Transformation of business collaboration in a digital age
Towards a multi-relation perspective

Jwan Khisro

Main supervisors: Katarina L Gidlund
Co-supervisors: Thomas Persson Slumpi

Faculty of Science, Technology and Media
Thesis for Licentiate degree in Computer and System Sciences
Mid Sweden University
Sundsvall, 2019
Transformation of business collaboration in a digital age
Towards a multi-relation perspective

© Jwan Khisro, 2019
Printed by Mid Sweden University, Sundsvall
ISSN: 1652–8948

Faculty of Science, Technology and Media
Mid Sweden University, Holmgatan 10, 851 70 Sundsvall
Phone: +46 (0)10 142 80 00
Mid Sweden University Licentiate Thesis 161
To my heartbeat, Adam and Celine
**Acknowledgement**

I would like to express my deep and sincere gratitude to my supervisors Katarina L Gidlund and Thomas Persson Slumpi for their continuous support, guidance, encouraging attitude and motivation through this thesis work. I'm extremely grateful to Erik Borglund for his invaluable advice. Special thanks to Christina Nyström for her vital comments on my pre-seminar. I would also like to thank the European Regional Development Fund (ERDF) for funding the ISERV project, and its members: Göran Samuelsson, Håkan Sundberg, Larsa Nicklasson, Daniel Adelander, Ann-Sofie Klareld, Caroline Wallmark and Erica Hellmer for their support. I am extending my thanks to research group FODI at Mid Sweden University, and also my colleagues: Annika Hasselblad, Tove Engvall, Martina Granholm, Karin Ahlin, Leif Sundberg and Leif Olsson. Furthermore, special thanks to my mentor Ulf Jennehag. I am grateful as well to my interviewees who provided me with very useful information and fruitful discussion. I owe many debts of gratitude to Maria Bergenstjerna for all the continuous support and encouragement. I would also like to express my heartfelt thanks to my caring, loving, and supportive family. Above all my gorgeous parents and awesome husband.
# Table of contents

Abstract ........................................................................................................................................... ix

Summary in Swedish ......................................................................................................................... xi

List of papers .................................................................................................................................. xiii

1 Introduction ..................................................................................................................................... 1

2 Aim and research question .............................................................................................................. 2

2.1 Disposition ................................................................................................................................. 3

3 Theoretical framework ..................................................................................................................... 4

3.1 Collaboration ............................................................................................................................... 4

3.2 Enterprise architecture ............................................................................................................... 8

3.3 Enterprise interoperability ......................................................................................................... 11

3.4 Boundary object ......................................................................................................................... 15

4 Methodology ................................................................................................................................. 16

4.1 Research context ......................................................................................................................... 17

4.2 Interviews .................................................................................................................................. 19

4.3 Analytical process ...................................................................................................................... 21

4.4 Ethical aspects ............................................................................................................................ 23

5 Paper results .................................................................................................................................. 24

5.1 Paper I ......................................................................................................................................... 24

5.2 Paper II ....................................................................................................................................... 26

5.3 Paper III ...................................................................................................................................... 28

6 Discussion ..................................................................................................................................... 29

7 Conclusion and future research ..................................................................................................... 31

8 References ...................................................................................................................................... 34

Appendix A ....................................................................................................................................... 42

Appendix B ....................................................................................................................................... 44
Abstract

The process of digitalisation is progressively transforming the way business is carried out and how enterprises collaborate. In this digital age, characterised by collaborations among a larger community of suppliers, customers, employees, and governments, all partners need to understand a variety of relations and how digitalisation transforms them. However, it is difficult to understand the multitude of unclear or even unknown relations generated by re-coordinating different types of relations in this digital age. Accordingly, this thesis contributes to the understanding of the transformation of business collaboration by exploring how collaboration can be understood in a digital age. The theoretical concepts involved collaboration, enterprise architecture, enterprise interoperability, and boundary object. These concepts enabled digging deeper into the complexity of sharing and aligning social and cultural worlds between communities of practice. The methodology employed was hermeneutics, which was suitable for understanding human activities. The study object concerned national development of data hubs for the electricity market in Denmark and Sweden, which replaced an old way of communicating point to point between companies. This was implemented in order to coordinate and manage data transactions between grid companies and electricity suppliers. The results indicated that digitalisation tends to increase the ability to manage collaboration and even closer relations among partners by clearly identifying every partner role and responsibility. Further, business collaboration appeared to transform from a traditional collaboration to a multi-relation collaboration that addressed digital age demands more comprehensively.
Summary in Swedish

List of papers


1 Introduction

The process of digitalisation is progressively transforming the way business is carried out and how enterprises collaborate (Rouse, 2005; Pagani and Pardo, 2017; Ebert and Duarte, 2018). In this digital age, characterized by collaborations among a larger community of suppliers, customers, employees and governments requires all partners to understand a variety of relations and how digitalisation affects the transformation of these relationships (Pagani and Pardo, 2017; Okdie and Ewoldsen, 2018). However, a systematic understanding of a social system, whether viewed as a single enterprise, a network of enterprises, or a society, can only be achieved by understanding the range of social and economic relations between the integral individual entities and how they influence and co-construct each other in the collaboration process (Grandori and Soda, 2006). As such, an enterprise is viewed as a multitude of complex social networks of individuals linked together in a variety of relations within a social system. Aimed at fulfilling decisions and actions, the social system interacts both internally and externally through information exchange (Szell et al., 2010).

However, while collaboration in networks and through digital artefacts conveys numerous benefits such as enabling big data collection, improve decision-making, increase efficiency and encourage innovation, issues can occur as well. Examples of often-discussed problems include information overload and fragmentation (Dean and Webb, 2011), which can be associated with the quantity and quality of the information provided (Bawden and Robinson, 2009). It is also difficult to understand the multitude of unclear or even unknown relations created by re-coordinating different types of
relations in this digital age (Pagani and Pardo, 2017). For networked enterprises, establishing digital relationships with a large number of partners can be time consuming (Legner and Wende, 2006). However, while research on customer-enterprise relationships in the digital age has primarily focussed on end users and consumer markets, far less research has investigated how digital communications affect the relationships among enterprises (Obal and Lancioni, 2013; Taiminen and Karjaluoto, 2015). Interesting studies have been conducted regarding the complex nature of collaboration (see for example Orlikowski, 2009; Canhoto et al., 2016; Pagani and Pardo, 2017), but a deeper understanding is still needed concerning how to fine-tune specific combinations of resources and activities, by attempt to deepen the understanding of the transformation of business collaboration in a digital age.

2 Aim and research question

This research thus aims to contribute to a deeper understanding regarding the transformation of business collaboration in a digital age by inquiring about the following:

- How can collaboration in a digital age be understood?

For the purpose of answering this research question and fulfilling the research aim, this general question was broken into three separate sub-questions reflected in the three papers included:

Paper 2 (2019): What is the relation between interoperability and data quality concepts?

Paper 3 (2019): What traces of boundary object properties can be identified in data hub development narratives?

Together, these three sub-questions provided a basis for deepening our understanding regarding the transformation of business collaboration. In the research process, interoperability success factors, data quality’s importance for interoperability, and digital technologies as boundary objects were explored and analysed as aspects of collaboration. In practice, they are not separate or exclusive, but rather interconnected. However, as analytical tools, they focus on certain parts and downplay or ignore others.

2.1 Disposition

This thesis contains three papers, all contributing to a deeper understanding of collaboration’s transformation in a digital age. This study is further split into eight chapters, beginning with an overview of what the reader can expect to find in each of chapter. Chapter Three deals with the theoretical framework that formed the basis for the research analysis. Chapter Four reviews the research methodology in terms of research context, interviews, analytical process and ethical aspects. Chapter Five summarises the papers included in
the thesis and offers a short account of the results. Chapter Six discusses the results in greater detail. Chapter Seven provides a conclusion and suggestions for future research. Finally, Chapter Eight contains a list of references, including the articles, books, reports, white-papers, and websites utilised to complete this thesis.

3 Theoretical framework

The overarching central concept of this study concerns collaboration, as explained further below. However, in a digital business context ideas of enterprise architecture and enterprise interoperability are also predominate. Enterprise architecture involves describing, organising, and managing businesses, while enterprise interoperability describes and pinpoints heterogeneity in order to overcome hurdles in collaboration between businesses. The analytical and theoretical concept of boundary objects is placed at the end of this chapter, being added last in the research process. However, this concept enables digging deeper into the complexity of sharing and aligning social and cultural worlds in between communities of practice. In the following, these four concepts are described more thoroughly.

3.1 Collaboration

To understand the shift from a traditional collaboration view to collaboration in a digital age it is valuable to create an overview of previous collaboration research. However, a broad understanding of collaboration is first needed. It is given by several definitions, for instance Gray (1989) who stated that collaboration involves interdependence, dealing constructively with differences to arrive at solutions, joint ownership of decisions, and collective
responsibility that recognises collaboration as an emergent process. Grandori and Soda (2006) claimed that collaboration concerns enterprises combining some or all of their processes in order to reach goals at a major level and working together towards a common goal that can be practiced on many different levels. According to Thomson and Perry (2006), collaboration occurs over time as organisations interact formally and informally through repetitive sequences of negotiation, commitment development, and execution of those commitments. A systems-thinking perspective provides further clarification of the notion of collaboration in that relationships are seen as interrelated entities that include elements, interconnections, and a goal or function between variables, as well as collaborative planning across areas of an organisation in order to work within a space where the system boundary may be unclear (Meadows, 2008; Kopainsky et al., 2011; Arnold and Wade, 2015). In line with this, relationships exchange theory predicts that the boundaries between organisations will become blurred over time. Therefore, organisations that collaborate will become more closely linked to each other, forming a kind of network (Fyall and Garrod, 2005; Fyall et al., 2012). Collaborations moderate relations among people, resources, and processes (Gil-García et al., 2018). However, when two or more organisations exchange information with each other, they are connected in the communication dimension; if they work together though, they become connected in the collaboration dimension. Meanwhile, collaboration is often interrelated in some way with one another. Thus, establishing collaboration often requires exchanging information about organisations as the basis for the relationship (Zhao et al., 2010).
Historically, collaboration research has primarily focussed on inter-organisational collaboration (Powell et al., 1996; Steensma, 1996), and on the close and well-defined relation between organisations working together towards a common shared goal (Longoria, 2005; Jastroch et al., 2011; Kożuch et al., 2016). Inter-organisational collaboration describes processes that may emerge as dependent organisational entities of a problem domain interact with each other to generate new organisational structures so as to act or decide on issues related to that problem domain (Döring and Schreiner, 2012). Cropper et al., (2008) stated that inter-organisational collaboration focusses on different interaction forms rather than the relation between the actors. Further, inter-enterprise collaboration theory distinguish between three different perspectives: business process, organisational, and business environment (Trienekens and Beulens, 2001). An example of the business process perspective is supply chain management that has developed beyond a focus on logistics processes (Cooper and Ellram, 1993; Hendrick, 1995; Huang and Gangopadhyay, 2004; Lee and Whang, 2004). The organisational perspective centres on governance relationships between organisations that have common shared goal (Larson, 1992). The business environment perspective focusses on the business within its environment, and an important aspect of this perspective concerns recognising stakeholders (Ackoff, 1981) that directly influence, and can be influenced by, the organisation’s actions. Ackoff (1981) identified six clusters of stakeholders: employees, suppliers, customers, creditors, debtors, and the government. In network theory, the organisation is viewed as a node in a network of organisations which emerged from the necessity of exchange resources (Håkansson and Snehota, 1989; Monge and Contractor, 2003; Castells and
Cardoso, 2006). Further, in collaborative networks, complexity is reflected in the relations between groups of heterogeneous enterprises with different competences that combine their most requiring reconfiguration (Chituc et al., 2009).

Cross-boundary information sharing studies has largely focussed on information systems among government agencies at the same level of government or between government agencies from different levels of government (Gil-Garcia, et al., 2009; Luna-Reyes and Gil-Garcia, 2014). This concept has been approached from the technical, business and organisational perspectives (Gil-Garcia, et al., 2016). The technical perspective has examined data structure and design that considers the technical obstacles involved in sharing across multiple platforms (Pardo et al., 2006). Business and organisational perspectives have focussed on trust issues among participants and incentives that contribute to an organisation’s ability to share information across internal and external boundaries (Pardo et al., 2009). Cross-boundary information-sharing studies have largely concentrated on intra-organisational, inter-organisational and inter-governmental information systems through the context of government information (Cresswell et al., 2005; Zheng et al., 2009; Yang and Maxwell, 2011).

All of the above mentioned studies, discussed and concentrated on collaboration from the perspective of a shared goal that worked as a glue which enabled different partners to work together in a collaborative relationship. The important insight from these studies was the idea of a shared
goal. It served as a point of departure for analysing and understanding the complexity of a collaborative process in a digital age.

3.2 Enterprise architecture

The enterprise architecture (EA) offers a framework for formulating strategic choices as well as the transportation to implement these choices effectively. Information and communication technology (ICT) may intensely enhance the organisation’s coordination and control capacity, and thus stimulate increased use of management systems (Spanos et al., 2002). Recently, researchers and practitioners have investigated EA as a means to organise and manage organisational resources in order to tackle both expected and unexpected circumstances. Primarily, they focussed on capabilities such as effective ICT use, while EA’s purpose is to ensure that information resources match enterprise requirements. The term ‘architecture’ was originally employed in relation to ICT as a means to deal with the complication of information systems (ISs) (Pessi et al., 2013). The level of researchers’ interest in EA is also clearly increasing. Thus, the concept has been expanded to incorporate the entire enterprise and inferred by academia as well as the private and public sectors.

The notion of architecture derives from the Greek language, in which ‘archi’ translates into ‘principles’, and ‘tecture’ into suitable patterns. Thus, architecture means principles for creating harmonious patterns (Magoulas and Pessi, 1998). In the current context, architecture in which the system in question concerns the entire enterprise refers to the enterprise’s business processes, technologies, and information systems (Sessions, 2007). A coherent
whole of principles, methods, and models is employed in designing and realizing an enterprise’s organisational structure, business processes, information systems, and infrastructure (Lankhorst, 2013). The fundamental organisation of a system is embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution (IEEE, 2000; Stelzer, 2010).

Different perspectives have been developed to describe enterprise architecture (Niemann, 2006; Ross et al., 2006; Winter and Fischer, 2006; Simon et al., 2014). However, they all explain enterprise architecture as a strategic instrument to control and manage an enterprise’s complexity through a structured description of the enterprise and its relationships. Enterprise architecture has tended towards a holistic management of information systems in organisational approaches (Ross et al., 2006; Winter and Fischer, 2006). All the business strategies and entities, such as systems, stakeholders, relationships, and dependencies, can be included in an enterprise architecture effort (Banaeianjahromi and Smolander, 2016). All enterprises possess an architecture that aims at developing an as-is overall view and a to-be overview of the enterprise, encompassing strategic, tactical, operational, business, and technical issues and aligning the organisation’s business and information technology (Gøtze et al., 2009; Kotzé and Neaga, 2010). According to Scott and Morton (1991), enterprise architecture describes both documentation and a form of management. Gøtze et al. (2009) defined enterprise architecture as a planned strategic information base, which can be utilised as a roadmap to achieve goals, as well as a management process for understanding the business. Meanwhile, Stelzer (2010) described enterprise
architecture as the enterprise’s fundamental organisation, embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution. Kluge et al. (2006) identified an enterprise architecture as ‘a coherent whole of principles, methods and models that are used in the design and realisation of an enterprise’s organisational structure, business processes, information systems, and infrastructure’. Greefhorst and Proper (2011) clarified enterprise architecture as an instrument to articulate an enterprise’s future direction while also serving as a coordination and steering mechanism towards the enterprise’s actual transformation. EARF (2009) clarified enterprise architecture as the continuous practice of describing a sociotechnical organisation’s essential elements and their relationships, both with each other and with the environment, in order to understand complexity and manage change.

The participants in the enterprise architecture process include business, information technology, and operations, as well as representatives of the competency centres supporting specific disciplines, such as business intelligence and the enterprise’s various management disciplines (e.g. business strategy and portfolio management). These participants retain their decision rights, but in an architected enterprise, those decisions are made in collaboration with other enterprise stakeholders as part of the enterprise architecture process rather than being made in individual functional silos (Greefhorst and Proper, 2011). Enterprise architecture programmes are not governed or delivered by the enterprise architecture team alone. Successful enterprises embed enterprise architecture within the culture of everyday activities. They also practise a variety of strategic and operational disciplines
integrated with enterprise architecture, such as strategic planning, shared services, portfolio management, and governance. By doing so, they shift from siloes’ one-off projects, information inconsistency, duplicative business processes, and tactical focus. Instead, they move towards a future where a unified view of the strategic imperatives drives daily decision making and an integrated approach to change can be realistically achieved. The enterprise architecture team’s facilitative and consultative skills help ensure that the enterprise architecture programme is embedded within the institution’s culture. The enterprise architecture team members must persuade the enterprise to believe and share the enterprise vision by communicating, advocating, and planning. Their primary role is facilitating the enterprise change agenda (Greefhorst and Proper, 2011).

3.3 Enterprise interoperability

One of the trends in the global market involves increasing collaboration among enterprises during the entire product life cycle. Organisations have to flexibly react to changes in markets and trading partners (Alonso et al., 2010; Panetto and Cecil, 2013). As such, today’s changing market demands and technological evaluation requires an enterprise system to be constantly and smoothly re-engineered. In addition, they have to cope with internal changes from both a technical and organisational point of view. Furthermore, legacy enterprise applications often hinder cooperation endeavours. Once written and implemented, software codes can hardly be re-engineered. Unfortunately, numerous applications were not designed to interoperate with other applications (Chalmeta and Pazos, 2015; Benaben et al., 2018). For instance, even the definition of common concepts such as ‘order’ or ‘customer’
may vary greatly among applications. Another obstacle concerns the lack of standards in a number of cases, such as for describing and orchestrating business process flows across multiple systems (Jardim-Goncalves et al., 2013). Interoperability is not only a problem of software and IT technologies. It also implies communication and transaction support between different organisations, which must be based on shared business references. To be shared among organisations, these references must be agreed upon and respond to the organisation’s co-operation needs. To gain time and efficiency, and to avoid re-defining the co-operation rules and the software supporting it each time, these references must be based on business standards or norms. Business standards must also be independent and weakly coupled with IT solutions and IT standards to avoid proprietary solutions and support openness (Chen and Doumeingts, 2003).

Enterprise interoperability refers to coexistence, independence, and associated environment (Lampathaki et al., 2012). The context in question also illustrates a network of heterogeneous subsystems with a continuously changing state. Thus, an enterprise interoperability system is unique to its enterprise. However, this is not the individual subsystems (e.g. physical computer devices or standard software applications), but rather a unique network of subsystems. To be able to connect existing subsystems, an infrastructure that supports a learning, sensing, adaptive, and complex network of information systems is required. The infrastructure further has to support interoperability in the components to be connected in order to form a complete enterprise interoperability system (Weichhart et al., 2016; Smirnov et al., 2019). Therefore, enterprise interoperability may be seen placed at the
intersection of two major trends: first, the ever-increasing use of information systems inside enterprises, the enterprise itself, its aims, its value streams, its progressions, its information, and other resources are more comprehended. Usually, the complexity involved arises from combining the enterprise’s inherently social and economic aspects on the one hand and design’s inherently analytical and technical aspects on the other. Second, the trend concerns the ICT-enabled transgression of business processes across the operational borders of individual organisational units, which challenges classical hierarchical arrangements inside enterprises and introduces horizontal coordination (Folmer et al., 2014; Agostinho et al., 2016).

The definition of enterprise interoperability has evolved to include the interaction ability between enterprise applications at three enterprise levels: organisation; business model, decisional model, and business process; as well as application and data. Enterprise interoperability is standardised and is defined as the ability of enterprises and entities within those enterprises to communicate and interact effectively (Daclin et al., 2016). Generally, Lampathaki et al. (2012) defined enterprise interoperability as the capability of two or more enterprises, including all the internal systems with their limitations and the external systems that they utilise to collaborate seamlessly, to achieve specific objectives over a sustained period of time.

A methodology for developing an enterprise interoperability system based on the barrier concept involves an interoperability framework developed to provide interoperability solutions and the interoperability measurement method to evaluate the capacity to interoperate. Such methodologies also
include structured approaches guiding enterprises in implementing interoperability solutions in a step-by-step manner to avoid hazardous approaches (Daclin et al., 2008). In addition, a generalised incompatibility concept, which is applicable not only at a technical level, but also at organisational and business levels, is fundamental within enterprise interoperability methodologies (Daclin et al., 2008). Currently, enterprise interoperability is measured only between two partners and can prove interesting for studying multi-partnerships, such as relationships between a provider and customers which are challengers.

Developing enterprise collaboration offers another methodology for implementing and improving enterprise interoperability. This methodology is based on components such as an interoperability framework assembling specific solutions of enterprise interoperability and is composed of abstraction levels, dimensions of views and approaches, and a technique to measure enterprise interoperability, including interoperability before maturity and during operational performances (Daclin et al., 2016). Within the context of an inter-enterprise collaboration, the collaborating enterprises will take advantage of enhancements in their interoperability. The methodologies espoused in interoperability research do not propose mechanisms for earlier endorsement of interoperability solutions. Such prior validation can be defined as the ability to evaluate the elements early in the project, including the potential improvement resulting from the solution’s implementation and how the interoperability improvement will affect achieving the collaborating enterprises’ objectives at the operational, tactical, and strategic levels (Camara et al., 2014).
3.4 Boundary object

Boundary object is a term coined by Star and Griesemer (1989) to define an artefact that adapts to local needs and constraints of numerous parties and possesses various meanings in multiple social worlds, as well as various identities in each. The boundary nature relates to how it is both abstract and concrete, specific and general, conventionalised and customised. At the same time, boundary objects are also important in development processes spanning different social worlds (Star and Griesemer, 1989; Star, 2010). As such, Karsten et al. (2001) pinpointed boundary object as a physical object, such as designs, maps, drawings, or contracts, employed to simplify collaboration and simultaneously allow a variety of interpretations. Dodgson et al. (2007) described boundary objects as arranged interactions among numerous communities of practice, such as different types of enterprises that participate in the process of forming a new combination of enterprises, technologies, and people by allowing a common basis for conversations about problem solutions. To Winter and Butler (2011), boundary object involve allowing a suitable platform for collaborative action for different social worlds. Nicolini et al. (2012) added that a boundary object concerns aligning social and cultural worlds through its interpretive flexibility. According to Abraham (2013) and Abraham et al. (2015), a boundary object can be either abstract as a model or concrete as a system.

As stated in the Introduction, the three papers included in this thesis address three aspects of collaboration: interoperability success factors, where enterprise architecture serves as a parallel framework; the relation between interoperability and data quality; and the complexity of sharing and aligning
social and cultural worlds between communities of practice. The previous section detailed the central concepts involved. In the following, the research process for gaining a deeper understanding through scientific work with the concepts as tools is described in greater detail.

4 Methodology

Shifting from theoretical concepts and prior research to developing one’s own in order to gain a deeper understanding requires making certain choices. Possibly one of the most important choices is determining how one can learn more from others performing, in this case, the collaboration in practice, including not only other researchers, but practitioners as well. The theoretical concepts might constitute the analytical tools, but other ways are also available to go about finding, listening, and translating practice.

As this study aims not to test or verify, but to explore and further understand, hermeneutics was deemed appropriate. Hermeneutics concerns the study of human cultural activity as texts with a view towards interpretation to find intended or expressed meanings (Kvale, 1996; Creswell and Poth, 2017). Interpretivism describes one of the major streams of sociology and organisational research. It aims to interpret reality with the support of a theory and apply a suitable method in order to achieve a trustworthy research result (Guba, 1990). Such as deductive approach is based on using literature to build theories and ideas—or, in other words, conceptual theoretical frameworks. The argument moves from general principles to particular examples (Williamson, 2002). As the interpretivist stream allows for human interpretations and meanings, it was fruitful to adopt this together with a
A qualitative method and a deductive approach for studying how can collaboration in a digital age be understood. A qualitative study enables performing a deeper analysis, which possesses utmost relevance for answering our question and presents valid results and conclusions (Holme and Solvang 1997; Haraldsson, 2011). In this way, explanations for what is interpreted between different concepts and/or phenomena can be found.

As a researcher, my role is then to engage in the study’s social context (Walsham, 2006). The idea of the researcher’s active involvement represents a necessity in interpretive research: ‘Interpretivism suggests that facts are produced as part and parcel of the social interaction of the researcher with the participants’ (Klein and Myers, 1999, p. 74). As such, my role has not been treated separately or outside the social context. This affected how the study, the interviews, and the results interpretation were performed. Based on the idea that knowledge of reality comprises a social construction and is suitable for explaining hidden reasons behind complex relations, I adopted a hermeneutic approach for understanding human cultural activities described as narratives. Furthermore, to understand people’s experiences and development, both as individuals and socially interacting, an interpretive approach was chosen as a means for understanding verbal communication.

### 4.1 Research context

For enacting the previously-described research role and conducting the research approach, it was decided to use the Nordic electricity markets in Denmark, Norway, Finland, and Sweden, since the electricity markets are undergoing a significant transition. Implementing the EU Directive 299/72/EC calls for changes in the national electricity regulatory frameworks (NordREG,
The directive’s purpose is to open up the electricity markets in the European Union to allow electricity customers to enjoy free choice of supplier, price competition, and a reliable supply. One core element includes ownership unbundling, which implies separating companies’ sale operations from their transmission networks. According to NordREG (2006), the Nordic wholesale electricity market offers an effective example of an electricity market with international cooperation. The cooperation has taken place across different platforms at the level of government, energy regulators, and transmission system operators. As early as August 2005, the Nordic energy ministers set the objectives for further development of the Nordic electricity market, nominating ‘a truly common Nordic retail market with a free choice of suppliers’ as one of its strategic priorities (NordREG, 2009).

The Danish and Swedish data hubs project was chosen for this study due to representing a case in which numerous market partners collaborate. The new Danish and Swedish data hubs replace an old manner of communicating point to point between companies. This change was implemented in order to coordinate and manage the data transactions between the grid companies and the electricity suppliers. Progress in the projects differed at the point of the study, with the Danish data hub project having reached the point of putting the data hub into use while the Swedish project remained in the development phase. It was interesting to learn from their experiences.
4.2 Interviews

In line with the hermeneutic approach, empirical material was gathered through interviews with 14 respondents in total; see Table (1) for a documentation of the three papers that have been peer reviewed. Semi-structured interviews utilise a predefined list of questions while also allowing the interviewer to provide follow-up questions. Semi-structured interviews thus possess a more in-depth character and enable capturing the respondents’ perspective on a situation or event under study (Williamson, 2002). The purpose of an interview is to understand the area in question from a subjective point of view and to uncover the real meanings of the interviewees’ experiences. Interviews included in this study employed careful and thoughtful choice of respondents. The main criteria consisted of possessing relevant experience and active involvement in the development data hubs in Denmark and Sweden, respectively.
<table>
<thead>
<tr>
<th>Role</th>
<th>Task and responsibility in relation to the development of data hub</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations officer</td>
<td>Provides billing data for staff in electricity companies through the data hub.</td>
<td>Energy company, Sweden</td>
</tr>
<tr>
<td>Operations administrator</td>
<td>No specific role at the moment. Takes special interest in grid and supplier companies’ situation in the data hub.</td>
<td>Energy company, Sweden</td>
</tr>
<tr>
<td>Member of expert group</td>
<td>Involved in business processes and technology issues for the data hub.</td>
<td>Electricity supplier, Sweden</td>
</tr>
<tr>
<td>Development engineer</td>
<td>Responsible for collecting and reporting measuring data to the data hub.</td>
<td>Grid company, Sweden</td>
</tr>
<tr>
<td>Customer service coordinator</td>
<td>Works with change of supplier, billing, requirement management, and customer service. Takes part in the analysis of information, data, and the data hub.</td>
<td>Energy company, Sweden</td>
</tr>
<tr>
<td>Swedish data hub owner 1</td>
<td>Works with change management issues for the hub project. Responsible for dialogue and communication between actors in the electricity market.</td>
<td>Energy authority, Sweden</td>
</tr>
<tr>
<td>Swedish data hub owner 2</td>
<td>Hub product owner. Responsible for systems requirements.</td>
<td>Energy authority, Sweden</td>
</tr>
<tr>
<td>Danish data hub owner 3</td>
<td>Project manager for the data hub project.</td>
<td>Energy authority, Denmark</td>
</tr>
<tr>
<td>Functional architect</td>
<td>Educates and has primary contact with grid companies and suppliers.</td>
<td>IT vendor, Denmark</td>
</tr>
<tr>
<td>Product manager</td>
<td>IT representative in the data hub project.</td>
<td>IT vendor, Denmark</td>
</tr>
<tr>
<td>Billing manager</td>
<td>Ensures internal systems are switched to correct suppliers.</td>
<td>Electricity supplier, Denmark</td>
</tr>
<tr>
<td>Project and IT development manager</td>
<td>Studies market regulations and the BRS guides for new working process and roles.</td>
<td>Electricity supplier, Denmark</td>
</tr>
<tr>
<td>Market data coordinator</td>
<td>Works with price element and data consistency in the data hub.</td>
<td>Grid company, Denmark</td>
</tr>
<tr>
<td>Project manager</td>
<td>Monitors communication between company systems and the data hub.</td>
<td>Grid company, Denmark</td>
</tr>
</tbody>
</table>

Table (1): Respondents’ role and responsibility in the data hub development and organisation.
4.3 Analytical process

According to Boeije (2002), a comparative analysis together with a theoretical framework forms the core of the qualitative analysis in qualitative research. This study consists of three separate papers analysing the same empirical context. In each of these analyses, I carefully listened to the interviewees’ narratives during the interviews in Denmark and Sweden, and later, when transcribing, I interpreted their verbal words and expressions. This generated further discussions regarding their own experience of collaboration relations. After producing the three papers, a more meta-reflection combining, comparing, and later discussing the narratives in relation to each other took place. Thus, due to the use of three papers, several phases comprised the analytical process.

In the first paper, the analysis occurred with the help of enterprise architecture alignment dimensions and enterprise interoperability dimensions as a theory base for structuring success factors, which were categorised into general project and change management, business process, and information and data. The analysis was performed by transcribing the recorded material from the interviews of national data hub development for Denmark’s electricity market and encoding it according to the theory employed in the first paper. The empirical result was then analysed by comparing it to the theory to discern similarities and differences between theory and practice. The analysis of the first paper produced wide and appropriate understanding concerning the success factors for overcoming the issues of business process and data fragmentation, which consequently affects collaboration relation in a digital age. The first paper analysis thus demonstrated data quality’s importance and
how it directly affects the collaboration relations, as without high data quality, interoperability will not happen effectively. However, the interviews with narrators in the Danish data hub project were performed when the project was in the implementation and use phase. This aided me in understanding what made the data hub successful in use. Thereafter, I followed this path and developed the idea of the second paper to deepen the understanding concerning the relation between interoperability and data quality.

In the second paper, the analysis was based on the theory of levels of conceptual interoperability model (LCIM) and the data quality dimensions of accuracy, timeliness, completeness, and consistency. Content analysis was employed as a method for analysing the interview result, as this contributes to understanding the human contribution within a context. As mentioned, the national data hub development for Sweden’s electricity market was still in its development phase. The analysis was thus performed in two steps. First, the content of each individual answer was analysed, as the interview questions were based on the available knowledge of each study concept in order to conclude the respondents’ particular understanding of the relation between them. Second, the respondents’ understanding of the relation between interoperability and data quality were analysed to identify strong and weak understanding of the relation between the two concepts. The empirical study of both papers served as a basis for the third paper to create a comprehensive understanding concerning how the data hubs in both countries work as a digital artefact bonding numerous partners with various interests. As such, the third paper involved reanalysing previously collected qualitative data from the national data hub development for the electricity markets in Denmark and Sweden, respectively. With the aim of identifying traces of
boundary object properties in data hub development narratives, key words and phrases were formulated from the theory: boundary object and the nine properties, shared syntax, modularity, concreteness, accessibility, visualisation, annotation, participation, malleability, and up-to-dateness. These were then compared to respondents’ answers in order to identify similarities and differences between theory and practice.

After writing all three papers included in this thesis, I combined all analyses together in a meta-analytical work to more stringently conclude and establish a more generalised understanding of collaboration in a digital age. The result indicated a need for something more than mere successful collaboration among enterprises, as several narratives struggled to explain the need for everyone (i.e. enterprises, decision makers, employees, information system developers, and citizens) to be included in the collaboration relations. Thus, based on a comparison of the available knowledge for collaboration presented in the theoretical framework and this analytical work, a lack of a suitable concept covering collaboration in the digital age seemed to be presented.

4.4 Ethical aspects

The role of research is to develop new theoretical concepts, such as in relation to the progressively increasing digitalisation process that transforms society (Swedish Research Council, 2002). In this sense, research should responsibly serve society by developing appropriate concepts that can assist in improving understanding, avoiding misunderstandings, and reaching a common understanding of a future society. This particular research process has been rigorously and responsibly performed as reported in the Methodology.
section. The result is relevant due to its contribution to developing new concepts that allow society to understand and discuss digitalisation’s further development and its meaning for society. Furthermore, this research serves society through Open Access (Resnik, 2005), where it can be easily found for all to share and discuss its findings.

The respondents participating in this study were all informed of the study’s purpose, how long the interview would take, and the issue of name and organisation anonymisation (Miller et al., 2012). The only job title used in the study consisted of the respondent’s position, which they accepted upon asking. Participation in the interview was voluntary, and respondents could interrupt the interviewer or stop the interview without explanation. The respondents all agreed to participate in the study. Each acceptance was confirmed via email. As a result, the names of the individuals or their organisational affiliations were never used in any material produced as a result of this thesis work.

5 Paper results

This section briefly summarises the papers used as the basis for this thesis and the results they generated. This section’s purpose is to provide an orientation concerning purpose, approach, results, and how the paper contributes to the purpose of the thesis.

5.1 Paper I

One of the trends in society consists of increasing diversity of collaborations between enterprises in a changing environment. Interoperability has therefore been suggested as essential for the success of private and public sectors. It contributes to effective data exchange when systems efficiently utilise each other’s functionality. However, the increased complexity and the risk of fragmented business processes and data in many-to-many relationships can hinder interoperability development unless better understanding is reached. Thus, enterprise interoperability development in multi-relation collaborations calls for better guidance. Accordingly, this study aimed to identify the success factors for overcoming issues of business process and data fragmentation in developing enterprise interoperability in multi-relation collaborations. In order to achieve this goal, a qualitative approach and case study of the Danish electricity market were chosen, as this enabled an in-depth understanding of interviewees’ experiences of the subject and its conditions. A literature study covering enterprise interoperability and enterprise architecture formed the basis for the semi-structured interview questions employed. Seven interviewees from the project partners were chosen with respect to their different views of the development process and its success factors. The result illustrated two versions of the data hub created in the systems development process. A traditional hierarchical process with late involvement of the market parties resulted in Version 1 of the new system. Trial and error characterised the situation. This included repeated actions and inaccurate activities with no or little balance between functional and technical point of view. Thus, the development process was not effective. We argued that this was caused by lack of communication in a fragmented crowd of enterprises. Creativity is required to go beyond organisational boundaries.
and find new ways to communicate the change of both information systems and business activities in order to collaborate in a multi-relation. This was demonstrated in the development of Version 2, which possessed clear and separated responsibilities with early and full involvement of all market partners. E-learning, mail, and daily discussions contributed to the timely discovery of positive and negative issues important to the development and improved skills and understanding. Focus was placed on sharing individual and overall goals to achieve the supplier-centric model and a harmonised electricity market. We argued that the process then started from required information and treated the individual stakeholder as a source of knowledge. Data migration, consistency, and quality were identified as major issues in implementing Version 2 of the data hub. Furthermore, the data hub development project influenced all enterprises involved and restructured the market. We argued that strong involvement and engagement from all parties, dialogue, and education assisted in the transformation of a monopolistic market into a competitive market. In order to be more proactive and efficient in a multi-relation collaboration in terms of time and economical and human resources, we concluded that several success factors should be considered for overcoming issues of business process and data fragmentation. These success factors fell into the categories of general project and change management, business process, as well as information and data.

5.2 Paper II
Today’s global market is witnessing an increasing collaboration among enterprises during the entire product life cycle. In addition, such enterprises have to cope with internal changes from both a technical and organisational point of view. Large organisations need to exchange information among numerous separately developed systems. In order for this exchange to be useful, the individual systems must agree on the meaning of their exchanged data. That is, the organisation must ensure interoperability. In order to coordinate and manage the processes and complex data transactions between electricity suppliers and grid companies, data hubs are being developed. The Nordic countries have reached different development steps ranging from requirements to implementation of the data hub with interoperability and data quality at the centre of interest. Data quality, or lack thereof, is widely considered one of the most critical problems for achieving interoperability. In order to achieve high interoperability, such as in the Swedish electricity market data hub, data hub development needs to better comprehend the relation between interoperability and data quality. Accordingly, this study investigated the relation between interoperability and data quality. In order to fulfil this study’s aim, a literature study was conducted to cover the LCIM and the data quality dimensions of accuracy, timeliness, completeness, and consistency. To this end, a qualitative study with a deductive approach was chosen, as this allowed for a deeper understanding concerning the relation between the concepts of interoperability and data quality. Empirical data were collected through seven semi-structured interviews based on an interview guide. Interviewees possessed different roles and responsibilities in the company and in the data hub development for the Swedish electricity market. Content analysis was employed to analyse the interview result, as this
contributes to understanding the human contribution within a context. This study has subsequently demonstrated that the relation between interoperability and data quality is mutually imbricated. In other words, data quality forms the backbone of interoperability. Data exchange between the systems and the ability to use the other system’s functionality represents the core of the interoperability concept.

5.3 Paper III

In information systems research, digital artefacts positioned between different constituencies to facilitate collaboration have occasionally been labelled ‘boundary objects’. Digital technology enables multi-relational collaborations between parties possessing different experiences, knowledge, values, and goals. When it comes to digital technology triggering enterprise transformation, the use of boundary objects as a theoretical model is not that frequent. Limited research has investigated the extent to which digital technology might assume the role of boundary object in enterprise transformation processes. We investigated what traces of boundary object properties can be identified in data hub development narratives. An interpretive approach was accordingly chosen to explore 12 narrators’ experiences of participating in data hub development for the electricity market in Denmark and Sweden respectively. Through a literature study covering boundary objects, nine boundary object properties were chosen for the theoretical frame used for analysing the narratives. The conclusion was that boundary object properties formed part of the data hubs’ narratives early
on in the in-use taking processes or even before the digital artefact was utilised.

**6 Discussion**

The process of digitalisation is progressively changing the way business is carried out and how enterprises collaborate (Rouse, 2005; Pagani and Pardo 2017; Ebert and Duarte, 2018) As such, this research set out to understand the ensuing collaboration transformation. The idea was to contribute to a deeper understanding regarding the transformation of business collaboration by inquiring how can collaboration in a digital age be understood.

The results indicated an important relation between enterprise architecture and enterprise interoperability, which can be viewed from both perspectives when it comes to multi-relation collaboration in a digital age. Viewed from an enterprise architecture perspective, the aspect of socio-cultural alignment received little attention, and most notably, partners missed the human-to-human relation. Viewed from an enterprise interoperability perspective, the technical aspects of collaboration have gained considerable attention, whereas organisational aspects have not yet been adequately addressed, such as the involvement of diverse partners and processes with different responsibilities creating a complex web of actions and relationships. However, multi-relation collaboration is not just about partner involvement in developing organisational aspects. It also entails direct and explicit involvement of social relations. The relationship between data quality and multi-relation collaboration can also be viewed from an enterprise interoperability perspective. In that sense, data quality seems to represent a vital demand for
enterprise interoperability. Data quality dimensions such as data accuracy, timeliness, completeness, and consistency are required to achieve successful collaboration. The indication was that interoperability represents a basic aspect of collaboration in a digital age. Thus, the understanding was that data quality can be viewed as the root of multi-relation collaboration. Furthermore, boundary object properties were understood as important for the relation between the digital artefact and its social context—namely, people collaborating together. Understanding of a digital artefact inhabits multiple social worlds and fulfils the required information exchange in each of them. In other words, boundary objects are emergent in collaboration, and thus essential for developing digital artefacts. Finally, the results indicated that the multi-relation collaboration aspect requires equal consideration as technical and social aspects of development.

Digitalisation tends to increase the ability to manage collaboration and even closer relations among partners by clearly identifying every partner role and responsibility. Collaborations in a digital age depend on existing social relations, which includes partners’ experience and work processes. Such socio-cultural aspects need to be equally modified, both internally and externally, to suite users’ and enterprises’ needs. Enterprise architecture appears to be a key factor for internally harmonising the enterprise and managing classical consensus collaborative relation, whereas enterprise interoperability and boundary object appear to be key factors for enabling external information sharing among the partnering enterprises or society, regardless of any shared goal. Rather, it is sufficient to share a common understanding of the digital artefact. This helps to enable overall
development coordination that includes different user focusses on the digital artefact on one hand and enterprise activities on the other. Collaboration through digital artefacts is complex and comprises different types of collaboration relationships. Thus, in this digital age, it appears difficult to place sharp boundaries around collaborating partners that enable new and valuable combinations of relations among people, activities, business leaders, decision makers, media, social actors or citizens, and even locations. We therefore argue that, in order to deal with relations of partners collaborating in a digital age, a new concept is required.

7 Conclusion and future research

The common aim of this research was to contribute to the understanding of the transformation of business collaboration by exploring how collaboration in a digital age can be understood. The conclusion is that business collaboration appears to transform from a traditional collaboration, for instance inter-organisational collaboration to a multi-relation collaboration that addresses digital age demands more comprehensively. Prior to the digital age, collaboration was based on either a shared pre-existing goal that was agreed upon, or all collaborative partners negotiated on a shared goal and used the available resources to achieve it. When the collaboration mechanisms are routinised and standardised by just shared goal among collaborating partners, then it tends to be vague and fragile when nowadays collaborating partners are more independent or semi-independent. By contrast, collaboration in the digital age can be performed regardless of a shared goal. It is sufficient for all partners to share a common understanding of the digital
artefact and for each partner to possess their own goal. Thus, collaboration relations in a digital age enable collaborating partners to keep their independent identity separate from a collaborative identity. As a consequence, it generates more competitive and innovative collaborative processes when they share their knowledge rather than their goals. However, this study reveals that in a digital-base collaboration all collaborating partners from different areas of expertise can share their separated information and knowledge which can reduce the conflicting nature of collaboration relation by allowing all partners to have their own vision, expectations and goals with no contradiction of others vision, expectations and goals. In addition, the ability to collaborate with or without shared goals facilitates multi-relation collaboration. Collaboration in a digital age thus allows a common shared understanding of the digital artefact and, at the same time, adapts this understanding to the local needs of individuals and groups. The vital benefit is that collaboration in a digital age can occur regardless of time and space and with or without shared goal. In fact, it is enough to have shared a digital artefact that enables a boundaryless collaboration. Thus, it seems collaboration in a digital age is transforming from the business domain to society as a whole. This thesis is however a first step towards deepening understanding of doing the right things coloured by “effectiveness” in multi-relation collaboration. A future study can further investigate doing things right, in other words “efficiency”, by inquiring how can efficiency and innovation in the public sector be addressed in digitalisation strategies. Another future research can focus on the alignment between effectiveness and efficiency, by inquiring how can effectiveness and efficiency be addressed in digitalisation strategies. Moreover, future research can focus on the
implication of citizen benefits and needs in digital strategies. Also, digitalisation effects end customer privacy and market partner possibilities for developing new digital services.
8 References


Niemann, K.D., 2006. From enterprise architecture to IT governance. Springer.


https://www.ei.se/Documents/Publikationer/rapportoch_pm/Rapporter%20202017/Ei_R2017_05.pdf


Appendix A

Research aim and question
The aim of this study is to clarify what are the success factors for overcoming issues of business process and data fragmentation in the development of enterprise interoperability in multi relation collaborations.

INTERVIEW GUIDE A

<table>
<thead>
<tr>
<th>Theory</th>
<th>Interview topic</th>
<th>Interview question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Architecture</td>
<td><em>Structural alignment</em> Decision process. The decision process for the Danish hub. The decision process for the companies’ internal systems and projects. The involvement and engagement of the companies.</td>
<td>How were you involved in the development of the Data Hub?</td>
</tr>
<tr>
<td>Alignment Dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Functional alignment</em></td>
<td>Development process. The development and implementation process for the Danish hub. The development and implementation process for the companies’ systems.</td>
<td>How would you describe the process of developing the Data Hub?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How would you describe the implementation of the Data Hub system?</td>
</tr>
<tr>
<td><em>Infological alignment</em></td>
<td>Tools, support and resources provided/required in the development and implementation process.</td>
<td>What support has there been for the development of information systems in your organisation (method, technique, model, framework, resources, tools, skills)?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Socio-cultural alignment</em></td>
<td>Socio-cultural aspects. Changes in values and culture. Changes in rules or policies. Goals and evaluation. Goals for and evaluation of the Danish hub project. Goals for and evaluation of the companies’ projects. Perceived value of the hub from different stakeholders’ perspectives.</td>
<td>What specific goals have guided the work of the DataHub?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Have they been evaluated?</td>
</tr>
</tbody>
</table>
## INTERVIEW GUIDE A continuing

<table>
<thead>
<tr>
<th>Theory</th>
<th>Interview topic</th>
<th>Interview question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Interoperability Dimensions</td>
<td><strong>Conceptual barriers</strong>&lt;br&gt;Conceptual model used in the Danish hub project. Conceptual model used in the companies’ internal projects. Other conceptual/semantic barriers in interoperability with the hub and between enterprises.</td>
<td>What was important to consider when developing the conceptual model for the multi-relation enterprise collaboration?</td>
</tr>
<tr>
<td></td>
<td><strong>Organisational barriers</strong>&lt;br&gt;Organisational changes required. Organisational issues inhibiting enterprise collaboration.</td>
<td>What organisational factors were crucial to create a uniform process for information exchange in the multi-relation enterprise collaboration?</td>
</tr>
<tr>
<td></td>
<td><strong>Technical barriers</strong>&lt;br&gt;Barriers at technical level, e.g. use of protocols.</td>
<td>What conditions were required to make the technical protocol remain useful?</td>
</tr>
<tr>
<td></td>
<td><strong>Business level concerns</strong>&lt;br&gt;Business models: Changes in the companies’ business models. Structural changes on the market. New services created.</td>
<td>What interoperability concerns did you experience in the business model?</td>
</tr>
<tr>
<td></td>
<td><strong>Process level concerns</strong>&lt;br&gt;Business processes: Changes in the companies’ internal processes and communication. Changes in the processes and communication between the organisations.</td>
<td>In which way did the exchange of information between you and the other organisations change?</td>
</tr>
<tr>
<td></td>
<td><strong>Service level concerns</strong>&lt;br&gt;Information/ Data: Information model used for the hub. Ownership of data. Time and quality issues with the data. Consequences for the companies and for the interoperability.</td>
<td>What was needed to agree on a suitable service level (SLA) for the multi-relation enterprise collaboration?</td>
</tr>
</tbody>
</table>
## INTERVIEW GUIDE A continuing

<table>
<thead>
<tr>
<th>Theory</th>
<th>Interview topic</th>
<th>Interview question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data level concerns</td>
<td>Systems: Choice of system solution for the hub. Purchase process for the hub system solution. Purchase process for the companies’ internal systems. Outcome and result of the chosen systems.</td>
<td>What was crucial in creating a common data model for the multi-relation enterprise collaboration?</td>
</tr>
</tbody>
</table>

## Appendix B

### Research aim and question

The aim of this study is to contribute to better understanding of the relation between interoperability and data quality concepts to improve data hub development. Thus, this study inquired what is the relation between interoperability and data quality concepts?

### INTERVIEW GUIDE B

<table>
<thead>
<tr>
<th>Theory</th>
<th>Interview question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central concepts</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td>What is the meaning of data?</td>
</tr>
<tr>
<td>Information</td>
<td>What is the meaning of information?</td>
</tr>
<tr>
<td>Data quality</td>
<td>Define data quality in three words.</td>
</tr>
<tr>
<td>Interoperability</td>
<td>Define interoperability in three words.</td>
</tr>
<tr>
<td></td>
<td>What is the relationship between data quality and interoperability?</td>
</tr>
<tr>
<td></td>
<td>What communication difficulties are there in today’s system?</td>
</tr>
<tr>
<td>Theory</td>
<td>Interview question</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Data quality dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>How do you ensure that data is correct in the data hub?</td>
</tr>
<tr>
<td></td>
<td>How can wrong data be avoided in the data hub?</td>
</tr>
<tr>
<td>Timeliness</td>
<td>How should data updates be handled in the data hub?</td>
</tr>
<tr>
<td>Completeness</td>
<td>How do you ensure that the data hub fully covers the data the business needs?</td>
</tr>
<tr>
<td></td>
<td>How do you plan to train relevant stakeholders in using the data hub?</td>
</tr>
<tr>
<td></td>
<td>How do you plan to test the data hub to make it as user-friendly as possible?</td>
</tr>
<tr>
<td>Consistency</td>
<td>How should data be structured in the data hub to meet the need for the right data and information in the business?</td>
</tr>
<tr>
<td></td>
<td>How should data in the data hub meet the need for the right information in the business?</td>
</tr>
<tr>
<td>Levels of Conceptual Interoperability Model LCIM</td>
<td></td>
</tr>
<tr>
<td>Level 2 and 3</td>
<td>How do you ensure that there is a common understanding of data that you read when communicating with multiple businesses?</td>
</tr>
<tr>
<td></td>
<td>How do you ensure that there will be no data in the data hub that contradicts each other in communication with multiple businesses?</td>
</tr>
<tr>
<td>Level 4</td>
<td>How do you ensure that there is a common logical reference model?</td>
</tr>
<tr>
<td></td>
<td>How do you plan to do to create a common understanding of the context and meaning of the information?</td>
</tr>
<tr>
<td>Level 5</td>
<td>In what way can the meaning of the information be retained when changes occur in the data hub?</td>
</tr>
<tr>
<td>Level 6</td>
<td>What internal work processes do you need to customize to fit the data hub?</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>What role do you have in working to create a common conceptual model for the data hub?</td>
</tr>
<tr>
<td></td>
<td>What is the role of common conceptual model in relation with interacting systems?</td>
</tr>
<tr>
<td></td>
<td>What changes need to be made to your conceptual model to fit the data hub? (process, information, context)</td>
</tr>
<tr>
<td></td>
<td>How do you ensure that the data hub provides full understanding of contexts, processes, information, etc. in other systems?</td>
</tr>
<tr>
<td></td>
<td>General aspects to consider for efficient data exchange?</td>
</tr>
</tbody>
</table>