timely fashion to the involved. Up-to-datedness was also of crucial importance to the narrators. For example, the Operations officer centered on that data definitely has to be updated often:

"Updating cannot wait days or weeks as we have it now. Today, communication is time consuming due to organizational issues and approval at different levels in the organization." Operations officer

Further stressing the importance of up-to-datedness the Operations administrator discussed that the data must be sent directly from the grid company to the data hub to avoid waiting time. Also, the Member of expert group explained the importance of data being up-to-date by exemplifying with an update of for instance a customer moving in or out of a dwelling, and that this update should be made immediately in the data hub. Perhaps not instantaneous, but virtually close to real time to have good data quality. Another aspect of up-to-datedness could be related to responsibility issues. The Development engineer said it would be defined carefully which actors should update which data and who is responsible for correct data. The data hub had always to confirm back that new data has been updated. Also, the Customer service coordinator and the Swedish data hub owners discussed on this matter. The Customer service coordinator mentioned if the data owner discovered data was wrong then it had to be corrected. There must be rules

stating who owns the data; the grid company or the electricity supplier. The Swedish data hub owners stated in turn that each partner is responsible for the correctness of their data stored in the hub. If data was incorrect then the partner responsible had to make an update immediately. Based on the above it is safe to say that up-to-datedness seems to be a crucial aspect in the narratives of the data hubs. Both when it comes to the importance of having up-to date data, and responsibility issues.

Discussion and conclusion

The aim was to contribute to the research on boundary objects as emergent entities in enterprise transformation processes by exploring traces of boundary object properties in narratives related to the development of digital technology. The exploration was conducted by scrutinizing narratives from two data hub development projects related to the electricity market in Denmark and Sweden, and the way properties that can be related to boundary objects can be found in those narratives. The findings of the research conducted were that the intentions with the data hubs fitted well with the overarching definition of boundary object provided by Star and Griesemer (1989). However, the traces of boundary object properties found in the narratives did not exclusively fit the definitions. The up-to-datedness, shared syntax, concreteness, visualization, participation and accessibility properties were clearly identified in the narratives. The annotation property was hard to identify whether as the malleability and modularity properties could not be identified at all in the narratives. Thus, a majority of the boundary object properties could be identified. From this we conclude that boundary object properties are part of the narratives of the participants in development pointing to data hubs starting to emerge early as boundary objects in enterprise transformation processes. We are aware of the critique from for example Tim et al. (2017) that it is tacitly assumed that if properties of a boundary object are identified as part of an artefact, it could serve as a boundary object. However, we argue that if narrators start talking, even though unconsciously, about the data hub by referring to properties of boundary objects a potentially boundary object has started to emerge. But with that not saying that the data hub, in the end, will become a boundary object in-use. To be able to do so, more research needs to be conducted on the relation between the emergent characteristics of boundary object and the way boundary object properties become part of the conceptualization of digital technology through the way they are narrated. Thereby a deeper understanding of digital technologies role in enterprise transformation processes and the creation of multi-relational collaborations can be achieved.

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