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Riikka Vilminko-Heikkinen

Data, Technology, and People

Demystifying Master Data Management

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Abstract

With the amount of data constantly increasing, better practices are needed to manage it. Master data management (MDM) is an organizationally horizontal flow of activities aimed at managing core business data (i.e., master data). MDM differs from traditional data management practices as an organization-wide function. The idea of managing an organization's most important data is impossible to achieve if MDM is simply treated as a data management practice or a technology-driven phenomenon. Establishing an MDM function involves introducing changes to an organization, which can relate to people and their ways of working, or technology and how it is used. If only a certain aspect is emphasized, the function will not deliver desired results.

The object of this thesis is to study MDM not as a straightforward IT project, but as a complicated and multi-dimensional function. The goal is to understand the factors that should be taken into account in the development of an MDM function. The empirical part of this study is an ethnographic case study in a public sector organization, where MDM development was in early phases when the observation began. Altogether, the two data collection periods lasted for 32 months and during this, two MDM development projects were carried out, and MDM development became rooted as part of the organization's routine operations.

MDM development was analyzed as an ensemble that includes social and material components. Its theorization begins with understanding the role of master data in an organization's information landscape and continues to examine the different views of MDM. Theories of change assist in understanding how change should be observed, understood, and managed.

The study indicates that MDM effects multiple levels of an organization. Many organizational factors influence its development, and extensive dependencies exist between these factors. Especially in terms of ownership, other roles and responsibilities assume key positions. By understanding these factors and their roles in MDM development, it is easier to manage them.

The study sheds light on the strong alignment between the complex concept of MDM and the organization. MDM literature is scarce and literature of public sector MDM is almost nonexistent. This dissertation contributes to research by widening the understanding of MDM in the public sector context, and by presenting a framework for establishing an MDM function as an organizational function that is closely linked with technology.

Tiivistelmä

Tämän väitöskirjan tarkastelee ydintietojenhallintaa IT-projektin sijaan monitasoisena organisaation toimintona. Tavoitteena on ymmärtää osa-alueet sekä tekijät, jotka tulisi huomioida ydintietojenhallinnan kehittämisessä. Tutkimuksen empiirinen osuus on etnografinen tapaustutkimus julkisen sektorin organisaatiossa. Organisaation MDM kehittäminen oli alkutekijöissään, kun datan keräämiseen liittyvät havainnoinnit aloitettiin. Datan keruu kesti kaiken kaikkiaan 32 kuukautta. Tänä aikana toteutettiin kaksi ydintietojenhallinnan projektia ja kehittäminen tuli osaksi organisaation jatkuvaa toimintaa.

Tutkimuksessa tarkastellaan ydintietojenhallintaa sosioteknisenä ilmiönä. Ydintietojenhallinnan teoretisointi lähtee liikkeelle ydintiedon roolin ymmärtämisestä organisaation informaatiokokonaisuudessa ja jatkuu ydintiedonhallinnan eri näkökulmien kartoittamiseen. Teoriat liittyen muutokseen auttavat ymmärtämään, kuinka ydintietojenhallintaan liittyvää muutosta tulisi tarkastella, ymmärtää sekä johtaa.

Tutkimus osoittaa, että ydintietojenhallinta vaikuttaa organisaatioon usealla eri tasolla. Useat organisaatio tekijät vaikuttavat ydintietojenhallinnan kehittämiseen ja tekijöiden välillä on useita riippuvuuksia. Erityisesti tiedon omistajuus sekä muut roolit ja vastuut ovat avainasemassa. On helpompaa johtaa näitä tekijöitä ymmärtämällä niitä sekä niiden roolia ydintietojenhallinnan kehittämisessä.

Tutkimus valottaa ydintietojenhallinnan sekä organisaation monimutkaista yhteyttä. Ydintietojenhallintaa tarkastelevaa kirjallisuutta on varsin vähän ja erityisesti julkishallinnon ydintietojenhallintaa tarkastelee kirjallisuutta ei ole käytännössä lainkaan.

Tämä tutkimus laajentaa ydintietojenhallinnan ymmärrystä julkishallinnossa sekä antaa viitekehyksen ydintietojenhallinnan toiminnon perustamiselle teknologiaan vahvasti liittyvänä organisaation toimintona.

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I want to give a special thank you to my son Otso. He offered a reminder of the truly important things in life by climbing into my lap and closing the laptop when it was time to do something else for a change. Last thank you is for my spouse and love of my life Mikko. He has in many ways made this dissertation possible by running our daily life, supporting me, encouraging me, proof-reading the publications, and just by being the amazing person he is.

Tampere 23.1.2017

Riikka Vilminko-Heikkinen

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List of Abbreviations

Abbreviation	Short name	Explanation
BI	Business Intelligence	Analytical business reporting solution
CRM	Customer Relationship Management	Sales and marketing driven practices, processes, systems, applications, and data for managing customer information, communication, and transactions
DM	Data Management	Administrative process to acquire, validate, store, protect, and process an organization's data to ensure its accessibility, reliability, and timeliness
DQ	Data Quality	Data that is fit for use by data consumers. Some examples of data quality attributes are accuracy, relevancy, timeliness, completeness, and accessibility (Wang & Strong 1996)
DW	Data Warehouse	Reporting system for analytical reporting purposes
EA	Enterprise Architecture	Enterprise architecture is a leadership and strategic development tool. It is used to define how IT and information systems, organizational processes, and the operating units and staff work as a whole (McNurlin et al. 2006)
ERP	Enterprise Resource Planning	Enterprise-level application for integrated financial and operative transaction processing
IM	Information Management	Management of information processes, information resources, and information technologies (Choo 2002)
IS	Information System	Information systems are technically mediated social interaction systems aimed at creating, sharing, and interpreting a wide variety of meanings (Hirschheim, Klein & Lyytinen 1995, 13)
IT	Information Technology	Various forms of data and information, which are digitalized, transferred, and stored with computers and other data processing devices; information and communication technology, ICT
MDM	Master Data Management	An application-independent process, which describes, owns, and manages core business entities. It ensures the consistency and accuracy of these data by providing a single set of guidelines for their management, thereby creating a common view of key company data, which may or may not be held in a common data source (Smith & McKeen 2008)

PDM	Product Data Management	Product data management is the use of software or other tools to track and control data related to a particular product
SOA	Service-oriented Architecture	Service-oriented architecture (SOA) is an architectural style that supports service-oriented thinking and the development of applications based on self-contained services, which may be composed of other services (The Open Group 2011).

List of Publications

This thesis is based on the following five publications. The rights have been granted by the publishers to include the publications in this dissertation.

I. Vilminko-Heikkinen R. & Pekkola, S. (2013). “Establishing an Organization’s Master Data Management Function: A Stepwise Approach”. Proceedings of 46th Hawaii International Conference on System Sciences. 4719 - 4728. Piscataway, NJ: IEEE Press.

II. Vilminko-Heikkinen, R. & Pekkola, S. Master Data Management and its Organizational Implementation: An Ethnographical Study within the Public Sector. Forthcoming in Journal of Enterprise Information Management. Emerald.

III. Vilminko-Heikkinen R. (2015). Establishing a MDM function: First Steps in the Master Data Management Architecture Design. Proceedings of 14th IFIP Elec-tronic Government and Electronic Participation, Vol. 22, 124-131. IOS Press: Amsterdam.

IV. Vilminko-Heikkinen R., Brous, P. & Pekkola, S. (2016). Paradoxes, Conflicts and Tensions in Establishing Master Data Management Function. Proceedings of the 24th European Conference on Information Systems. Paper 184. AIS Electronic Library. http://aisel.aisnet.org/ecis2016_rp/184

V. Vilminko-Heikkinen R. & Pekkola, S. (Submission in progress). Changes on Roles, Responsibilities, and Ownerships in Establishing Organization’s Master Data Management Function.

In this thesis, these publications are referred to as Publication I, Publication II, Publication III, Publication IV, and Publication V.

Contributions of the author in the publications

Publication I

The author collected the data, conducted the study, coordinated the writing process, and wrote the paper with the co-author. The paper was presented by the co-author in the Hawaii International Conference on System Sciences (HICSS).

Publication II

The author collected the data, conducted the study, coordinated the writing and publication process, and wrote the paper together with the co-author. An earlier version of the paper was presented by the author in the International Conference on Information Quality (ICIQ).

Publication III

Sole author of the paper. The paper was presented by the author in the IFIP Electronic Government (EGOV) and Electronic Participation (ePart) Conference 2015.

Publication IV

The author collected the data, conducted the study, coordinated the writing, and wrote the paper together with the co-authors. The paper was presented by the third author in the European Conference on Information Systems (ECIS).

Publication V

The author collected the data, conducted the study, coordinated the writing and publication process, and wrote the paper together with the co-author.

1 Introduction

1.1 Background

This dissertation observes how people, organizations, technologies, and data are related and intertwined. Data and information management have gained a lot of attention in practice (e.g., Davenport 1998). With the amount of data constantly increasing, better practices are needed to manage it. Different kinds of data have different roles in information management, and they should be managed accordingly (Panian 2010).

Master data management (MDM) is an organizationally horizontal flow of activities aimed at managing core business data (i.e. master data). This kind of data forms the essence of a business and should be harmonized, up-to-date, and available in every part of an organization and all its functions, because it has a significant effect on an organization's business (Haug & Stentoft Arlbjørn 2011). Establishing an MDM function involves presenting many changes to an organization, which can relate to people and their ways of working, or technology and how it is used.

This research was initially motivated by practical challenges that the author experienced in her work. The primary personal motivation for this work was to understand what MDM development is really about. The author worked for several years as an information architect in the public sector. During this time, MDM was considered a difficult issue and implementation was seen as problematic. The inability to comprehend the issues involved was evident, while MDM applications and the technical capabilities of MDM were accentuated. As a starting point, this seemed like a very narrow approach. The development was about establishing new activities that changed the old way of doing things. Technology's role was to affect and enable the change. This triggered the author's interest to understand the phenomenon more profoundly. The scarce literature on the subject,

and especially from the public sector point of view increased the interest on the phenomenon. When the organization began its full-scale MDM development, the idea of following the development in detail surfaced. The objectives can be summarized in the following research question: What should be taken into consideration when establishing an MDM function?

An organization's actions and decisions emerge from the ecology of information processes (Choo 2002). The challenge is to manage the information. Choo (2002) presents information management as a broad vista to information processes, information resources, and information technologies. As early as 1985, Porter and Millar stated:

> The information revolution is sweeping through our economy. No company can escape its effects. Dramatic reductions in the cost of obtaining, processing, and transmitting information are changing the way we do business. (Porter & Millar 1985, 149)

In many ways, the information revolution is ongoing and the end is not in sight. The amount of data increases cumulatively because of the rapid growth of information systems (IS). Information technology (IT) is essential for current operations, communications, and future strategies of modern enterprises (Nolan 2012). The information stored in IS is essential for creating successful, competitive firms, managing global corporations, adding business value, and providing useful products and services to customers (Laudon & Laudon 2007). Several different IS and applications have been developed to provide necessary information across functions, business units, and geographically dispersed organizations, such as enterprise resource planning (ERP) systems (Holland & Light 1999).

The information quality problems that many companies face today are related to technological developments in the last decades. The development of IT has enabled organizations to collect and store more data than has ever been possible before (Haug & Stentoft Arlbjørn 2011). Organizations should be aware of their information resources in order to use them effectively and ensure high-quality information. As the volume of data increases, the complexity of managing it does as well. However, the risk of poor information quality has increased, since larger and more complex information resources are being collected and managed (Watts et al. 2009).

Data work as building blocks for information (Zins 2007), and information quality is thus highly dependent on data sources. Data management forms the foundation for information management (English 1996). It is a fairly large concept that consists of several subareas, such as database management, data architecture, data security management, and data quality management (Mosley et al. 2010). It also refers to technical data management practices, with the emphasis often on the technical aspects that enable data

management (e.g., databases), which are observed as technical components of an information system (e.g., Gordon 2007, 11). The point of view is often concentrated in an individual operating area of an organization or certain information system.

Organizations often lack openness and unity when it comes to data management (Atzmueller et al. 2016), and IS and data management practices are often built as silos (Fatehali 2011). Each organization typically develops and runs its own databases and IS without considering data interoperability, transferability, and usability (Dahlberg 2010; Dahlberg et al. 2011). Furthermore, the data landscape is becoming increasingly versatile. As the number of IS and data storage systems continues to increase, the data of the same citizens, services, and professionals are increasing in number in these data storage and information systems (Dahlberg & Nokkala 2015). Public sector organizations are to some extent obligated or strongly encouraged to publish their data as open data (e.g., Huidboom & Van den Broek 2011; Shkabatur 2012). Data quality issues are emphasized when the data published is not usable (Janssen et al. 2012).

Organizations and enterprises are keen to pursue new opportunities and create new services, but often stumble upon problems with their data. Quality issues or problems with data accuracy or availability result in barriers in their development. Partial optimization of data quality is not a long-term solution and will usually create problems in the long run that accumulate in other processes. This is especially the case when data is common for several main processes. Standardizing and integrating critical data stabilizes the organization's core activities and increases the predictability of outcomes (Ross 2009, 179). However, to do this, the organizations must understand the data their core activities rely on (Ross 2009, 180).

1.2 Positioning the concept of MDM

As found, the concept of MDM is associated with several areas within an organization and areas of information management. Figure 1 presents the rough positioning of the concept of MDM to the related fields of research. In a larger context, businesses and organizations form the environment for MDM. Organization's external factors could also be observed as a wider environment, but here the emphasis is on the internal factors.

To contemplate the internal environment, MDM should be built as a part of a wider enterprise information management strategy (Radcliffe 2007). Thus, it should be observed in the context of information management, as it is generally considered a sub-area of data management practices (Mosley et al. 2010). Data management practices include several different sub-areas, such as data governance efforts (e.g., Haug et al. 2013).

Data governance is a framework for decision rights and accountabilities to encourage desirable behavior in the use of data (e.g. Khatri & Brown 2010). These are also a pivotal part of MDM (e.g. McKnight 2009).

MDM builds on information architecture and IS. Data quality and information security set the demands and objectives for MDM at a more detailed level. Often master data in question includes sensitive data that should be handled with specific regulations. These, in addition to data quality requirements, set several demands for the technical architecture, as well as for the information management and data governance efforts.

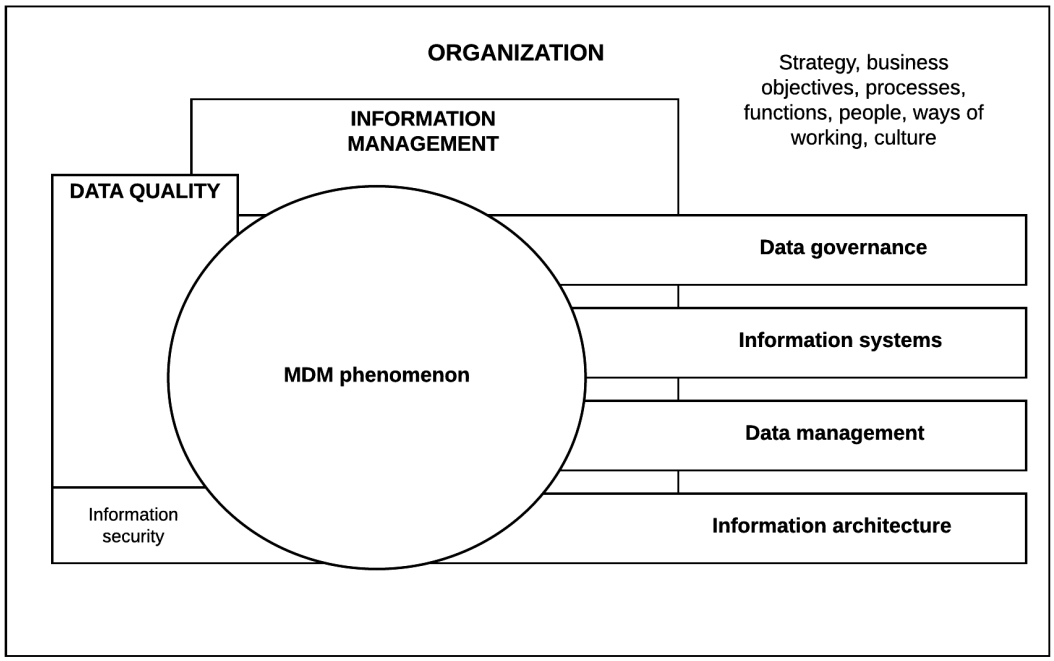

FIGURE 1 Positioning the concept of MDM

MDM is not about storing and governing a large amount of data. It is about understanding which part of the data is common for the organization and has the largest effect on business (Haug et al. 2011). It is more about quality than quantity. Master data presents a view into core shared information assets within the enterprise, and as such, managing the master data asset should be considered a critical component of an enterprise information management strategy (Loshin 2009, 23). Errors in master data can induce errors in business operations that can accumulate into false decisions and costs. Even a small amount of incorrect master data can incur significant costs for an organization (Haug &

Stentoft Arlbjørn 2011). The challenge in managing this kind of core data is to manage it as an organization-wide resource. It cannot be treated as a unit or database-specific function. The main barriers to achieving high-quality master data are related to organizational issues, namely unclear roles and responsibilities, a lack of procedures and policies for data management, and a lack of management support (Haug et al. 2013).

The literature only contemplates MDM as a technical concept or data governance issue from a single point of view. Vilminko-Heikkinen and Pekkola (2011) have identified the themes that the current MDM research covers to gain a better understanding of the MDM literature and the different areas of MDM. This was extended by reviewing the same six databases (Emerald, SpringerLink, Scopus, IEEE Xplore, EbscoHost, and ACM Digital library) again in 2015. Table 1 summarizes the themes that emerged from the MDM literature.

TABLE 1 Categorization of the publications (adapted from Vilminko-Heikkinen & Pekkola 2011)

Theme	**Number of references**	**References**
Architecture	16	Loser et al. 2004; Berson & Dubov 2007; Dreibelbis at al. 2008; Andreescu& Mircea 2008; Kokemüller & Weisbecker 2009; Loshin 2009; McKnight 2009; Otto & Hüner 2009; Bai et al. 2010; Cleven & Wortmann 2010; Maedche 2010; Otto & Schmidt 2010; Otto 2012/b; Gomede & Barros 2013; Oberhofer et al. 2014; Poess et al. 2014
Data content management	1	Chisholm, 2008
MDM in big data or BI	2	Kekwaletswe & Lesole 2014; Oberhofer et al. 2014; O'Leary 2014
Data governance	21	Griffin 2005/b; Dyché & Levy 2006/a; Joshi 2007; Moss 2007; Radcliffe 2007; Dreibelbis at al. 2008; Power 2008; Shankar 2008; Smith & McKeen 2008; Snow 2008; Tuck 2008; Cochrane 2009; Loshin 2009; Lucas 2010; Power 2010; Otto & Reichert 2010; Waddington 2010; Zornes 2011; Bonnet 2013; Buffenoir & Bourdon 2013; Allen & Cervo 2015
Data models	13	Moss 2007; Andreescu & Mircea 2008; Loshin 2009; Menet & Lamolle 2009; Wang et al. 2009; Choi et al. 2010; Cruz et al. 2010; Cao et al. 2014; Kikuchi 2014; Subotić 2014; Lamolle et al. 2015; Singh & Singh 2015; Talburt & Zhou 2015
Master data development	13	Griffin 2005/a; Griffin 2006/a; Griffin 2006/b; McKnight 2006; Longman 2008; Loshin 2009; Cleven & Wortmann 2010; Das & Mishra 2011; Fatehali 2011; Silvola et al. 2011; Zornes 2011; Vilminko-Heikkinen & Pekkola 2013; Sarkar 2015

Master data domains	12	Dyché & Levy 2006/a; Dyché & Levy 2006/b; Dreibelbis at al. 2008; Power 2009; Cleven & Wortmann 2010; Cervo & Allen 2011; Fitzpatrick, Coallier & Ratté 2012; Liyakasa 2012; Otto 2012/a; Huhtala, Lohtander & Varis 2014; Karpischek et al. 2014; Abraham, 2014
Master data lifecycle	2	Loshin 2009; Ofner et al. 2013
Master data privacy & security	5	Berson & Dubov 2007; Dreibelbis at al. 2008; Loshin 2009; Yakovets et al. 2012; Piedrabuena et al. 2015
Master data quality	11	Knolmayer & Röthlin 2006; Otto & Ebner, 2010; Waddington 2010; Dahlberg, Heikkilä & Heikkilä 2011; Haug & Stentoft Arlbjørn 2011; Knapp & Hasibether 2011; Loshin 2011; Otto et al. 2012; Sammona, Tadhg Naglea & Carlsson 2012; Haug et al. 2013; Zoder 2015
Maturity assessment of MDM	6	Waddington 2006; Dyché & Levy 2008/a; Dyché & Levy 2008/b; Shankar & Menon 2010; Bonnet 2013; Spurt & Pietzka 2015
MDM applications & technical requirements	28	Yang 2005; Beyer 2006; Dyché & Levy 2006/a; Berson & Dubov 2007; Henschen 2007; Joshi 2007; Kobielus 2007; White 2007; Zornes 2007; Menet & Lamolle 2008; Suram & Muppala 2008; Loshin 2009; Wang et al. 2009; Bai et al. 2010; Galhardas et al. 2010; Cervo & Allen 2011; Chisholm & Corzo 2011; Kikuchi 2011; Otto & Ofner 2011; Murthy et al. 2012; Kobielus 2013; Nedumov et al. 2013; Baghi et al. 2014; Castelltort et al. 2014; Cheung & Chung 2014; Ekchart 2014; Subtonic et al. 2014; Feng, Wang & Tan 2015
MDM enabling SOA	3	Berson & Dubov 2007; Dreibelbis at al. 2008; Huergo et al. 2014
MDM project	3	Levy 2007; Bai et al. 2010; McKnight 2010
Objectives for MDM	8	Loser et al. 2004; Karel et al. 2006; Fung-A-Fat 2007; Gokhale 2007; Snow 2008; Wise 2008; Mukherjee 2013; Kumar 2015
Public sector MDM	1	Fatehali 2011
Strategy to approach MDM	7	White et al. 2006; Swanton et al. 2007; Cleven & Wortmann 2010; Silvola et al. 2011; Zoder 2011; Mukherjee 2013; Kumar 2015

The idea was to understand the main interest areas under MDM research. Practice-oriented papers tend to concentrate on MDM applications. Current research has been more focused on data governance, which observes how organizations should be formed in order to support data management (Gordon 2007). As a theme, data governance does not include the technical architecture, and more importantly, it does not include how the technical issues are intertwined with governance. As a result, the phenomenon is simplified and merely single aspects are stressed (Smith & McKeen 2008). Simplifying MDM could result in creating yet another data silo. IT is a self-evident part of organizations,

but the viewpoint should be on people and technology, rather than people versus technology (Galliers & Newell 2001). If only a certain aspect is emphasized, the function will not deliver desired results. Also, current research especially of public sector organization's MDM is almost nonexistent. Only one of practice-oriented papers was identified as one (i.e., Fatehali 2011).

1.3 Research objectives and structure of the thesis

The object of this study is to indicate that MDM is not a straightforward IT project, but a complicated and multi-dimensional function. The term "function" describes the MDM practice profoundly by indicating that its role is similar to a business function. In addition to referring to organizational units, the literature often refers to organizational functions when referring to cross-functional activities, such as human resources (Schüler 1990), IT (Sauer & Willcocks 2003), and marketing (Childe et al. 1994). The organizational term "unit" is often used to describe the division of labor functions, such as sales unit (e.g., Kowalkowski et al. 2015). Similarly, the practice-oriented publications also often refer to data management as a function (e.g. Mosley et al. 2010), and MDM is referred to as a function in this study. MDM organization is usually part of the primary organization of a company (Otto & Reichert 2010).

Taking into account various aspects when designing and establishing an MDM function will ensure that certain business benefits are enjoyed when the whole potential of the function is exploited. If technology is not the key, we turn our attention to the beginning of the development in order to understand what should be done in the organizational setting, and in this way, we begin to comprehend why it is not about technology. Here it will be argued that managing master data differs from traditional data management practices because of its organization-wide scope. The goal is to understand which factors should be taken into account when establishing an MDM function. The term "establish" used throughout this thesis refers to creating something new.

Figure 2 presents the focus of this research. To contemplate the presented question of what should be taken into consideration when establishing an MDM function, the themes of MDM and organizational development were derived from the need to understand how the function affects the organization. Also, the theme for information governance was selected to include the areas related to the concept of MDM (as presented in Figure 1) and the main findings of the literature review.

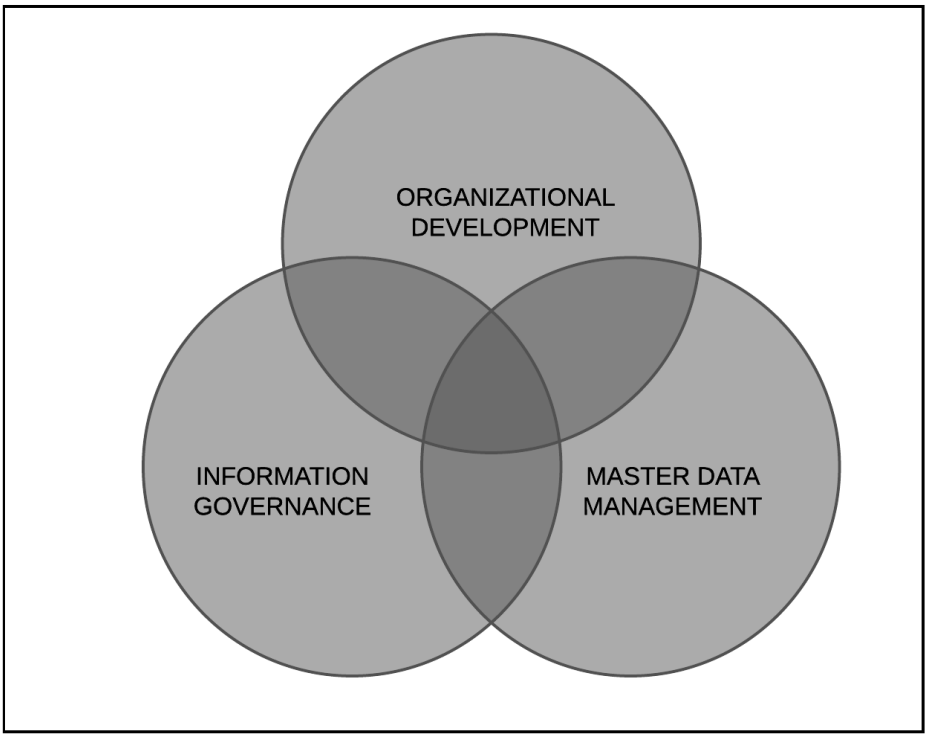

FIGURE 2 The three design areas to build the theoretical foundation for MDM

The three areas are studied more closely to build the theoretical foundation for observing MDM. Organization forms the environment and context for MDM. The idea is to observe how the organizational context effects the development of MDM, and especially, how organizational development and MDM development align. The concept of data and information are observed more closely to understand the basis for master data, data management, and further on, MDM. After this, the management of master data is defined in more detail. As seen in the literature review, data governance has been a recurring topic in recent MDM literature. Here, we expand this a bit further and contemplate the theme of information governance in order to understand the concept of data governance also as a part of managing information on the enterprise level.

This research focuses on the public sector, because MDM has been studied even less in this context. The maturity of MDM is lower in the public sector, and the environments are often more complex (Fatehali 2011). Consequently, they offer an interesting setting for empirical research. The author's position offered a prominent place to follow MDM development in the organizational context. Therefore, traditional research methods, such as interviewing, seemed insufficient. The author's position presented the opportunity to closely observe MDM development over an extended period of time. Ethnography seemed a suitable research method, especially when the organizational context offered a unique opportunity to expand the prior research on MDM, which lacked the public sector viewpoint.

The thesis can be divided into two parts. The purpose of the first part is to provide an introduction to the research area, describe the motivation and research questions of the study, describe the research process and methodological choices, summarize the main methods and findings of the individual publications that are presented in detail in part 2, and discuss the contributions of the study. The first part of the thesis was written after the individual publications were published in academic journals and conferences. The main point of the first part is to cover the main topics related to the publications, and also to present some new viewpoints that were not included in the publications. The second part of the thesis consists of five original publications.

2 Theoretical background

The theoretical background for this thesis includes the definition of the concept of data and information to understand the foundation for master data. Data management and data governance are discussed as related concepts before observing MDM in detail. Organizational development is observed to form a foundation for understanding the changes in relation to MDM.

2.1 Data, information, and knowledge

The three concepts of data, information, and knowledge are fundamental in the context of information science (Zins 2007). The difference between data and information is functional, not structural (Ackoff 1999). Galliers and Newell (2003) offer a distinction between the terms “data,” “information,” and “knowledge”:

> It is perhaps useful to go back to basics and understand the distinction between data, information and knowledge – terms that tend to be used synonymously in every day parlance. Data become informative for a particular purpose to human beings by the way people interpret the world about them through their own individual lenses, and by applying their memory personal knowledge to each new situation they confront. This is how we innovate and adapt. Data are context free and can be interpreted in many different ways for different purposes . . . So-called information technology therefore processes data, not information. (Galliers & Newell 2003)

Data, for example characters, figures and numbers, carry no meaning on their own (Davenport & Prusak 1998). They are unprocessed, unrelated raw facts or artifacts that work as information’s building blocks (Zins 2007). All organizations need data and many are heavily dependent on it (Davenport & Prusak 1998). It is raw material for the creation of information and decision-making, and further on knowledge, but it will not tell us what to do (Davenport & Prusak 1998).

Information is data that has been processed into a form that is meaningful to the recipient (Davis & Olson 1985). The word “inform” originally meant “to give shape to,” and information is meant to shape the person who gets it (Davenport & Prusak 1998). Data needs to be given structure in ways that reflect the interests and information-use modes of the organization and its members (Choo 2002). Information becomes knowledge when it is associated with a certain context (Galliers & Newell 2001). Information is data extracted that has the capacity to perform useful work on an individual’s knowledge base (Boisot & Canals 2004). Although the terms “data” and “information” are often used interchange-

ably, in this thesis, we refer to data when describing unprocessed data. Theoretical differentiation between data and information is clear, but practitioners often use the term "data" in a broader sense (Falge et al. 2012).

Boisot and Canals (2004) present a schema that views data, information, and knowledge as distinct kinds of goods, with each possessing a specific type of utility and agent as a rational information processor. Effective cognitive strategies extract information from data and then convert it into knowledge (Boisot & Canals 2004).

In order to understand the functions of information management and data management, two terms should be further distinguished. Galliers and Newell (2001) have identified the characteristics of data and information to distinguish the terms (Table 2).

TABLE 2 Characteristics of data and information (adapted from Galliers & Newell 2001)

DATA	**INFORMATION**
Explicit	Interpreted
Exploit	Explore
Use	Construct
Accept	Confirm
Follow old recipes	Amend old recipes
No learning	Single-loop learning
Direction	Communication
Prescriptive	Adaptive
Efficiency	Effectiveness
Predetermined	Constrained
Technical systems	Socio-technical systems
Context-free	Outer context

Information management describes how an organization manages its information, including its information processes, information resources, and information technologies. Data is the foundational level of information management, and managing data is an activity that is responsible for making sure that the organizations internal and external data sources offer the raw material that is needed (Zins 2007).

Numerous types of data exist in organizational settings (Figure 3): transactional data, master data, metadata, and reference data (Cleven & Wortmann 2010), where typically the syntactic, semantic, and pragmatic means of data are mixed. Hence, by dividing the types of data more meaningfully as noted above, rather than merely into data, information, and knowledge as suggested by the information theorists (Davenport & Prusak 1998), transaction data is the organization's basic data, which is connected to its business processes and functions and is generated as the business is run (e.g., when placing

an order on an item). Transaction data consists of both financial transactions and production-specific data. If the master data is not correct, the transactions will not fulfill their intended purpose, because transactions use master data (Sen 2002; Haug & Stentoft Arlbjørn 2011). Skewed data appears as duplicates, missing attribute values, and data value conflicts (Dahlberg 2010). Data errors and inconsistencies lead to monetary and qualitative losses (Snow 2008). Also, maintaining many different data sets, perhaps for each and every IS, is enormously expensive. Yet, the indirect costs are far more important than direct costs (Davenport 1998).

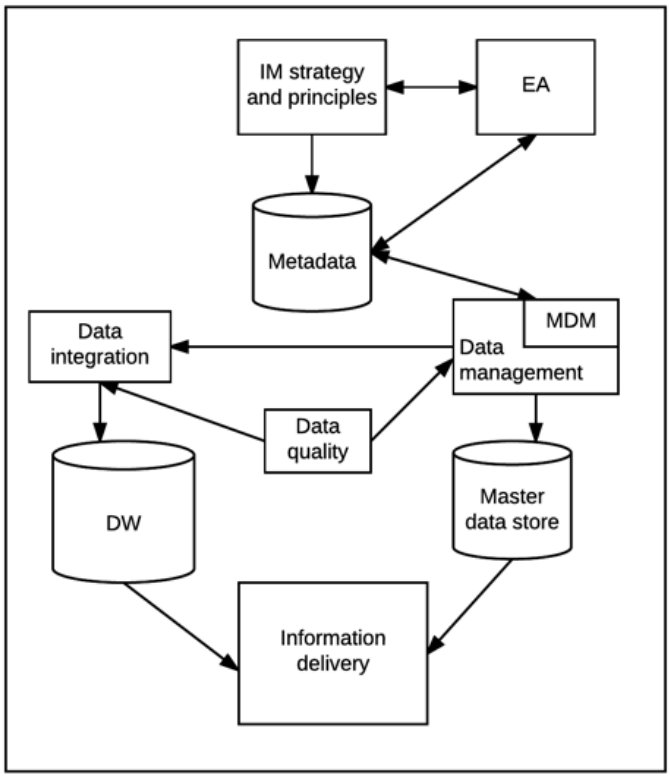

FIGURE 3 Master data in a data eco-system (Smith & McKeen 2008)

In addition to transactional business data, organizations use various types of sensor data, including data created by robots, and open data, which is typically data made available by public sector organizations (Dahlberg & Nokkala 2015). Metadata is data about the data, while reference data describes the data derived from other contexts for business use (Sen 2002). Master data forms the foundation for transaction data (Haug & Stentoft Arlbjørn 2011). It usually consists of the basic registers connected to data from multiple transactions and is, therefore, essential for business operations – missing or erroneous customer, product, or payment term data mean problems in business transactions.

2.2 Data management

Gordon (2007) describes data management as a corporate service that helps with the provision of information services by controlling the definitions and usage of reliable and relevant data. It is the process of applying information strategies and principles to individual data entities. It includes clarifying the roles and responsibilities for each piece of data and establishing proper control for change (Smith & McKeen 2007). Data management is a shared responsibility between the business data stewards serving as trustees of enterprise data assets, and technical data stewards serving as the expert custodians for these assets (Mosley 2008).

Data management deals with the different data types. Data management is the development and execution of architectures, policies, practices, and procedures to properly manage the full data lifecycle (Mosley et al. 2010). Topics under data management include data governance (planning, supervising, control over data management, and use), data architecture (blueprint for managing data assets), database operations management, data security management, data quality management, reference and master data management, data warehousing and business intelligence management, document and content management (managing data outside of databases), and metadata management (integrating, controlling, and providing metadata) (Mosley et al. 2010). Often these themes are observed individually, but the main emphasis has been on database management.

The areas under data management are versatile and it can be considered an umbrella term. Sub-functions are wide and often very independent areas in an organization. Also, master data management can be observed as a topic in data management practices that specifically address the management of master data.

2.3 Data governance

Data governance is setting the policies and procedures that support the building and maintenance of the master data, as well as some of the more detailed tasks in an MDM function (McKnight 2009). The concept of governance “refers to the way the organization ensures strategies are set, monitored, and achieved” (Rau 2004). Mosley et al. (2010, 37) defines data governance as, “The exercise of authority, control, and shared decision making (planning, monitoring and enforcement) over the management of data assets.” Data governance ensures that data and information are managed appropriately (Brous et al. 2016). According to Otto (2011a), important formal goals of data governance for

public organizations are to enable better decision making, to ensure compliance, to increase business efficiency and effectiveness, and to support business integration.

Data governance specifies the framework for decision rights and accountabilities to encourage desirable behavior in the use of data (Wende & Otto 2007). It includes formal processes, roles, and responsibilities that are appropriate to the levels of authority and accountability in the organization (Radcliffe 2007; Shankar 2008). Dreibelbis et al. (2008) see data governance as part of managing MDM and describe it as a process of changing an organization's behavior to enhance and protect data as a strategic enterprise asset. It provides a process and structure for managing information as a resource (McGilvray 2006; Cleven & Wortmann 2010).

Data governance should ensure that data meets the needs of the business (Panian 2010). According to Brous et al. (2016), an organization outlines its individual data governance configuration by defining roles, decision areas, and responsibilities with a unique configuration, and specialized people need to be hired, trained, nurtured, and integrated into the organization. They propose principles, which are presented in Figure 4. Other initial frameworks for data governance have also been presented (e.g., Khatri & Brown 2010).

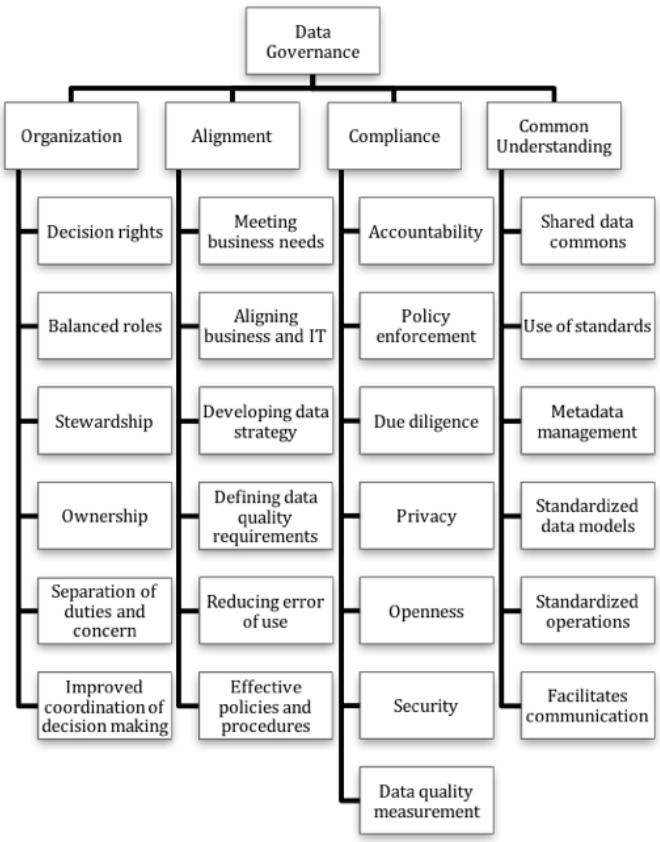

FIGURE 4 Key concepts and principles of data governance (Brous et al. 2016)

Data governance is needed to address both organizational and technical perspectives, and in this way, demands leadership, authority, control, and resource allocation (Lucas 2010). It defines the responsibilities and tasks for different roles. According to Otto (2011), data governance is an organizational design task, which comprises the design of organizational goals, the design of the organizational form, and organizational transformation. Governance necessitates the definition of clearly articulated objectives and the assembly of appropriate organizational structures. These include roles and stewardships, activities and decision areas, and responsibilities (Swanton 2005; Weber et al. 2009; Cleven & Wortmann 2010). Governance sets the roles for the primary business owners of the master data involved in MDM initiatives (Smith & McKeen 2008). Governing data also includes ensuring compliance to the strategic, tactical, and operational policies that the data management organization must follow (Brous et al. 2016).

2.4 Master Data Management

2.4.1 Master data

Master data includes the business objects, definitions, classification, and terminology that constitute business information (Snow 2008; Baghi et al. 2014). It has – at least implicitly – pragmatic, semantic, and syntactic representation identified for the purpose of the business. That is, master data represents a business customer and what it means, as well as what the data attributes describe and which are needed to define a business customer in different countries for business transactions (Dahlberg et al. 2011). It is typically both the data itself and the metadata describing the data, although the practice seems to vary. Therefore, high-quality master data is a prerequisite for companies and their performance (Otto & Hüner 2009). In general, master data is defined as the data that has been cleansed, rationalized, and integrated into an enterprise-wide "system of record" (Berson & Dubov 2007).

Identifying master data and distinguishing it from other data types can be done by assessing it against certain criteria or features. Typical features are presented in Table 3.

TABLE 3 Master data features

Feature	Description
Stability	Master data does not change often (Samaranayake 2008; Otto & Reichert 2010).
Complexity	Master data tend to exist in more than one business area within the organization; for example, the same customer may show up in a sales system and in a billing system (Loshin 2009).
Reuse	Master data is usually reused, which is also one of the reasons why managing it is emphasized (Berson & Dubov 2007).
High value for the organization	Master data is very important for the organization as key business data (Loshin 2009).
Lifecycle	If the lifecycle of data involves multiple ways to generate, read, update, or remove data, it is most likely master data (Samaranayake 2008).
Independence	Master data can exist without other objects (Dreibelbis et al. 2008; Otto & Reichert 2010).
Behavior	Master data is closely related to transactions and often occurs in such contexts (Samaranayake 2008; Snow 2008).

To summarize, master data items describe the core entities of an organization. They typically persist in independent business domains, and their structures and attributes rarely change. Even those master data attributes that change from time to time, such as

standard unit price or an address, remain static between the updates. This describes the essence of master data: enter and maintain data once and transfer appropriate attributes to all tasks where such data is needed. Ideally, master data is non-redundant, and the number of master data records stays rather stable over time, when compared to the seasonal business transaction data volumes.

Most organizations have a limited number of master data domains (Dahlberg 2010). Typical examples of master data domains are parties (customers, employees, and vendors), places (customer locations and office sites), and things (accounts, contracts, products, and services) (White et al. 2006; Cleven & Wortmann 2010). Enterprises have usually identified a few data sets that are the main focus of MDM (Dahlberg & Nokkala 2015), such as “customer data” (e.g., Loser et al. 2004; Dreibelbis et al. 2008; Otto & Reichert 2010; Haug & Stentoft Arlbjørn 2011; Silvola et al. 2011;), “product data” (Smith & McKeen 2008; Otto et al. 2012), and “vendor data” (e.g., Hüner et al. 2009; Loshin 2009; Otto & Reichert 2010). In public sector organizations, these vary somewhat from the private sector (Fatehali 2011). For example, citizen data differs from customer data and “service” is often observed as a master data domain instead of “product.”

In addition to persistency, ideal non-redundancy, and rather constant volumes, master data differs from transactional data by its independence from transactional entities, which, in turn, are dependent on master data. For example, sales orders (transactional data) cannot exist without customers (master data), products (master data), and payment terms (master data) (Cleven & Wortmann 2010). Also, the attributes of master data typically act as the identifiers of data queries and are the basis of sorting transactional data to perform various aggregations and calculations to generate reports. This emphasizes the quality of master data, which has the highest quality requirements (Loshin 2009). Since most business transactions are linked to several master data objects and attributes at the same time, one of the main challenges of MDM is its concurrent management within multiple domains. Here, multiple domains or domain neutral MDM differ significantly from a single domain MDM, such as Product Information Management (PIM).

Master data is used across multiple business processes. For example, sales, delivery logistics, after sales and services, spare parts business, billing, accounts receivable and finance, and management through managerial and analytical reporting may all rely on customer data, but at the same time have different needs and priorities. Furthermore, some processes may be cross-functional, for example order to cash, whereas other processes or activities are functional, for example recruiting employees. As a consequence, each domain may have several data objects, and their number is growing. A typical SAP ERP system installation some years ago contained approximately 150 master data objects, such as currencies and payment terms, in the domain of management accounting alone (Dahlberg 2010). The high numbers are partly due to redundancy, as master data

is stored in many different IS in the organization for a myriad of reasons. Multiple IS typically hold seemingly similar data, as that data have developed and evolved in silos over the years (Lee et al. 2006). In most companies, many versions of functionally same master data exist and appear in different formats across IS.

Technically speaking, non-redundant information sharing between IS is relatively simple: just connect IS together using a network and then transfer data between them according to set transformations. Difficulties arise when the receiving information system cannot interpret the data or the interpretation is wrong (Gordon 2007). Some data conflicts can be easily solved by integrating IS and eliminating data redundancy. This is rarely an adequate approach, especially in large and complex organizations (Andreaescu & Mircea 2008). MDM is intended to add to the ability to integrate, analyze, and exploit the value of their key data assets, regardless of where that information is stored (Tuck 2008).

2.4.2 Managing master data

MDM aims to solve data quality issues by focusing on business processes, data quality, and IS standardization and integration (Silvola et al. 2011). It targets the challenges that stem from data fragmentation, stand-alone systems, inconsistent processes, and complex architectures (Fatehali 2011). MDM defines the most trusted and unique version of important enterprise data, such as customers, products, employees, locations (Karel et al. 2006). MDM is sometimes referred to as reference data management, as it integrates business and IT functions that focus on the management and interlinking of master (or reference) data that is shared by different systems and used by different groups within an organization (Apostol 2007).

The amount of data has long ago exceeded organizations' abilities to manage it. This is because the complexity of managing data increases when data volumes increase (Watts et al. 2009), and the data is usually spread across numerous systems and databases. It aims at ensuring the quality of data in an organization by managing the organization's core data (i.e., master data). MDM tackles data issues by focusing on business processes, data quality, and IS standardization and integration (Silvola et al. 2011). MDM is consequently an ensemble of methods that target fragmented data stored in numerous databases and silos in the organization (Poolet 2007). It uses business applications, information management methods, and data management tools to implement policies, services, and infrastructures to support the capture integration and sharing of accurate, timely, consistent, and complete master data. MDM is not an application system, but rather an organizational function (Dayton 2007; Otto 2012). Designing master data architecture comprises decisions on a technical level (e.g., architectural styles) and cannot be isolated from organizational aspects (e.g., allocation of decision-making rights regarding data standards) (Otto 2011b).

Often it is expected that master data is managed in a centralized manner by focusing on business processes, data quality, and the integration of IS (Silvola et al. 2011). Loshin (2009) describes MDM as a function that governs the methods, tools, information, and services for master data:

> . . . a collection of best data management practices that orchestrate key stakeholders, participants, and business clients in incorporating the business application, information management methods, and data management tools to implement the policies, services and infrastructure to support the capture, integration, and subsequent shared use of accurate, timely, consistent and complete master data (Loshin 2009, 8)

Loshin's definition underlines the essence of MDM: "to orchestrate"; that is, MDM is aimed at organizing data management to be used across the organization. MDM consequently ensures that the most important business assets are accurate and timely for the organization's use. Smith and McKeen (2008) see MDM as not about technologies:

> . . . an application independent-process which describes, owns and manages core business entities. It ensures the consistency and accuracy of these data by providing a single set of guidelines for their management and thereby creates a common view of key company data, which may or may not be held in a common data source. (Smith & McKeen 2008)

This definition approaches MDM as a guideline that describes, manages, and owns core data. However, Snow (2008) concentrates on the business information aspect as

> Master data includes the business objects, definitions, classifications, and terminology that, in sum, constitute business information, as well as format specifications for transactional data. MDM makes it possible to define and link master data, including those definitions, references, rules, and metadata. It seeks to establish and maintain a high level of data consistency and reliability. (Snow 2008)

This definition links master data and transactional data with metadata and reference data as the responsibilities of MDM. All of these definitions define MDM through a set of responsibilities, activities, and outcomes, and not by technical terms. They do not consider how the data should be maintained, managed, or administrated in the enterprise IS, but tells what the objects and objectives of MDM are. Alkkiomäki (2015) states that the focus of MDM practices has been more on cost optimization rather than benefits. Cost optimization is one perspective on the issue, but as the definitions point out, benefits are much more extensive if the MDM function is widely adopted in the organization.

On the other hand, in a more limited sense, MDM is seen as focusing on the tools and workflows for the lifecycle governance of master data (Kobielus 2007). MDM seeks to consolidate data into a single version of "truth" by defining and maintaining its consistent definitions and enabling data sharing across the organization's multiple IS. Yet, it is not bound to a specific application (Maedche 2010) but links MDM to business. MDM thus

supports the organization's architectural representation by maintaining and providing access to the consistent views of uniquely identifiable master data entities across the operational application infrastructure (Loshin 2009). It is a method that one can use to target incomplete, inaccurate, and fragmented data that is stored in various data stores in an organization (Poolet 2007). Data quality is emphasized in the context of MDM. Some examples of data quality attributes are accuracy, relevancy, timeliness, completeness, and accessibility (Wang & Strong 1996). It should be supported with IS (Wang 1998), but most importantly it should be monitored. To do this different data quality metrics should be implemented as part of the data monitoring (Pipino et al. 2002). For example, key performance indicators (KPI's) can be used as data metrics.

MDM is often observed as part of an organization's internal information and management practices, but it can also be observed in networks (Falge et al. 2012). Kagermann et al. (2010) have stated that master data can bring a position of power even within one company, and it can bring a strong competitive advantage between different companies. Data-driven business models are raising the awareness of the value of data in enterprises, especially in-house data management practices (Alkkiomäki 2015).

2.4.3 Conceptualizing MDM

MDM can be conceptualized through four subsets of the organization's enterprise architecture (EA) (adapting, e.g., Zachman 1987): conceptual level business architecture, including strategy, process map, processes, stakeholders, and roles; information architecture from the logical level, including modeling the master data; technology architecture; and applications architecture from the physical level, including integrations and MDM applications. Also governance is seen as a factor of the overall EA and MDM, respectively. EA defines the structures and components, their roles, and how they are interrelated.

Also, different viewpoints for different design areas have been presented, especially in practice-oriented literature. Otto and Hüner (2009) present design areas for corporate MDM (as shown in Figure 5) and put forth the idea of observing the design areas on different levels: 1) strategy level; 2) organization level; and 3) systems level.

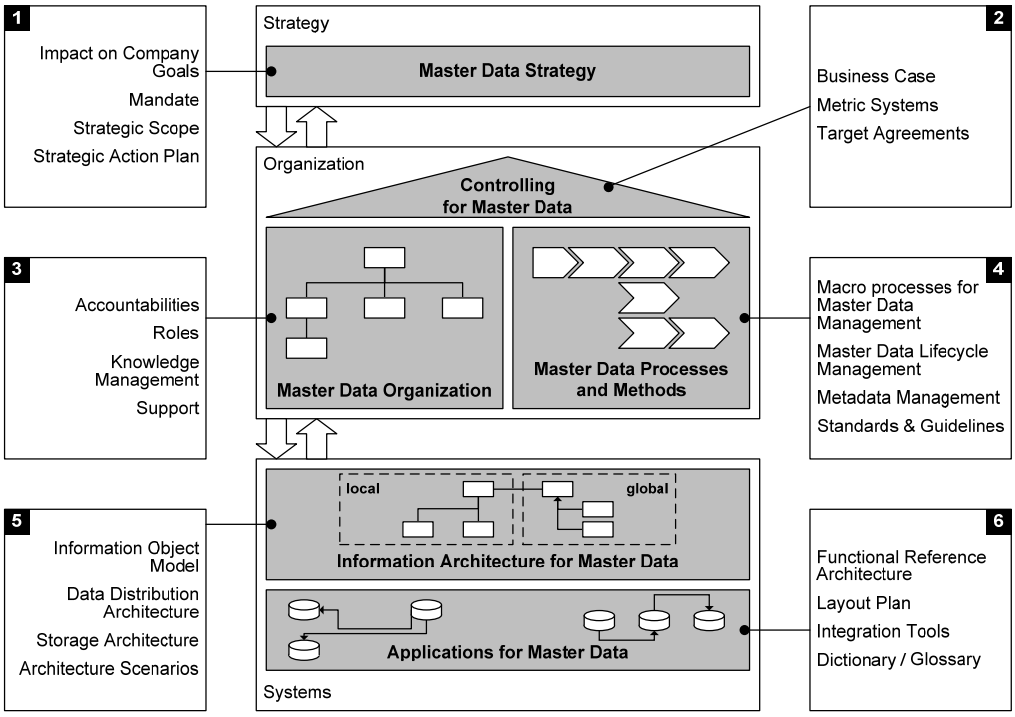

FIGURE 5 Design areas for corporate MDM (Otto & Hüner 2009)

Fatehali (2011) also emphasizes the stages, but in the context of designing objectives for MDM (Figure 6). The stages used here are: 1) enterprise; 2) strategic; and 3) tactical level. Thus, operational level is not included, even though tactical level also indicates operational activities. In addition, benefits are often visible on the operational level (e.g., Haug et al. 2011). These can be realized, for example, in the reduction of manual work.

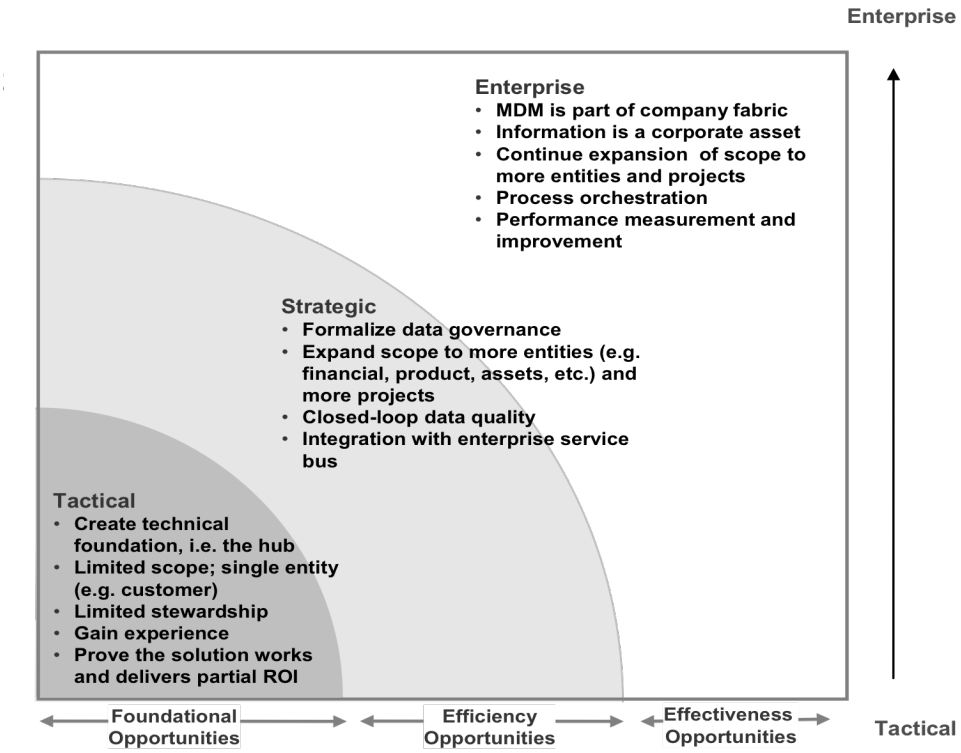

FIGURE 6 MDM evolution (Fatehali 2011)

Both of these models strongly indicate that MDM should be observed at the strategic, tactical, and operational levels, and that these are also levels that are affected by MDM development. Similarly, Otto and Reichert (2010) have stated that MDM has implications on the strategic, organizational, and IS levels of an organization.

2.5 Organizational development

IT and its association with organizational change has been an important theme in the IS research for the past 30 years (Ahmad et al. 2011). Change has been observed from different perspectives, for example organizational change (e.g., Orlikowski 1993, Van de Ven & Poole 1995), IS change (e.g., Robey et al. 2002), management of change (e.g., Aladwani 2001), and technical change that was later observed as socio-technical change (e.g., Doherty & King 2005). Uncertainties and tensions are specifically inherent in any change process in organizational contexts (Salmimaa et al. 2015a). The change itself can be observed through the content (what), which provides the overall direction for the change, and through the process (how), which describes the implementation and adoption of change (Burke 2014).

Normann (1977) discusses the concept of business renewal. Several enablers are needed for business to change, such as identification and/or creation of driving forces, political process, knowledge development, and resource development. Driving forces can be, for example, technology, political changes, or a new competitor (Normann 2001). The political process mobilizes the support for change aligned with the driving forces and handles blockages to change both inside and outside the organization (Normann 2001).

2.5.1 Organizational change

Organizational change is essential for short-term competitiveness and long-term survival (Lücher & Smith 2008). Burke (2014, 21) defines two types of organizational change: revolutionary and evolutionary. Revolutionary change requires total system events (i.e., a need to make dramatic modifications). Evolutionary change requires improvement measures. Van de Ven and Poole (1995) presented the models of lifecycle, teleology, dialectics, and evolution as four basic theories to explain the processes of change in organizations, which were later transformed into process models of change (Figure 7) by Van de Ven and Sun (2011). The process models differ in terms of unit of change (i.e., whether they apply to single or multiple organizational entities), and mode of change (i.e., whether the change process follows a prescribed sequence or is constructed as the process unfolds) (Van de Ven & Sun 2011).

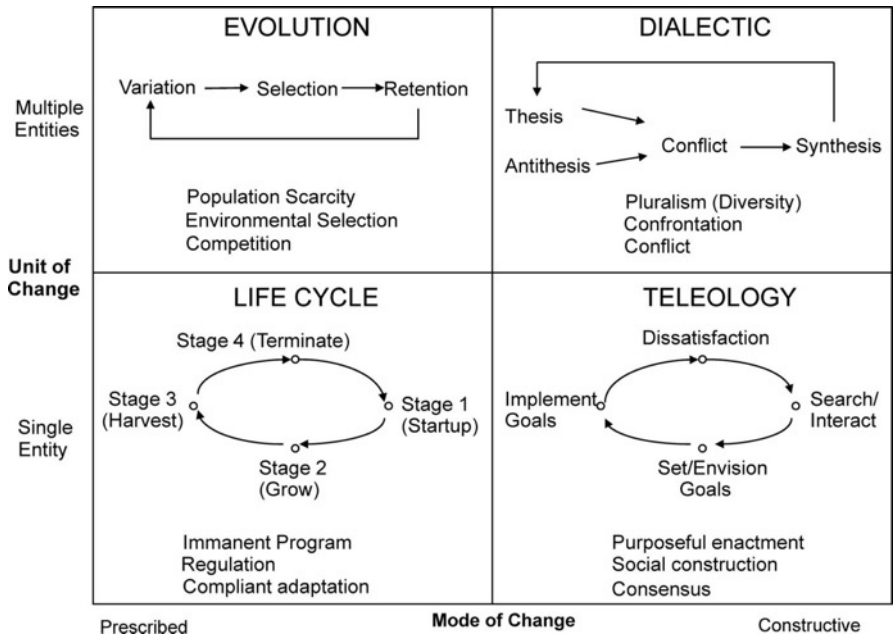

FIGURE 7 Process models for organization change (Van de Ven & Sun 2011)

Lifecycle process theory (regulated change) depicts the process of change as a sequence of stages and activities, which are regulated by natural, logical, or institutional

routines (Van de Ven & Sun 2011). Change is imminent. The evolutionary approach builds on lifecycle models by adding room for human agency, ambiguity, and uncertainty (March & Olsen 1976). An organization is like a living organism from its initiation to its termination (Burke 2014, 171). The change events in a lifecycle model are a coherent sequence (Van de Ven and Poole 1995), and a regulated lifecycle model is appropriate for managing many recurrent and predictable organizational changes. It breaks down if the rules are wrongly designed and when people or units resist implementing the change mandates (Van de Ven & Sun 2011).

Teleological and dialectical models are partially incorporated within the framework of evolution, rather than treated separately as competing alternatives (Aldrich 1999). A teleological process theory (planned change) views development as a repetitive sequence of goal formulation, implementation, evaluation, and modification of an envisioned end state based on what was learned or intended by the people involved (Van de Ven & Sun 2011). The model applies when a group of participants agrees on and moves toward a goal, and the model breaks down when participants cannot reach a consensus on a goal or when the conclusions reached are subject to individual and group biases (Van de Ven & Sun 2011). Dialectical process theory (conflictive change) explains stability and change in terms of the relative balance of power between opposing entities that can be internal to an organizational entity because of several conflicting goals or interest groups competing for priority (Van de Ven & Sun 2011). For example, in IS projects, ambiguities emerge easily if collaborating parties have conflicting goals (e.g., Jarzabkowski et al. 2013). Robey and Boudreau (2002) proposed “logic of opposition” to explain the diversity of organizational consequences of information technology. A dialectic motor of change can be invoked in theories in organizational and national culture. In organizational culture, dialectics can describe the tension between the established culture versus requirements for new practices (Romm et al. 1991), for example, ICT-enabled work practices.

The evolutionary model (competitive change) explains change as a recurrent, cumulative, and probabilistic progression of variation, selection, and retention of organizational entities (Weick 1979; Pfeffer 1982; Van de Ven & Sun 2011). The evolutionary model applies when multiple units within or between organizations compete for scarce resources by developing different methods of products for a given market, and breaks down when variations are homogeneous and competition is low (Van de Ven & Sun 2011).

In addition, IT-enabled organizational change has received a lot of attention (e.g., Benjamin & Levinson 1993; Markus & Benjamin 1997; Markus 2004). There, the emphasis has been on IT and how it is linked to people, tasks, structures, and leadership processes. IS literature focuses on the adoption of IT artefacts (Currie 2009). Changes in organizational functions have been studied especially from the perspective of IT as the initiator and driver for change (e.g., Luftman, Lewis & Oldach 1993; Klouwenberg et al. 1995;

Sauer & Willcocks 2003). In terms of organizational design, technology continues to act as the engine for business processes, but more than that, it is the most important influence on changes in organizational functions (Sauer & Willcocks 2003).

2.5.2 IS change

The interaction between IT and simultaneously pursued changes has been theorized through the idea of the duality of technology (e.g., Orlikowski 1992), social constructionism (e.g., Grint & Woolgar 1997), and actor networks (e.g., Latour 1991). IS change is concerned with the generation, implementation, and adoption of new elements in an organization's social and technical subsystems that store, transfer, manipulate, process, and utilize information (Swanson 1994; Lyytinen & Newman 2008).

Socio-technical change observes the change through the continuous, intertwined interactions between technology and people. A model often referred to is Leavitt's socio-technical system theory (Joshi & Joshi 2015, 94). Leavitt's (1964) model is used to identify the relationships and effects between structures, actors, technology, and tasks in IS implementation, and views organizational systems as multivariate systems of these four interacting and aligned components (Lyytinen & Newman 2008). These four elements are highly interdependent and a change in any one of them results in a change in the other elements (Leavitt 1964). After Leavitt's (1964) socio-technical change model and its four interacting elements of actors, tasks, technology, and structures, Lyytinen and Newman (2008) developed a punctuated socio-technical IS change model (PSIC) to understand changes in IS development. They view change as a socio-technical change process in which technologies, human actors, organizational relationships, and different tasks change in pursuit of equilibrium. Here, IS change is not solely or even mainly incremental and cumulative, but more episodic or punctuated (Gersick 1991). The change can be observed on multiple levels. The PSIC-model is an extension of Newman and Robey's (1992) social process model, which is adaptable with the process theory (Van de Ven & Poole 1995) approach (Ahmad et al. 2011).

The punctuated equilibrium change model (Tushman et al. 1986; Gersick 1991; Romanelli & Tushman 1994) has been used to make sense of the dynamics of alignment (e.g., Sabherwal et al. 2001). The PSIC-model addresses the scope of IS change and organizations and the properties of systems involved in IS change, the nature of the change in systems associated with IS change, and the content of these changes as socio-technical phenomena (Lyytinen & Newman 2008).

The next step in socio-technical change, the concept of sociomateriality, presents a view where sociomateriality is the practice in which technology is embedded (Orlikowski, 2007), and the social and the material are intrinsically linked (Orlikowski 2007; Orlikowski

& Scott 2008). Another perspective on sociomateriality maintains that the social and material overlap each other, as well as the affordances and constraints that affect this overlap (Leonardi 2011). Human action is dependent on and constituted by materiality and material artefacts. In a sociomaterial assemblage, the agency of both technology and people are constituted (Bratteteig & Verne 2012). By definition, assemblage consists of multiple, heterogeneous parts linked together to form a whole (Müller 2015). Sociomateriality can explain the factors that contribute to change and especially how these factors affect one another.

2.5.3 Management of change

The management of change can also be viewed as an aspect in IS change. Dynamic capabilities (Teece & Pisano 1994), alignment (Galliers & Leidner 2003), and agility (Galliers 2006) have become the key elements for building IT capabilities and adapting business models to the market needs (Salmimaa et al. 2015b).

Kotter (2012) presents eight stages that produce a successful change. The stages evolve from identifying the crisis into anchoring new approaches in the culture (Figure 8).

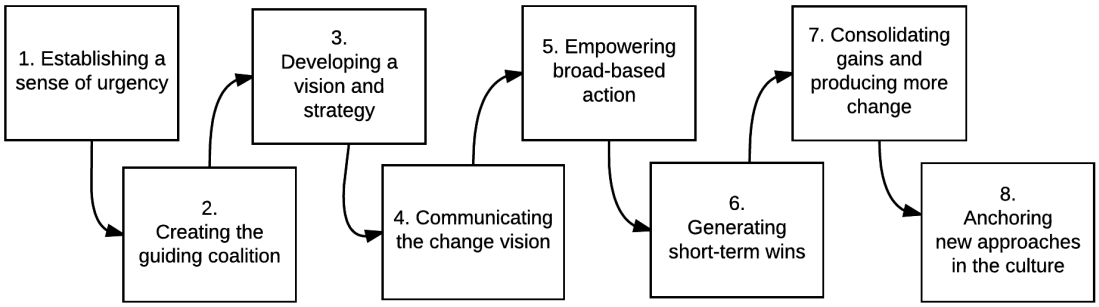

FIGURE 8 Eight steps to change (adapted from Kotter 2012)

Middle managers serve as critical change agents (Lücher & Smith 2008). They need to implement change while managing subordinates' emotions, for change can spur debilitating anxiety and defensiveness. In this context, "sensemaking" becomes exceptionally vital and difficult for middle managers. Sensemaking is an effort to create orderly and coherent understandings that enable change (Weick 1995).

An organization's sustainability can be achieved by managing both its internal and external tensions (Salmimaa et al. 2015a). Tensions can be observed as the embodiment of change. Managing tensions can also be perceived as one perspective of managing change. Lüscher and Lewis (2008) also present a process model, a collaborative process

of working through paradox. The starting point, a “mess,” presents the issue at hand, which is more specifically “the problem”. The next stage, “dilemma,” creates a sense of paralysis because it implies that a choice must be made between dualities. Paradoxical thinking is spurred by recognizing a dilemma in which no choice can resolve the tension because opposing solutions are needed and interwoven (Lewis 2000). Moving from a mess to a “paradox” encourages a deeper exploration at each stage towards a more “workable certainty” (Lüscher & Lewis 2008). The last step of working through the paradox is challenging simplistic solutions to motivate on-going experimentation. The process is presented in Figure 9.

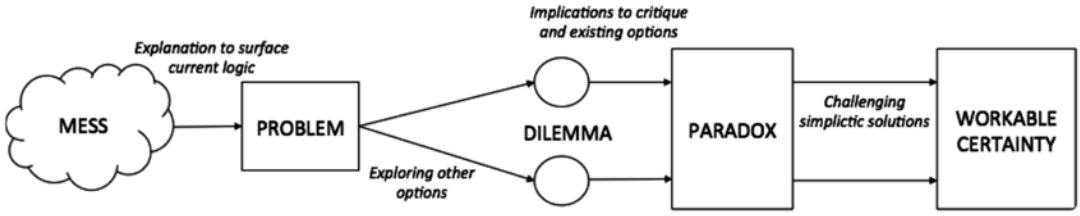

FIGURE 9 A Collaborative Process of Working through Paradox (adapted from Lüscher & Lewis 2008)

The model of a collaborative process of working through paradox concentrates especially on understanding how change is constructed and evolves, and how it can be managed. Managers and researchers can explore paradoxes to understand the inconsistencies, contradictions, and absurdities of their dynamic setting (Eisenhardt 2000).

2.6 Summary of theoretical background

Master data management is a topic that has not gained a lot of attention in prior research (Otto 2011b). It is a concept that is associated with several different themes, with the emphasis on technical aspects and architecture, as well as data governance. It is described as an organizational function for managing an organization’s core data that is common for its business processes. Technology works as an enabler for the function, but the emphasis should be on organizational processes, roles, and responsibilities to ensure that the common data is available for all of the processes and functions, and that it meets the requirements of good quality data, such as accuracy, completeness, and timeliness (Wang & Strong 1996). Leonardi (2013) emphasizes the role the actors play in the creation of the sociomaterial over time. In the MDM context, data can be seen as a material agency, while activities, processes, practices, and people form a social agency.

Data management is a versatile concept that can be observed as an umbrella term for MDM (e.g., Mosley et al. 2010). Instead of treating MDM simply as a sub-area of data management, this thesis presents it as a parallel view on data management that also includes several sub-areas of data management (similarly to Loshin 2009), such as data governance. The object for data management is data, and for MDM, it is master data. This forms the conceptual difference between the concepts. Due to the amount of data, data management is often concentrated on database management in order to manage the quantity of data. Then again, data governance focuses on how data should be governed. It does not take a position in using technology to support the organization. Both of these perspectives are important and offer valuable insights, but neither one on its own offers a sufficient context for understanding MDM.

Establishing an MDM function involves presenting many changes to an organization. Changes can relate to people and their ways of working, or technology and how it is used. Theories of change assist in understanding how this change should be observed, understood, and managed. Referring to MDM as a function (similarly to Otto & Ofner 2011), it is considered a cross-functional activity. Loshin (2009, 16) refers to MDM as “a program,” but the option he presents is “an application.” In this thesis, the concept of program is not sufficient either, because MDM is seen as a continuous activity instead of a temporary project. MDM’s role as a cross-functional activity is similar to ERP, which is often seen as crucial in enabling cross-functional business integration and the management of cross-functional processes (Shanks et al. 2003). Organizational changes involved in ERP implementation result from the shift in a business design from a fragmented, functional-based organizational structure to one that is process-based and served by an integrated system (Al-Mashari 2001).

This thesis observes MDM more as a business managerial issue, as opposed to an IT or data modeling issue. Prior research indicates that several steps should be taken before implementing the technical architecture (Loshin 2009). The emphasis in this thesis is to understand these phases, and to a certain extent, exclude the application implementation phase.

Furthermore, this thesis observes MDM as an initiator of change and provides new insights into how steps of establishing an MDM function entail changes in the organization, how MDM fits in the organizational context, and how the socio-technical issues affect the process of establishing an MDM function.

3 Research design and methods

This part of the thesis discusses how the research was designed, and the use of ethnography as a research method. It also presents how the method was used, and how the analysis was conducted. Also the case study organization is introduced. First, the research questions are presented.

3.1 Research questions

The theoretical foundation is focused on the three themes of organization development, information governance, and MDM. The purpose of this study is to increase understanding of the various aspects of establishing a master data management function into an organization, and the main research question (MRQ) of the study is described as follows:

MRQ: What should be taken into consideration when establishing an MDM function?

As shown in Figure 10, the main research questions intersect the three themes.

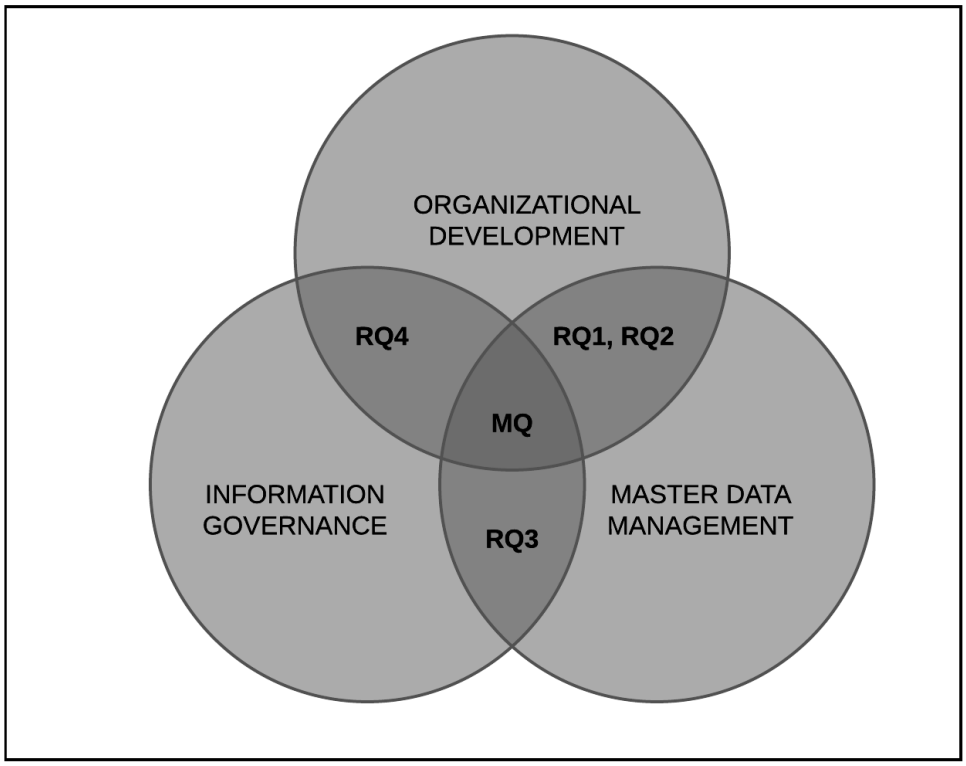

FIGURE 10 The relationships between the main themes of the theoretical background and research questions

The attention is on establishing the function, while the implementation phase of MDM is excluded. We take the research further by observing the intersections between the themes of organization development, governance, and MDM. The first research question (RQ1) is aimed at understanding the overall process for establishing an MDM function. This helps to understand the main areas of MDM development. The steps are first identified from prior research and additional ones are identified in the empirical work. The study sheds light on the process for establishing an MDM function in an organization by providing not only a step-by-step approach but deciphering the steps more closely and observing the links between them.

MDM presents many changes to an organization, including people and their ways of working, and technology and how it is used. RQ1 and RQ2 observe the intersection between MDM and organizational development to understand how the organization and MDM affect each other. The first research question was formed as follows:

RQ1: What kind of steps and phases does the process for establishing an MDM function include?

After comprehending the overall process, more detailed issues are observed. The prior literature emphasizes two aspects: organizational (e.g., Power 2008; Otto & Reichert 2010; Otto & Schmidt 2010) and technical (e.g., Ambler 2007; Joshi 2007; Kobielus 2007; Menet & Lamolle 2008; Loshin 2009; Kikuchi 2011; Murthy et al. 2012; Kobielus 2013). These are used as themes for the following research questions. Thus, the second research question was formed:

RQ2: What are the organizational issues that can be encountered in establishing an MDM function?

For research question II, the work to identify the organizational issues that may be involved in establishing an MDM function begins with an examination of the organizational issues identified in previous literature. These are affirmed and additional ones are found in the empirical part.

Achieving an enabling technology base is foremost a matter of management, not technology (Sauer & Willcocks 2003). As it has been stated, IS change is concerned with the generation, implementation, and adoption of new elements in an organization's social and technical subsystems that store, transfer, manipulate, process, and utilize information (Swanson 1994; Lyytinen & Newman 2008). To understand the relationship between the technical aspects of MDM and people more profoundly, RQ3 observes the intersection between governance and MDM. Consequently, the third research question was formed as:

RQ3: How is a technical architecture for an MDM function to support business needs designed?

Several relevant studies were found, and the review and analysis of these identified the possible scenarios for MDM used to observe the architectural decisions in a case study organization. RQ2 and RQ3 revealed that the development can encounter different conflicts and can either complicate or even prevent the development. These conflicts are studied more carefully by using the existing theory base of paradoxes. By using this theory, the issues could be taken into consideration on different levels of the organization and evolved in entities that could be observed in detail. Therefore, the final research question was formed as:

RQ4: How do changes in ownership, roles, and responsibilities evolve in an MDM development project?

RQ4 observes the intersection between organizational development and governance. The emphasis in on understanding the core issues of governance – ownership, roles,

and responsibilities – and how they take the process of establishing an MDM function further and shape the organization through dialogue of the social and material agency.

The design of the research has a four-level structure, with each level more detailed (Figure 11). The main research question defines the objective for the research. The individual research questions take the observation to three more in-depth levels.

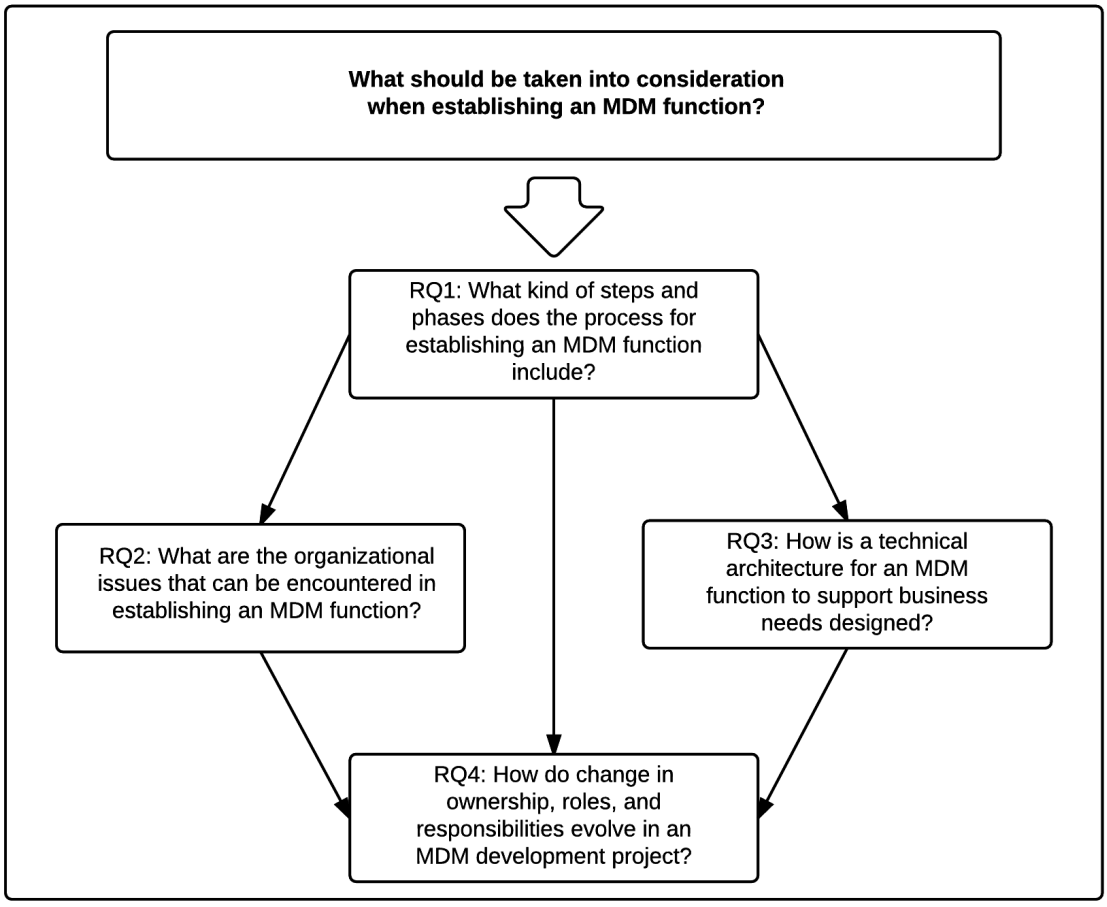

FIGURE 11 Relationship between research questions

The previous phases show that the MDM can be observed from an organizational and a technical aspect. In the last phase of the research, research question four (RQ4) combines these and observes the function as a sociomaterial assemblage, especially changes in the roles and responsibilities related to the function. Also, technological components are integral parts of sociomaterial assemblages (Hedman et al. 2013). The focus is on understanding how changes in ownership, roles, and responsibilities evolve in an MDM development project, and how the material and social agencies affect these changes.

3.2 Research approach

The research is conducted as an ethnographic case study (following the instructions of Myers 1999 and Randall et al. 2007). This can also be characterized as complete participation, where the researcher is a member of the group under observation (Myers 2009). The observer may see things that might routinely escape the people in the setting and has less need to rely on prior conceptualizations (Patton 2002). The research was conducted in one organization. This is typical in ethnographic research, because the method is very time consuming (Myers 1999).

3.2.1 Ethnography

Ethnographic research is one of the most in-depth research methods, as it allows the researcher to obtain a profound understanding of the people, the organization, and the broader context within which they work (Myers 1999). The main difference between case study research and ethnographic research is the extent to which the researcher immerses himself or herself in the life of the social group under study (Myers 1999) and adds the dimension of personal observation (Brown 2014). Consequently, it enables more detailed data collection in contrast to conventional data collection methods used in case studies (Brown 2014).

Ethnographic research provides rich insights into the human, social, and organizational aspects (Harvey & Myers 1995, 22). In ethnography, the field researcher develops an intimate familiarity with the dilemmas, frustrations, routines, relationships, and risks that are part of everyday life (Grills 1998). The ethnographer sees what people are doing as well as what they say they are doing. (Myers 1999).

Several different schools and types of ethnography exist (Myers 1999). This study can be categorized as critical ethnography, where ethnographic research is seen as an emergent process, involving a dialogue between the ethnographer and the people in the research setting. Researchers using critical ethnography tend to “open to scrutiny otherwise hidden agendas, power centers, and assumptions that inhibit, repress, and constrain” (Myers 1999). Critical ethnography offers a more direct style of thinking about the relationships between knowledge, society, and political action (Thomas 1993, 4).

3.2.2 Ethnography in IS research

Ethnography is appropriate for understanding the implementation of a new ICT artifact, and the different conflicts in culture or values within the organization and in between

stakeholders (Brown 2014). The advantage of using ethnographic methods in IS research is the way it promotes the real-world character and context of work (Randall et al. 2007, 4). Therefore, ethnography has the potential to improve our understanding of the behavior produced by and within organizations in response to the installation of technology or concepts (Brown 2014), such as MDM. Therefore, ethnography equips us with an in-depth method for observing organizational issues in MDM development.

Ethnographic research can provide IS researchers with rich insights into the human, social, and organizational aspects of IS development (Harvey & Myers 1995, 22). Ethnographic methods assist with the delineation of work design problems by providing greater knowledge of the social organization of work, and recognizing that problems need to be placed and resolved within the context of the work setting. (Randall et al. 2007, 4.) It can be an appropriate method for understanding the implementation of a new ICT artifact, and the clashes of culture and values either within the organization or with other stakeholders that the change can cause (Brown 2014). Ethnography has the potential to improve our understanding of the behavior produced by and within organizations in response to the installation of new information and communication technologies (Brown 2014). In addition, it provides unique opportunities to understand profound reasons and causes, and not just superficial and obvious findings.

For example, studies of system implementation and adaptation have traditionally been ethnographic (Schulze 2000; Schulze & Boland 2000; Miscione 2007; Lyytinen & Newman 2008,); also, research of developing IS has relied on this method (e.g., Orlikowski 1991; Preston 1991; Myers & Young 1997; Lee & Myers 2004), and the relationship between IS and organizations has been studied through ethnography (Orlikowski 1991; Orlikowski & Robey 1991).

3.2.3 Dealing with subjectivity in ethnography

Due to the researcher's role, ethnographers need to balance subjectivity and objectivity. Ethnographies are expected to meet standards of objectivity even when ethnographic research is highly dependent on the individual's unique knowledge and experience (Schultze 2000). Understanding always involves interpretation, which means using preconceptions so that the meaning of the object can become clear (Gadamer, 1975, 358). The researcher should observe the possible biases and systematic distortions in the narratives collected from the participants (Klein & Myers 1999).

Our views and biases are to a large extent determined by our own culture and personal history, and our ideas and personal experience have a significant impact on how we view

the world (Myers 2004). Therefore, it is important to know how the researcher approached the research (Myers 2004). Researchers must become aware of their own history (Gadamer, 1976b, 125).

Certain measures were taken in order to gain some distance between the researcher and the context, and to keep data entries as neutral as possible so that they were not limited or affected by the analysis of earlier entries. Systematic diary entries were made and documents were annotated throughout the data collection, but to minimize unintended entry manipulation, all materials were analyzed in their entirety on two occasions: (1) at the end of the first project in October 2011; and (2) at the end of the overall data collection in June 2013.

It is beneficial that the researcher is the data collector, ethnographer, and data analyzer as in-depth contextual knowledge helps one to consider emerging issues and their relationships in the right context. Thus, the method still remains quite subjective, but these are also characteristic of ethnographic research (Randall et al. 2007) and add depth to the data analysis.

Because of the long data collection period and intensive data analysis periods, data analysis can be regarded as content analysis, in which an external researcher makes his or her own interpretations (Myers 1997). However, since the researcher also collected the data and "lived with the tribe," she was able to complement and interpret it within the organizational context. This made it easier to understand the organization's culture and social structures and their impact, and to theorize the subject more richly and in more complex ways (Kemmis & McTaggart 2005).

3.3 Description of the case organization

An ethnographic case study was conducted in a Finnish municipality comprising 220,000 inhabitants and approximately 14,500 employees. The municipality's services are produced using the multi-provider model, in which external companies and communities provide services alongside the city's own service providers. This operational model separates service purchasers from their providers.

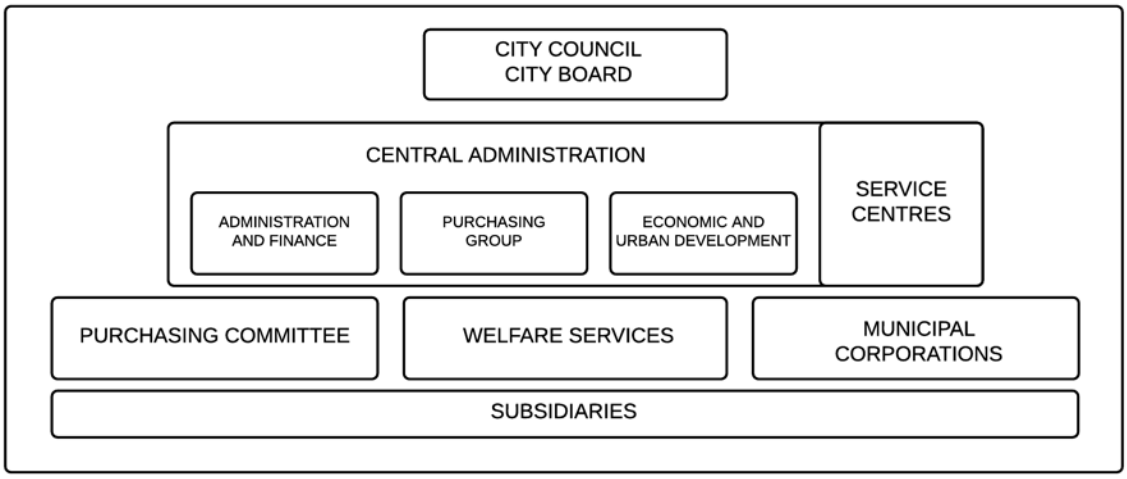

FIGURE 12 Organization chart of the case study organization

During the data collection periods, two MDM development projects were carried out, and MDM development became rooted as part of routine operations. The timeline for data collection and the organization's MDM development is presented in Figure 13.

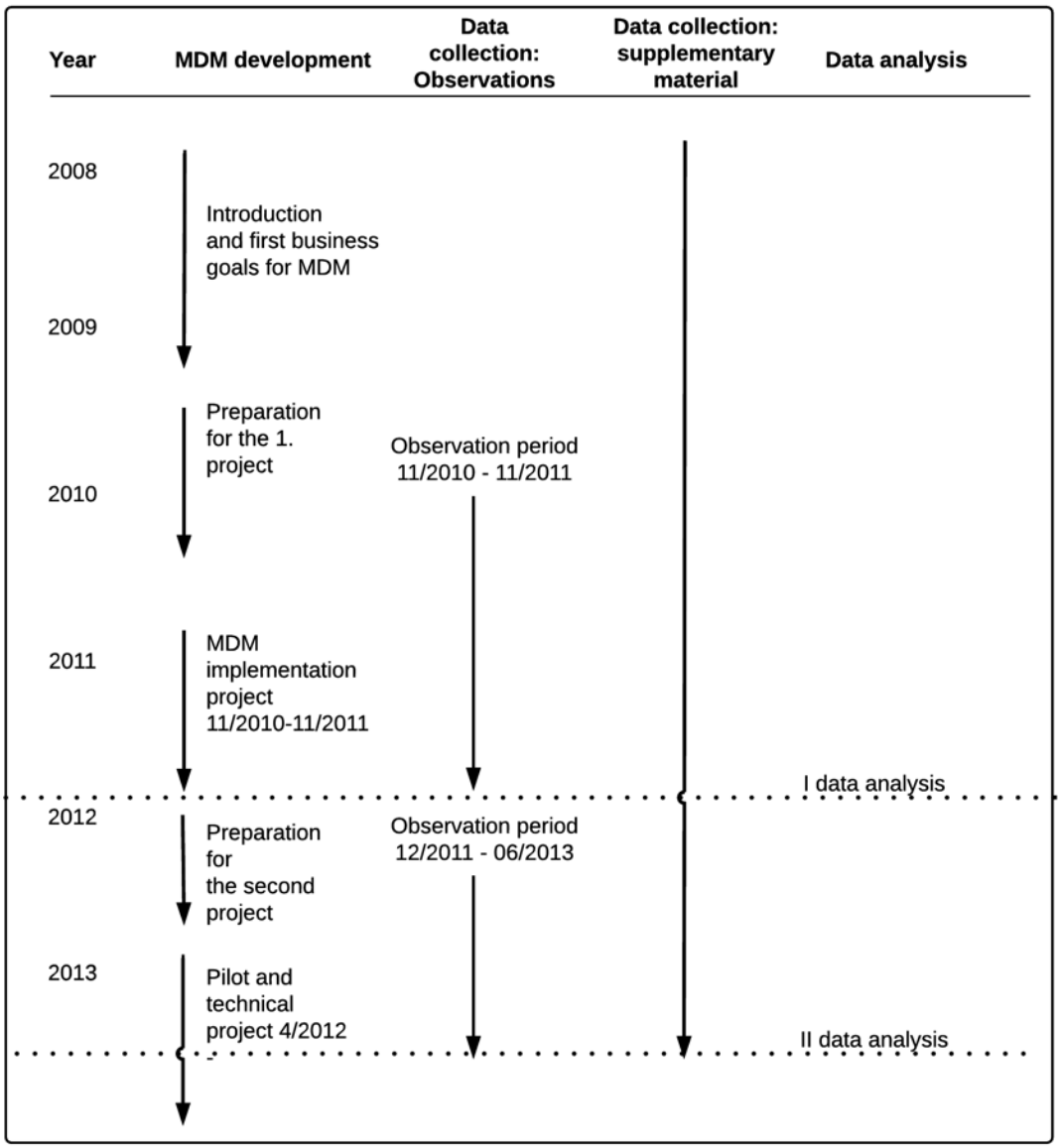

FIGURE 13 Timeline for the MDM development and data collection

The motivation for starting the MDM process in the subject municipality goes back to 2007, when a centralized IT unit was established. Prior to 2007, IS were acquired independently by the departments and business units, with the rare exception of some organization-wide systems (e.g., ERP). This resulted in a large number of separate systems and interfaces. Approximately 400 IS were in use. The municipality has several different operating areas that differ from each other and an extensive variety of IS exists, which also contain legacy systems. In 2008, the value of the organization's core data was explicitly acknowledged. The problems with data quality across business processes was severe. MDM was introduced as a solution to these problems; thus, an MDM development process was initiated.

Several data quality problems demonstrated the value of the data and the lack of value: the most critical problems involved duplicate data and data access maintenance. Since these were assumed to originate from business processes and independent applications, MDM was considered a viable solution. The MDM's business objectives were identified as streamlining the work processes and organizational structure, improving reporting, and achieving better interoperability with a service-oriented architecture (SOA). Additional MDM objectives were identified, which included processes for data collection, integration, consolidation, quality assurance, and distribution to ensure data integrity, maintenance, and information usage control.

The first MDM project began in November 2010 and ended in October 2011. Its objectives were to identify the master data sets and other issues having an impact on the MDM development, and to form a management model for MDM. The project's organization included a project group, a steering group, and an expert group; a total of 33 individuals were involved, representing different functions within the organization. In addition, two vendors acted as consultants. The information management unit was responsible for project implementation.

The second project was initiated in April 2012. Fourteen individuals from IT, human resources, business administration, procurement, and all core processes were actively involved. In addition, one vendor acted as a consultant. During the project, 17 workshops were held with business people (data owners, data stewards), IT people (information architecture, technology architecture, and technical specifications), and data security and privacy representatives. The objectives of the second project were to create a consolidated view of master data, enable information sharing between systems, control data publishing, improve business reporting, enhance data quality, and enable controlled data entries and workflows. System requirements were first gathered and composed in the form of a pilot. The pilot had one organizational data set that bridged all units. The data set consisted of approximately 4,000 data items and several hierarchies. The data set was distributed across 21 IS.

3.4 Data collection

The first part of the data collection was conducted during the period of 1 November 2010 to 31 October 2011. Thus, the overall duration was 12 months. The second phase of the data collection started in the beginning of November 2011 and ended in June 2013, for an overall duration of 20 months. Publication I is written on the basis of the first data collection period. Publications two to five are written on the basis of the first and second data collection periods.

Observation is the main data collection method in ethnography, and this was also the case in this research. Observation studies how the practices are taken and understood in a particular context and enables more systematic theorizing of the matter at hand (Kemmis & McTaggart 2005). The researcher was actively involved in the first MDM project as a member of the steering group and as a member of the expert group. In the second project, the researcher acted as a project manager and a member of the steering group. This offered a unique opportunity to observe and understand the project while also participating in it and can be identified as what Walsham (1995) has described as an "involved researcher." Thus, the observation can be characterized as complete participation where the researcher is a member of the group under scrutiny (Myers 2009).

Observation was done by participating in several project meeting (project group, steering group, kick-off and closing seminars), and other project-related meetings and informal discussions. Diary entries were made weekly and whenever MDM-related issues were observed. Also, the author's questions that emerged along the way and any impressions were documented. To complement the diary, project documentation was also used: procurement documentation, project plans, monthly status reports, and a set of memos from the working group, steering group, project portfolio group, stakeholder groups, and kick-off and closing seminars. Also, other related documents were used: memos from the IT development group and the architecture group, internal documents, such as information management strategy, business intelligence (BI) status report, and working materials of the status report. Table 4 summarizes the data collection methods.

TABLE 4 Summary of the data collection methods

Observations	
Project activities (first project)	Activities were observed around Request for Information (RFI) document preparation, project management, project plan preparation, project implementation, vendor engagement, and evaluation
Project activities (second project)	Activities were observed around project plan preparation, RFI document preparation, project implementation, vendor engagement, and evaluation
Field notes/diary	Observations were recorded weekly from formal and informal discussions. 137 formal meetings (236 h) were observed, including vendor meetings and demonstrations, project-related meetings, and workshops for defining requirements
Documents	

Project documentation (first project)	This included procurement documentation, project plan, monthly status reports, different memos (working group, steering group, project portfolio group, stakeholder groups, kick-off and closing seminars), and emails. Reviewed project documentation included RFI document, vendor RFI responses and product information, tendering documentation, vendor evaluation reports, monthly reports, project-related emails, and final report of the project
Project documentation (second project)	Project documentation reviewed included RFI document, vendor RFI responses and product information, vendor evaluation reports, monthly reports, and project-related emails.
Organizational documentation	IT-strategy, BI status report and working materials of the status report, Enterprise architecture documentation
Public documents	Public documentation of the organization

3.5 Data analysis

In the first paper, the analysis was conducted by adopting the principles of grounded theory (Glaser & Strauss 1967). Achieving useful results requires that the complexities of the organizational context are incorporated into an understanding of the phenomenon, rather than ignoring them (e.g., Strauss & Corbin 1990). Thus, objective project documentation was analyzed through subjective diary entries, and subjective reflections were backed up by objective entries. This provided a basis for being able to step back and critically construct a generalizable step-by-step model without losing the contextual understanding.

In the four other papers, the analysis was made by following the interpretive research approach and the seven principles for interpretative field research of Klein and Myers (1999). The first principle of the hermeneutic circle “suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form.” The second principle of contextualization requires critical reflection of the social and historical background of the research setting to understand the current situation under investigation (Klein & Myers 1999). The researcher needs to be in the organization for a reasonable length of time to collect a sufficient amount of data during the period of fieldwork (Myers 1999).

The third principle of interaction between the researchers and the subjects requires critical reflection on how the research data was socially constructed through the interaction

between the researchers and participants (Klein & Myers 1999). The fourth principle of abstraction and generalization requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action (Klein & Myers 1999). The ethnographer's main challenge is to convince this audience in particular of the worth of their research (Myers 1999).

The fifth principle of dialogical reasoning requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings with subsequent cycles of revision (Klein & Myers 1999). Anyone reading the published article should be able to evaluate the validity of the findings (Myers 1999). The sixth principle of multiple interpretations requires sensitivity to possible differences in interpretations among the participants, which are typically expressed in multiple narratives or stories about the same sequence of events under study.

The final principle of suspicion requires sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants (Klein & Myers 1999). Ethnographies are expected to meet standards of objectivity even when ethnographic research is highly dependent on the individual's unique knowledge and experience, and his/her actions as a thinking agent who brings his/her subjectivity to bear on the construction of information and knowledge (Schultze 2000). The interpretative research approach acknowledges that the researcher can never assume a value-neutral stance, and is always implicated in the phenomenon being studied (Orlikowski & Baroudi 1991).

4 Overview of the research papers

This chapter presents the research papers and their relationship to the main research question and the other research questions. The five publications indicate that MDM is not a straightforward IT project, but a complicated and multi-dimensional function.

TABLE 5 Relationship between research questions and research papers

Publication/Research question	**RQ1**	**RQ2**	**RQ3**	**RQ4**
Publication I: Establishing an Organization's Master Data Management Function: A Step-Wise Approach	X		X	
Publication II: Master Data Management and Its Organizational Implementation: An Ethnographical Study within the Public Sector		X	X	X
Publication III: Establishing an MDM Function: First Steps in the Master Data Management Architecture Design	X	X	X	
Publication IV: Paradoxes, Conflicts and Tensions in Establishing Master Data Management Function	X	X		X
Publication V: Changes on Roles, Responsibilities and Ownerships in Organizing Master Data Management	X	X	X	X

The individual research papers are presented next.

4.1 PUBLICATION I: Establishing an Organization's Master Data Management Function: A Step-Wise Approach

The objective of the first publication is to identify the steps for establishing an MDM function in an organization. The emphasis was on the whole process and how these steps are interconnected. The study was based on a year-long project where the attempt to estab-lish the MDM function was ethnographically observed. The publication was written after the first data collection period ended.

4.1.1 Content and results

The paper describes the process for establishing an MDM function as a step-by-step model that includes 10 phases (Figure 14). In addition to identifying the steps, how these steps are interconnected is also observed. Some steps are taken in parallel and others in a consequential order, while some steps act as preconditions for the following phases.

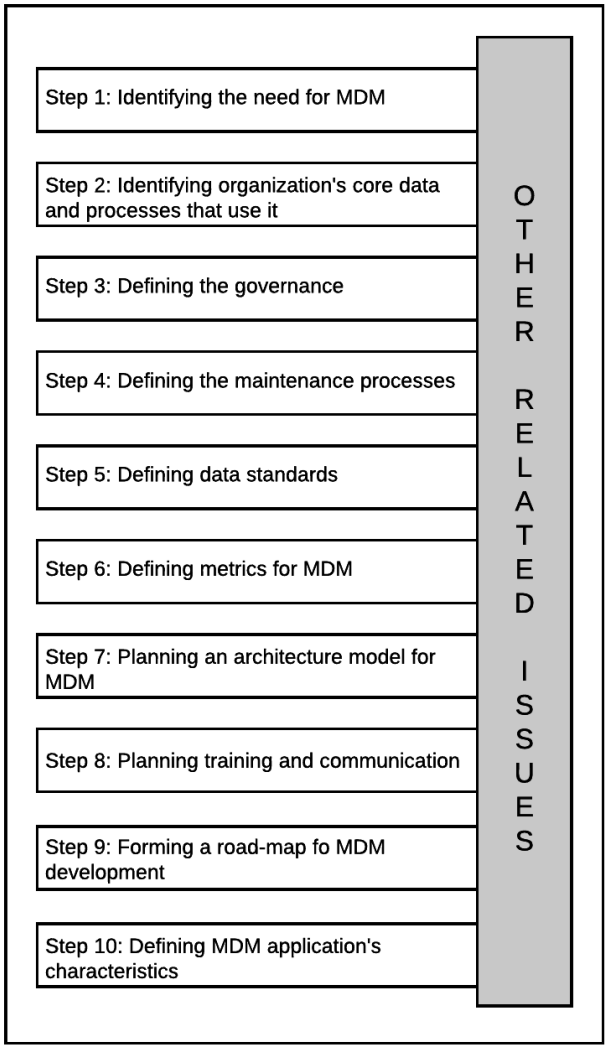

FIGURE 14 Process model

Common interdependencies that need to be acknowledged throughout the project were also identified. These are support functions that should be included in the MDM design.

4.1.2 Relationship to the whole

The paper answers two research questions (RQ1 and RQ3). The research observes the process for establishing an MDM function as a whole. The process model serves as a foundation and a starting point for the rest of the papers and for the thesis. The paper offers a comprehensive view to MDM development, while the following papers offer different viewpoints to the function.

4.2 PUBLICATION II: Master Data Management and Its Organizational Implementation: An Ethnographical Study within the Public Sector

This paper constitutes understanding the organizational challenges that an organization can encounter when establishing an MDM function. Identification of these issues is based on an analysis of previous literature and an ethnographic study in a municipality. Data was analyzed in two rounds. The first analysis was done after the first data collection period of 12 months. The second analysis was conducted after the second data collection period that lasted for 20 months. The first analysis was completed and further analyzed during the second analysis.

The majority of the organizational issues were already identified during the first data collection period. Some of the issues manifested throughout the case study, and several issues from the literature were verified.

4.2.1 Content and results

The paper provides a new understanding of the challenges in establishing and developing the MDM function within an organization. Altogether, 15 issues were found and compared to the prior research. Several issues from the literature were verified. These include communicating the essence of MDM to different groups, establishing common terms, developing concepts, committing people to the initiative, preparing for organizational changes, requiring high-level coordination, setting organizational responsibilities and roles, a lack of management support, and missing data owners. Several new issues were found: accomplishing a mutual understanding of the objectives, identifying the entities that need to be involved in the MDM initiative, defining the level of granularity for defining organizations' master data sets, problems with related concepts, inter-organizational cooperation, mutual understanding of master data domains, and considering legislation-driven challenges.

The case revealed several new issues: accomplishing mutual understanding of the objectives, identifying the entities that need to be involved in the MDM initiative, defining the level of granularity for defining organizations' master data sets, problems with related concepts, inter-organizational cooperation, mutual understanding of master data domains, and considering legislation-driven challenges.

Eight of the issues were identified as MDM-specific. Four issues were not identified or were identified only partly in prior research. The case study also emphasized some issues more than the literature. All of the issues were identified as preconditions or as

affecting factors for the others. Data ownership, organizational roles and responsibilities, and unified data definitions were identified as pivotal issues.

4.2.2 Relationship to the whole

The paper answers three research questions (RQ2, RQ3, and RQ4). Paper II and III complement each other by providing parallel and complementary viewpoints to the topic.

4.3 PUBLICATION III: Establishing an MDM Function: First Steps in the Master Data Management Architecture Design

This paper presents an empirical case study examining the factors that affect the architectural decisions when establishing an MDM function. The paper starts by presenting the architectural alternatives for MDM identified in the prior research. The emphasis is on the usage scenarios. Key aspects are gathered and observed in detail. The findings from the case study are reflected upon the found scenarios and the factors affecting the choice of the usage scenario are discussed in detail.

4.3.1 Content and results

The prior research names three layers in the MDM architecture design. The first step includes identifying the method of use for MDM. The second step is to determine the right architectural implementation style for MDM. The last step, the application architecture, defines the technical architecture in detail. The first step has gained less attention, and because of this, it was observed more closely through the case study.

The case organization was evaluated and the aim was to identify different factors that point to a suitable approach. Because there were characteristics of multiple approaches, the usage scenario could be identified as enterprise MDM. The number of objectives supporting the scenario was inadequate to refer to a suitable scenario. Indirect objectives, such as cost savings, could be used as assessment criteria, but in the case organization, these were not considered at this stage. Cost savings were much more seen as a result of the business needs, instead of as a separate factor.

Business needs should indicate primarily the chosen architectural scenario, but also other factors have an effect. Business needs supported almost all of the scenarios to some extent. Because of this, the organization and IT-landscape were also observed as factors that emphasize the suitable scenario option. The IT environment was the final factor in identifying the suitable usage scenario. This also indicates that the architectural implementation style should respond to different use scenarios. The model of centralized

IT would support the operational scenario. The organization's IT environment is complex, and for the legacy systems, publication to other applications as defined in the reference architecture would be more interoperable with these. The operational usage scenario seemed to echo the business needs and IT environment most. Because of this and the needs for analytical usage, the organization's usage scenario was enterprise MDM.

4.3.2 Relationship to the whole

The paper investigates features and characteristics of establishing an MDM function in detail. The paper complements Paper IV by expanding the organizational view by describing the technical design for an MDM function. Similarly to the previous paper, this paper also answers three research questions (RQ1, RQ2, and RQ3).

4.4 PUBLICATION IV: Paradoxes, Conflicts and Tensions in Establishing Master Data Management Function

The aim of the publication is to observe how conflicts and tensions are identified in an MDM development process and what factors contribute to the emergence of these conflicts. Managing master data as an organization-wide function enforces changes in responsibilities and established ways of working. These changes cause tensions in the organization and can result in conflicts.

The tensions and conflicts are studied through the theory of paradox (Smith & Lewis 2011). The ethnographic study is conducted in a municipality by observing an organization's development process for establishing an MDM function. Lüscher and Lewis's (2008) process for working through paradox is used as a tool for identifying and forming the paradoxes from the case study.

4.4.1 Content and results

Altogether, 13 MDM specific paradoxes were identified and the factors leading to them were presented. Paradoxes were grouped into categories that represent the organization's core activities to understand how tensions are embedded within the organization, and how they are experienced.

Most paradoxes could be labeled under the core concepts of MDM, such as governance or maintenance processes. The found paradoxes were also observed against the development phases in order to understand the factors that contribute to the emergence of tensions. One of the phases, defining data governance, was observed more closely and related paradoxes were discussed in detail. Altogether, five paradoxes were observed

closely, using a vignette as an illustrative example. This was done to understand the mechanisms that lead to paradoxes. Working through the tensions also sheds light on the question of how these paradoxes should be managed. This example illustrates how problems emerge as dilemmas and evolve into paradoxes.

Initial problems that led to tensions were categorized under different themes in order to assess how paradoxes that emerge from these problems would later be categorized. Ten categories were used that represented core activities and elements of the organization's knowledge, identity/interpersonal relationships, processes, and goals (Figure 15). Regarding similarities between the paradoxes that initially emerged from similar problems, themes and categories were compared to understand these similarities and differences. In this way, the paper observed the kinds of paradoxes that emerge from the MDM development process, and also discussed four paradoxes in detail to understand the mechanisms that led to them.

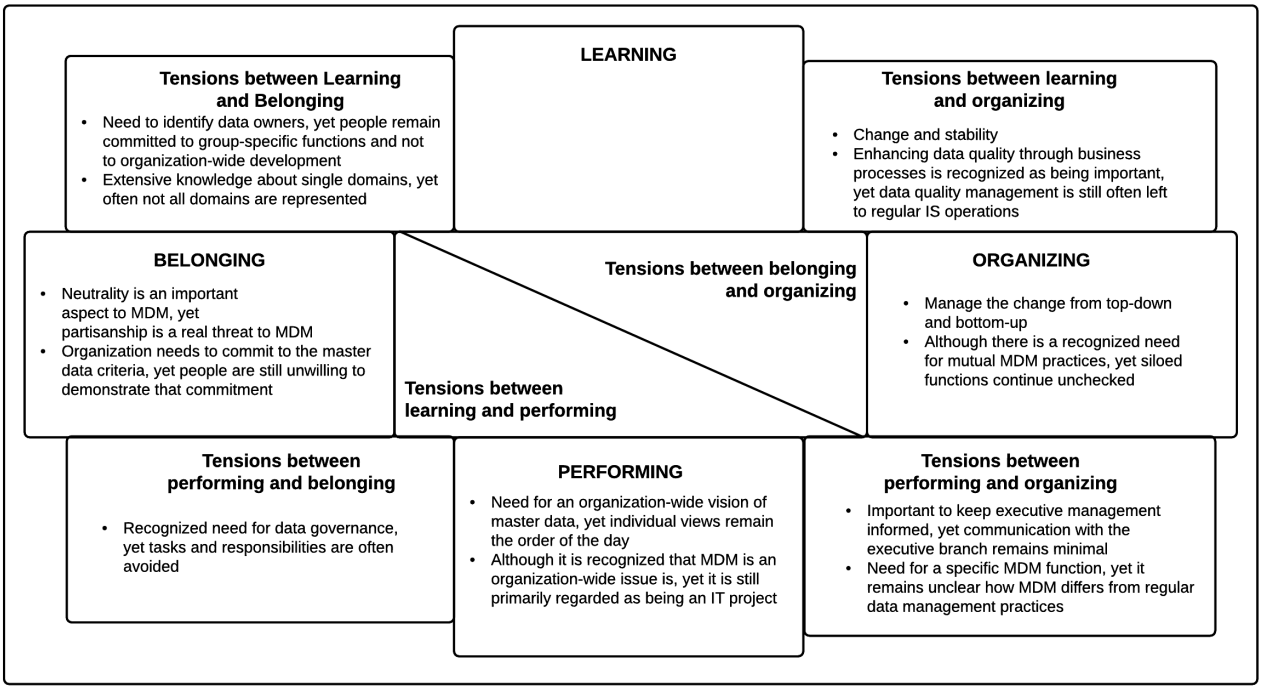

FIGURE 15 Categorized paradoxes

The paper also briefly observes how the tensions can evolve into workable certainties, and in this way, the certainties could be worked through and managed more effectively. Identifying the level of analysis for the paradoxes fosters the working through process. Each paradox was observed through strategic questioning to form a workable certainty. Most of the paradoxes emerged on the individual, group, or organization level. The identified level helps to understand the polarization and how the paradoxical tension should be resolved.

4.4.2 Relationship to the whole

The paper emphasizes the impact of MDM on different organizational levels and illustrates the MDM function's organizational implementation. It also presents MDM as a multi-dimensional function that bridges several traditional functions together. The paper answers three of the original research questions (RQ1, RQ2, and RQ4).

4.5 PUBLICATION V: Changes on Roles, Responsibilities and Ownerships in Organizing Master Data Management

The paper describes how ownership, roles, and responsibilities are perceived, and how they change and evolve during the MDM development process. The paper observes three angles of development, which are ownership, roles, and responsibilities, and their changes in the development project.

Sociomateriality was used as a theoretical lens to identify the factors that influenced the change, and to observe if the change was a result of the intertwined social and material factors. Here, sociomateriality can be seen as a way of thinking about the world, and not as an empirically testable explanation of social behavior (Müeller & Raeth 2012). In addition to the change itself, the factors contributing to the change were also observed. The overlap of human and material agencies (Leonardi 2011) served well as a model to do this, because instead of emphasizing the change itself, it underlined the factors that ignited the change and tried to explain what affects the change. The ethnographic study was conducted by observing two MDM projects in a municipality over a 32-month time period.

4.5.1 Content and results

In MDM, data ownership differs from the roles and responsibilities. While roles and responsibilities could be observed as related terms, ownership had some distinct features. For example, it was often the object of change, while roles and responsibilities acted as factors initiating the change. The changes and the affecting factors in the MDM development process are presented as a process of reorientation and a process of convergence.

The process can be observed as incremental, as the changes in roles and responsibilities were a kind of scale adjustment. Yet there were some features that point to a punctuated equilibrium model of change. This was especially evident in terms of how the change itself affected social and material agencies, and shaped them. This also had an impact on how the change progressed. As a result, changes in technologies and routines formed a process of convergence with incremental change mechanisms. Their material

and social agencies formed a process of reorientation, wherein the patterns of consistency are fundamentally reordered. According to Choi (1995), these two processes form the punctuated equilibrium model of change.

4.5.2 Relationship to the whole

The paper continues the idea of Paper II. The theory of sociomateriality continues the theory of paradoxes by observing the relationship between the IT artifact and the organization. The paper answers all of the original research questions (RQ1, RQ2, RQ3, and RQ4).

5 Discussion

Publication I builds a profound foundation to observe the MDM development process. Each of the other four publications adds to this process model by extending the understanding of a certain aspect of it. Together, publications II, III, IV, and V form an understanding of the MDM function by observing different aspects of it in detail, and in this way, form a detailed comprehension of the factors that should be taken into account when establishing an MDM function. The idea was to contemplate the process up until the measures for implementing an MDM application began. This was because the technical implementation can vary depending on the organization, and it is even possible that an application may not be needed. The process until this can be seen as more standard and, therefore, is a much more fruitful research subject.

In the following section, the four research questions are processed one by one.

5.1 What kind of steps and phases does the process for establishing an MDM function include? (RQ1)

MDM is aimed at bridging the data silos, organizationally and technically. To understand this, a description of the MDM development process is needed to describe how the organizational and technical components are included. Because technology is not seen as key to the MDM development success (e.g. Dayton, 2007; Otto 2012), the emphasis is on all of those factors at the beginning of the development that should be considered before implementing a technical solution for MDM.

Publication I sheds light on the process for establishing an MDM function in an organization by not only providing a step-by-step approach, but also deciphering the steps more closely and observing the links between them. It identifies the process, its steps and their order; some steps are taken in parallel and others in a consequential order. The identified steps and their order are: 1) Identifying the need and objectives; 2) Identifying the organization's core data and processes that use it; 3) Defining the governance; 4) Defining the maintenance processes; 5) Defining data standards; 6) Metrics for MDM; 7) Planning an MDM architecture; 8) Planning the training and communication; 9) Forming a roadmap for MDM development; and 10) Defining the MDM applications' functional and operational characteristics.

Common interdependencies that needed to be acknowledged throughout the project were identified. These were data security and privacy, connections to other development

projects, and enterprise architecture. These were considered issues that help align MDM development with the organization and its other goals.

Prior research has identified governance as one of the most important factors in MDM success (e.g. Otto 2011b). Yet the phenomenon is not that straightforward. In our study, the governance is about governing the situation on three different levels: organizational level, support function level, and data set level. Each of these levels necessitates different types of governance structures and practices. This is also seen in Publication IV, which observes the development process in detail. The viewpoint differs, as it concentrates on the paradoxes that arise in the development phases concerning the step of Defining governance (step 3). Five paradoxes were identified under this step (c.f. Smith & Lewis 2011). These observe the issues that were included in the development step, such as MDM governance as an organization-wide function, tasks and responsibilities related to governance, management of the function, and changes the development initiates. Conflicts that were encountered during this phase could be identified on the levels of individual, group, and organization (c.f. Smith & Lewis 2011). This demonstrates that MDM has an impact on different organizational levels, and this should be taken into account already in the development phase. Paradoxes demonstrated the link between opposing forces and give meaning to contradictions (Vince & Broussine 1996).

Publication III confirms that several steps in MDM development should be taken before designing the architecture. The technical architecture design concentrates on the architecture model (step 7) and application characteristics (step 10).

Organizational changes are evident in the development process, and Publication V observed the changes that the MDM development process initiates in ownership, roles, and responsibilities. These are usually associated with the governance development phase, but the effect on these can be observed in all phases of the MDM development process. The process model from Publication I was used to analyze the changes. The change process could not be explicitly identified as evolutionary, where the change occurs gradually, nor revolutionary, where change happens swiftly and affects all parts of the foundation (c.f. Van de Ven & Poole 1995). It was somewhere between the two, as there were phases where the change was small scale and phases where the change was more fundamental.

This sheds light on how the development process proceeds from one step to another and how the steps intertwine. The change itself affected social and material agencies, and shaped them further (c.f. Leonardi 2011). Realized benefits emerge when people interweave with the system in practice to generate new uses of the system (Anaya 2013), and components weave together to develop or modify technologies (Leonardi 2011).

This also had an impact on how the change progressed. As a result, changes in technologies and routines formed a process of convergence with incremental change mechanisms, where the incremental changes consisted of continuous minor improvements or adjustments (Boudreau & Robey 1999). Their material and social agencies formed a process of reorientation, wherein the patterns of consistency are reordered.

The four Publications (I, III, IV, and V) together form an in-depth understanding of the MDM process model and the steps it includes. Often architecture models vary between the master data domains within an organization, and this was also the case in the case organization. Also MDM application requirements are considered individually with every master data set as their requirements differ, despite the fact that coordination between the applications and data sets is eventually essential. Both of these views emphasize the development as continuous, and confirm that the process model for MDM development presented in Publication I is, in fact, circular instead of linear (Figure 16). This also emphasizes that the development model should vary from a traditional approach to an agile approach, and is highly configurable for the organization's needs and type.

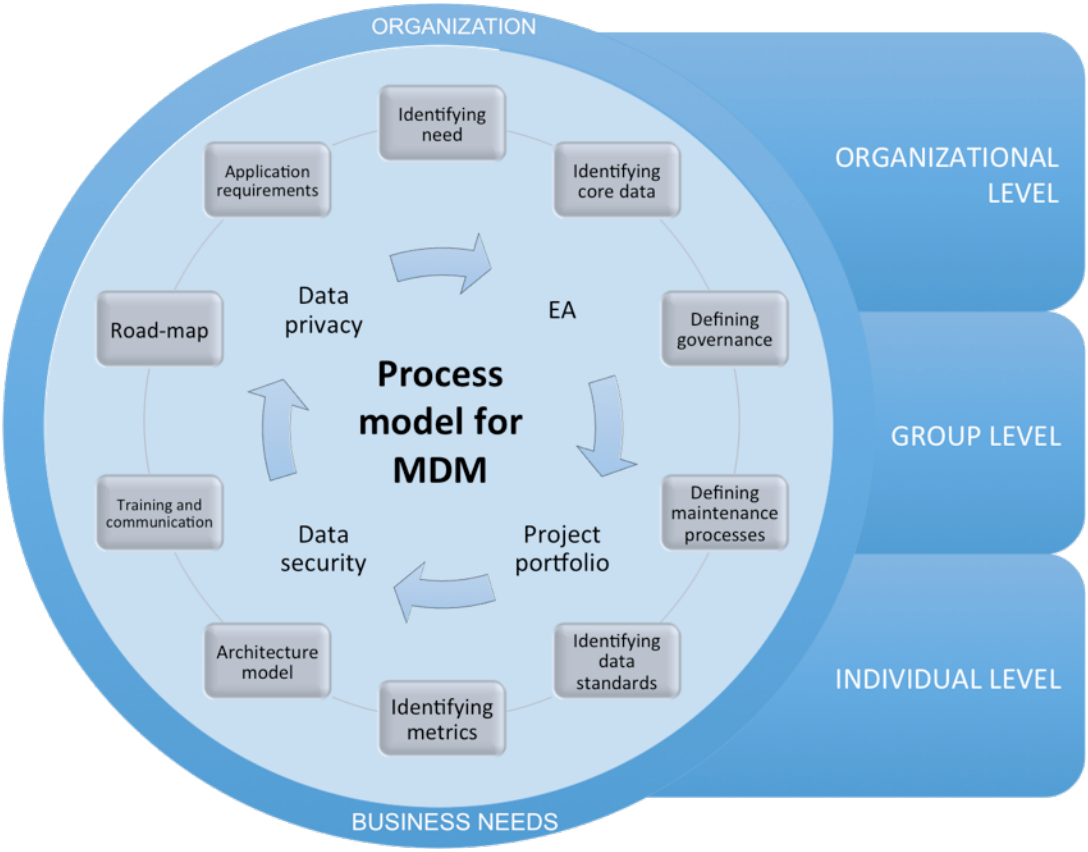

FIGURE 16 Process model for developing MDM

5.2 What are the organizational issues that can be encountered in establishing an MDM function? (RQ2)

To move away from the IT-aspect, the phenomenon was observed also from the organizational aspect. Publication II provides a new understanding of the challenges in establishing and developing the MDM function within an organization. In addition to MDM-specific issues, several of the issues were general factors, such as the lack of management support. Four new MDM-specific issues were named that were either not identified or only partly identified in prior research.

All of the issues were identified as preconditions or as affecting factors for the others. The problems that were formulated into paradoxes in Publication IV were very similar to the organizational challenges that were identified in Publication II, especially the issues of unclear responsibilities, missing data owners, lack of engagement to the development from units other than IT, inconsistent goals for MDM development, and different opinions on what the organization's common master data is. Publication IV observes how these problems evolve into paradoxes (following Smith & Lewis 2011) and how they could be resolved (following Lüscher & Lewis 2008).

MDM-specific issues had an impact on other MDM-specific issues, while general issues were isolated or only had an impact on other general issues with a few exceptions (e.g., inter-organizational cooperation is a precondition for data governance roles and responsibilities). Figure 17 presents the MDM-specific issues, their dependencies, and identified tensions related to these.

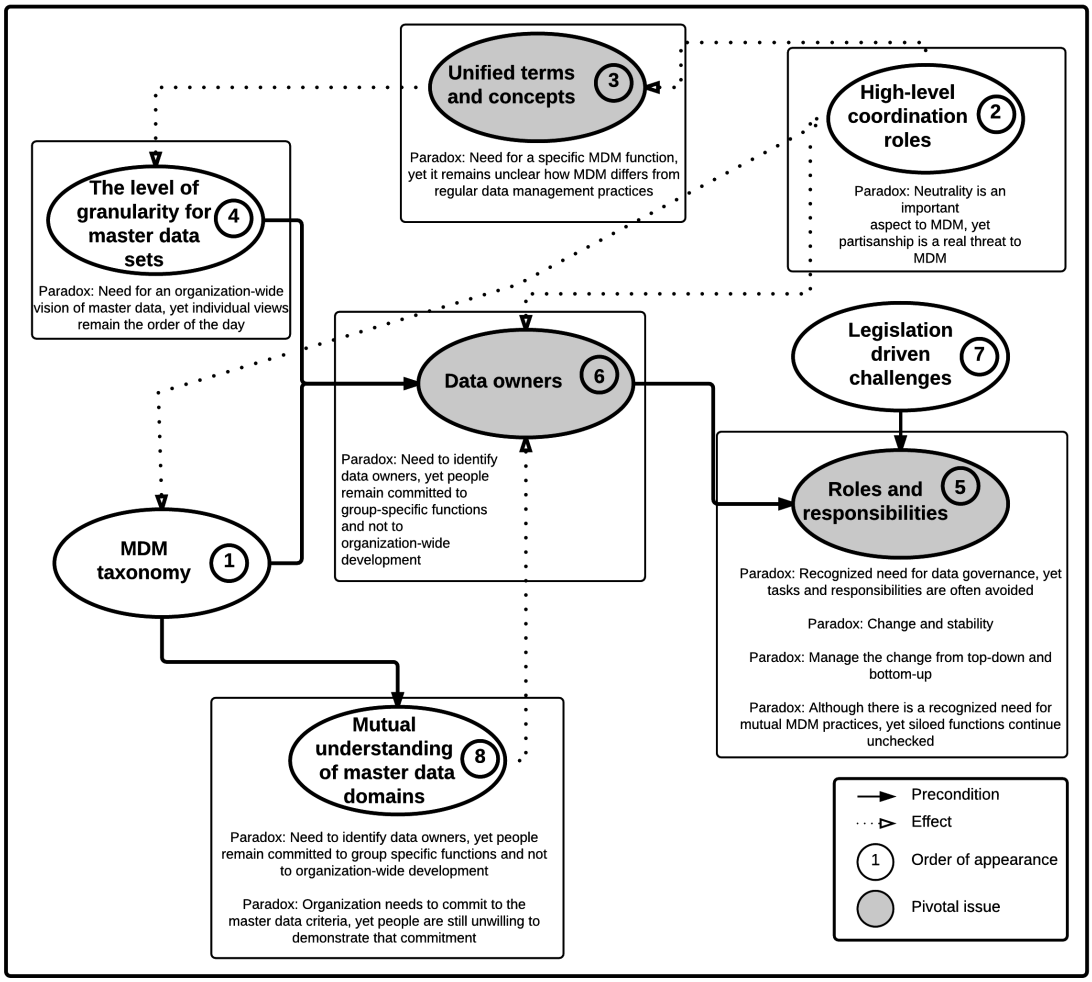

FIGURE 17 Found issues, dependencies, and related paradoxes

Data ownership, organizational roles and responsibilities, and unified data definitions were identified as pivotal issues. The majority of the tensions identified in Publication IV were related to these issues. These issues were also associated with several other issues. The role of data owner can have a more comprehensive effect on data management practices and data quality management (Weber et al. 2009; Panian 2010). The role of the data owner has gained more attention within the MDM domain (e.g., Smith & McKeen 2008; Hüner et al. 2009; Loshin 2009; Weber et al. 2009; Khatri & Brown 2010; Silvola et al. 2011; Otto 2012), but could also be studied more in a wider information management context.

The dependencies were also observed in Publication V, which emphasizes the alignment between social and material agency. The affordances and constraints (similarly to Leonardi 2011) present the issues that affect the process to evolve through change and to proceed. Again, the factors of unclear responsibilities and missing data owners are

identified as affecting factors, in addition to the organization's other ongoing development and business goals.

Still, to understand how IT and the organization align, Publication III observes how the organizational factors affect the technical architecture design. The type of organization had an effect. Different laws bind municipality operations; for example, they determine how information privacy should be managed. This was also evident in Publication II. The operating IT-unit was centralized and set some demands for the architecture. In addition, the organization's other ongoing development had an effect on the architecture design. The strategic emphasis on knowledge management and BI-development steered the MDM work in many ways (similarly to Yeoh & Koronios 2010). This was also identified in Publication II as the features, environment, and context of an organization were seen as factors affecting the challenges it encounters (similarly to Otto 2011b).

5.3 How is a technical architecture for an MDM function to support business needs designed? (RQ3)

To balance the point of view, the technical angle is also important to consider. The process model in Publication I presents the steps and the order to design an MDM architecture. It also shows that the needs of the organization form the basis for MDM technology. The characteristics originate not only from the technologies – even though they set some requirements – but also from the interplay between organizational needs, data sets, and technologies.

Publication III takes a more technical view by observing the steps in designing a technical architecture for MDM. Starting the MDM architectural design process by identifying the usage scenario for MDM through business objectives and the IT environment sets the architectural path in right direction. The usage scenario indicates the suitable architectural implementation style and also helps the organization to comprehend what they should emphasize in their development. It was also discussed that usage scenarios imply the applicable architectural styles (Cervo & Allen 2011), and further, the suitable application architecture. They also clarify how objectives are translated into design decisions for the organization.

The technical viewpoint is affected by organizational factors, and a need exists for a dialogue between the technical design and organizational design. This was demonstrated in Publication V, which indicates that the material and social agencies are intertwined. The social agency shapes the material agencies, and vice versa. This is also

emphasized in Publication II, which indicates that organizational factors largely affect the design of the technical solution.

5.4 How do changes in ownership, roles, and responsibilities evolve in an MDM development project? (RQ4)

The organizational factors identified in Publication II emphasize the concepts of ownership, roles, and responsibilities. They are identified as MDM-specific issues that have dependencies between the other issues (as seen in Figure 17). Thus, they could even be observed as success factors in MDM development.

In Publication IV, the focus is on tensions that can emerge in MDM development and the factors that contribute to these conflicts. The emphasis in on the problems that emerged during the development phase of defining the governance model. During this phase, almost all of the found issues were related to the concepts of ownership, roles, and responsibilities. Many of the paradoxes were related to conflicts with responsibilities. For example, the organization lacked a group that would be responsible for data quality management. Such group could support the operative owner, data owners, and process owners to accomplish what the organization's MDM requires (Dyche & Levy 2006; Weber et al. 2009; Otto 2011b). The ownership role clearly impacted development in terms of investments. When there was ambiguity about ownership, the organization was reluctant to invest in the development. The organization's development project policies required a named owner for the project. Even though the operational owner was officially appointed, the lack of data owners and changes in the steering groups seriously affected the development, at least by causing ambiguities. Here it was evident that the existence of a paradox does not automatically generate change; they can also paralyze and lead to inaction, instead of generating change (Fiol 2002).

Publication V contemplates the phenomenon again from an organizational angle, especially from the perspective of the concepts of ownership, roles, and responsibilities in a more profound manner. The emphasis is on understanding the change and the factors contributing to it. The overlap of the social and material entities demonstrates the continuous and intertwined process of ownership, roles, and responsibilities in MDM development. Also here, the pivotal issue of ownership worked as an aggregating factor. All of the changes to routines were somehow related to ownership (Figure 18).

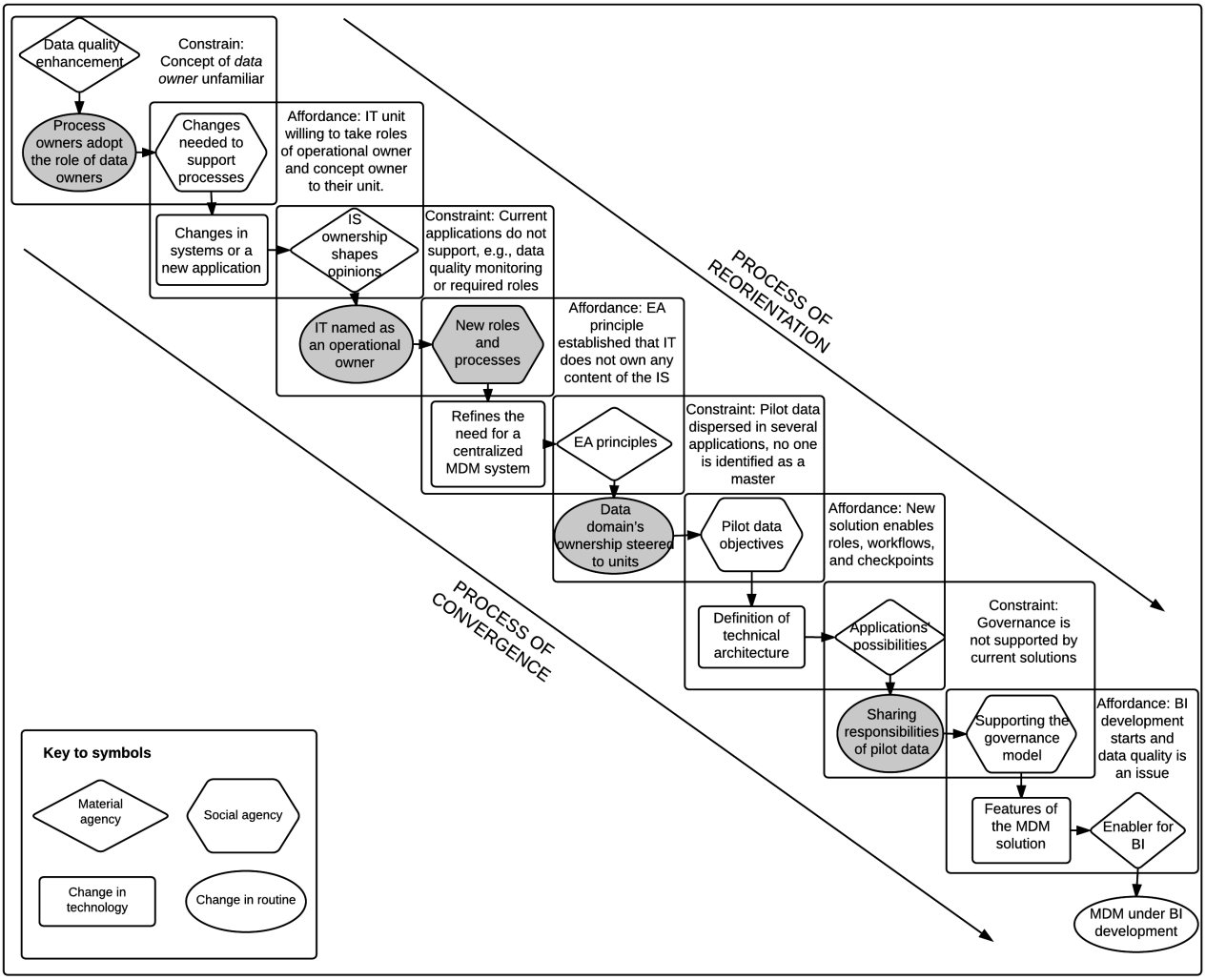

FIGURE 18 Changes and affecting factors in ownership, roles, and responsibilities

Certain issues regarding the data owners surfaced regularly in Publications II, IV and V. A common understanding of the importance of the data owner was evident. As demonstrated in Publication V, even when the data owners were not officially appointed, people responsible for the business processes wanted to be involved and steer the development. This had an impact on how the development proceeded and how the roles and responsibilities evolved. This seemed to reflect the maturity level of the data governance in the organization (Hüner et al. 2009). When different organizational units conflict and confront each other on an issue, they fail if inadequate methods are used to solve the conflicts and power inequalities limit confrontations (Van de Ven & Sun 2011). Although the development process lasted the whole data collection period (almost three years), the organization was not able to define the concept of “data ownership.” While the understanding of the term was missing, an individual development project could not implement the role. While variations stimulate the selection of new ways of working, retention works to

maintain those practices that were selected in the past (Weick 1979; Pfeffer 1982). Still, the development project was able to start the clarification of roles and responsibilities.

6 Contributions

Managing master data differs from traditional data management practices as an organization-wide function. Data management functions are often designed to support a certain information system or operating area. The idea of managing the organization's common, most important data is impossible to achieve if MDM is simply treated as a data management practice or a technology-driven phenomenon. Instead of treating it as a sub-area of data management, it could be observed as a parallel area. Many of the other sub-areas of data management (e.g., Mosley et al. 2010) also apply to MDM.

The starting point is to understand what kind of data MDM aims to manage and why. The organization could even have only one or two master data domains that should be systematically managed. Still, the impact on business is extensive (Loser et al. 2004; Haug & Stentoft Arlbjørn 2011). MDM's challenge is not the quantity of data. The challenge is with several IS, databases, documents, and other storage places that have the same data (Dahlberg & Nokkala 2015), and the several units, groups, projects, and individuals that somehow contribute to the data (McKnight 2009). The challenge for MDM is to manage these.

MDM is a complicated and multi-dimensional function that effects multiple levels in the organization: mainly the individual, group, and organizational levels. This has similarities with Markus and Robey's (1988) division of IS research into macro and micro levels, where macro level research is at the group and organizational level, and the micro level of analysis may combine mixed research at the individual, group, and organizational level. This study can be classified as a combination of these, but there may be a slight tendency to include more micro-level explanations because an empirical study is executed by one individual and in one organization. Also (following Walsham 1998), macro theory is applied to generalize results from micro studies.

Many organizational factors have an influence on MDM development and extensive dependencies exist between these factors, especially ownership (Smith & McKeen 2008; Hüner et al. 2009; Loshin 2009; Weber et al. 2009; Khatri & Brown 2010; Silvola et al. 2011; Otto 2012), other roles and responsibilities, inter-organizational cooperation, goals for MDM development, and understanding the organization's common master data. As recurring factors, ownership, roles, and responsibilities can even be considered key success factors for establishing an MDM function. By understanding these factors and their role in MDM development, it is easier to manage them.

To underline the main contributions of this study, theoretical implications and relationship to the main related literature is presented next, followed by the practical implications, and concluding with the limitations of this research.

6.1 Theoretical implications

This dissertation contributes to research by widening the understanding of MDM as an organizational function that is closely linked with technology, and by presenting a framework for establishing an MDM function. This enables researchers to develop different solutions to evident problems, and possibly theorize about the phenomenon.

The issues discovered in the research shed light on the strong alignment between the complex concept of MDM and the organization. Consequently, the results of this study may assist researchers in their endeavors to understand the various aspects of MDM, and to build theoretical models, frameworks, practices, and explanations further on.

6.1.1 Relationship to the MDM literature

Several steps in the MDM development and affecting issues have not gained attention in prior MDM literature. The research on MDM is quite fragmented and emphasizes certain aspects, such as MDM architecture (e.g., Andreescu and Mircea 2008; Kokemüller & Weisbecker 2009; McKnight 2009; Bai et al. 2010; Maedche 2010; Gomede & Barros 2013; Oberhofer et al. 2014; Poess et al. 2014), applications (e.g., Beyer 2006; Henschen 2007; Menet & Lamolle 2008; Bai et al. 2010; Chisholm & Corzo 2011; Kikuchi 2011; Murthy et al. 2012; Kobielus 2013; Nedumov et al. 2013; Castelltort et al. 2014; Cheung & Chung 2014; Eckhart 2014; Feng, Wang & Tan 2015; Subtonic et al. 2014), and data governance (e.g., Moss 2007; Dreibelbis at al. 2008; Power 2008; Shankar 2008; Snow 2008; Tuck 2008; Cochrane 2009; Otto & Reichert 2010; Power 2010; Waddington 2010; Zornes 2011; Bonnet 2013; Buffenoir & Bourdon 2013).

Although MDM has been a subject of interest, the process for establishing the MDM function has been studied only marginally and from a technical perspective – even though MDM itself has been identified as being more than just technologies (e.g., Smith & McKeen 2008). The order of the steps in the development and the links between the steps are important. Several models for practitioners (e.g., Joshi 2007; Radcliffe 2007; Cleven & Wortman 2010; Allen & Cervo 2015; Spurt & Pietzka 2015) present similar steps or design areas, but do not observe the relationship between the steps. The steps before designing the technical architecture are complex. The technical viewpoint is steered by organizational factors and a need for a dialogue exists between the technical

design and organizational design. Identified challenges were associated more with certain phases of the development, and the majority of these are related to the first identified steps in the MDM development process. One current topic in MDM literature is missing data owners (e.g., Soares 2014; Spurt & Pietzka 2015). The issue effects the MDM development profoundly, but the effect on overall MDM development has not been underlined.

Data governance is one of the most important factors in MDM success (e.g., Weber et al. 2009; Mosley et al. 2010). Especially, data ownership, other relevant roles, and the responsibilities related to these roles are at the core of MDM. These are often associated with the phase of developing the governance, but their effect can be observed in all phases of the MDM development process – either by the MDM development process initiating changes in ownership, roles, and responsibilities or by steering the following steps of the development. These issues are pivotal for MDM development, and they necessitate changes in the organizational practices, disciplines, methods, roles, responsibilities, policies, and procedures (Moss 2007; Snow 2008).

Data governance is often observed without the material agency or the IT artifact. In MDM development, certain components of data governance are also visible in the development phases concerned with the technical design. Data governance is linked to the whole process, rather than a certain phase or a step. Thus, it should not be observed as a distinct component.

Treating the subject only on an individual or organizational level simplifies the phenomenon. The data governance in MDM is also about governing the function on multiple levels: organizational level, support function level, and data set level. Each of these levels necessitates different types of governance structures and practices. Understanding how the development should be treated on different levels forms a more profound understanding of the issues that occur in MDM development. Opinions vary on which level is more resistant to change (Fiol 2002), for example, individual identities (Gioia 1998) and organizational identities (Pratt & Foreman 2000).

General issues, such as management support, are important to the development. Understanding these more profoundly assists in understanding how MDM is positioned in organizations. In addition to understanding the general factors effecting MDM development, the MDM-specific issues are the ones that determine if the development is proceeding in the desired direction. Some of these issues have been contemplated in prior research (e.g., Haug & Stentoft Arlbjørn 2011), but their depth has been insufficient for understanding the interdependencies between the different factors. This is particularly the case in relation to data governance. By contemplating MDM from a technical aspect, the social factors have not been adequately considered.

This is clear with the factor of differing opinions on what the organization's common master data is, and this has an extensive effect on MDM development. MDM has an impact on different organizational levels. The common master data appears different whether it is observed on the organizational, group, project, or individual level. Simplifying the viewpoint to one of these results in different opinions and ambiguity in the development.

6.1.2 Relationship to change management literature

Change management is aimed at understanding the change itself. Development is always some kind of change, and it is also an important aspect to understand in MDM development. For example, changes in ownership, roles, and/or responsibilities have been studied, especially from the change management perspective (e.g., McAdam & Galloway 2005) where the emphasis is on the management aspect, and not on understanding the contributing factors.

Observing the changes in the MDM development context explains the relationship between the organizational and social issues, IT, and data elements. The theories of change (such as Van de Ven & Poole 1995) help to understand the form of the change.

Often stakeholders' differing and conflicting demands are a source of tensions (Denis et al. 2007; Smith & Lewis 2011). This was established in this context, especially in the tensions that arose with the ambiguity of the objectives of MDM development, or the definition of the organization's common master data. Tensions are the consequence of change. Tensions further evolve into paradoxes by adapting the theory of paradox (Smith & Lewis 2011), and resolving the paradoxes by working through them (Lüscher & Lewis 2008) sheds light on the management of change. In this study, the development process is observed throughout from the change management point of view by identifying the process, the individual factors affecting the changes, how these changes further affect the development, and how they should be managed.

6.2 Practical implications

As it has been discussed, establishing an MDM function is a versatile and complex issue. The motivation for this research was triggered by the author's desire to understand what the development involves, and how the organizational and technical factors should be taken into account to establish an MDM function that fulfills the business objectives. In other words, the starting point was practical. This thesis has been written with the idea of offering practical implications in addition to widening the scarce academic literature and theory of MDM.

The step-by-step process for MDM development is a generic model that indicates the kind of steps that should be taken in MDM development, and in what order. The model can be used for planning an MDM function or a project. Also, it gives implications on how to proceed with the technical architecture design in order to meet the business objectives that have been identified. Other related issues in the framework assist in understanding the factors that should be taken into consideration when planning and implementing an MDM function. These factors can be used, for example, in evaluating risks and their probability. Also, the identified tensions in MDM development and the process for working through these tension offer insights for public sector or private sector professionals who are planning to introduce MDM or already have MDM projects underway. Understanding the factors that contribute to change helps practitioners manage it. In this way, the research also offers practitioners insights into how to prepare and manage changes in the MDM development process.

The thesis was executed in a public sector organization (i.e., a municipality). In Finnish municipalities, MDM development is taking its initial steps. Therefore, this thesis can indicate how to proceed and offer public sector-specific insights that are currently difficult to obtain.

6.3 Limitations

This research was a single case study, and caution should be exercised with regard to generalizations. A limitation of the present study may be its focus on the public sector, with the result that the findings may not be extrapolated to the private sector.

The choice to contemplate the process up until the measures for implementing an MDM application limits the view to the overall process and can be regarded as a limitation. This choice has been rationalized throughout the dissertation.

The type of organization itself has also an effect. The case study organization, a municipality, set some restrictions and demands for the MDM function. These are most likely similar in other municipalities and other public sector organizations. The structure, size, IT-landscape, and organizational culture also have their own influence. This means that MDM design cannot be identical in every organization. The affecting factors have to be evaluated and used to form the appropriate model for each organization. Thus, the process model is formed with the affecting factors used as a framework for establishing an MDM function. Organizational environments are contingent to a number of internal and external factors (similar to Weber et al. 2009, Weber & Otto 2007; and Otto 2011). Con-

text-dependency in terms of roles, activities and results of each step would have contributed to the research. As a single case study the required cross-case analyses were not a possibility and this is left for further research.

Also, the ethnographic research method surely has an impact on the findings, as the researcher's personal interests might emphasize some issues. The personal bias was minimized by separating the data collection and analysis phases, and by relying on other materials. Klein and Myers (1999) point out that prejudice is the necessary starting point of understanding. However, the suspension of our prejudices is necessary. This does not mean that we simply set aside our prejudices, but we need to be aware of them (c.f. Klein & Myers 1999).

6.4 Conclusions and recommendations for further research

The process model in this thesis presents the steps MDM development acquires. The steps are highly linked to each other, and many work as preconditions to the following steps. The MDM function consists of social and material agencies. The development process is a continuous dialogue between these components that affect each other and mold the changes needed in the organization to drive the process forward. This also underlines the need to observe MDM separately from traditional data management practices. For example, Galliers and Newell (2001) divide data into technical systems and information into socio-technical systems. Here, it is evident that MDM cannot be simplified into a technical system; nevertheless, observing it as a socio-technical system further explains why developing MDM is a complicated endeavor. Accentuating the technical or organizational aspects could disadvantage the balance and result in undesired results.

The architecture design should highly depend on the organization's business for MDM, which should indicate the suitable design. The architecture was seen as an entity comprising processes and IS for governing MDM.

The dependencies confirm the order of the steps and highlight some of the steps as more pivotal than others. These issues were data owners, roles and responsibilities, and unified terms and concepts. These are especially related to the first four steps. Challenges with these phases of the development could affect the overall development process. Thus, the first four steps are profound steps for the development. This also indicates that technical steps are not relevant until later on in the development.

Finally, the process should be observed as multi-dimensional. The MDM function has an effect on the organizational, group, and individual levels, and this should be taken into account in the early phases. The related issues of EA, project portfolio, data privacy, and data security are issues that should be taken into account in the development. Data privacy should be underlined in public sector organizations, where legislation steers the data privacy regulations. These four issues support the MDM functions and set some requirements for the development.

Observing the process of establishing an MDM function in other organizations could offer an interesting point of reference. For further research, it would be particularly interesting to observe the MDM-specific issues in detail, such as the kinds of conflicts and tensions these issues can cause in an organization Also, it could be fruitful to observe how the type of organization effects the issues; for example, does a multinational corporation encounter additional or different MDM-specific issues or general issues that affect the MDM-specific issues due to different nationalities and languages inside the organization.

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ORIGINAL PAPERS

I

ESTABLISHING AN ORGANIZATION'S MASTER DATA MANAGEMENT FUNCTION: A STEPWISE APPROACH

by

Vilminko-Heikkinen R. & Pekkola, S, 2013

Establishing an Organization's Master Data Management Function: A Step-wise Approach

Riikka Vilminko-Heikkinen
Information Management and Logistics, Tampere University of Technology
riikka.vilminko-heikkinen@tut.fi

Samuli Pekkola
Information Management and Logistics, Tampere University of Technology
samuli.pekkola@tut.fi

Abstract

Master data management (MDM) provides an access to the consistent views of an organization´s master data. Yet the establishment of MDM function, i.e. a department that attempts to ensure master data consistency is not an easy task as several stakeholders have different interests and expectations, among many other reasons. This paper is based on a year-long MDM project, from which we identify the process for establishing MDM functions in an organization, and what are the different steps and interdependencies that should be taken into account. These steps and their dependencies, and other incidental issues help organizations when establishing MDM function, and complement the scarce MDM literature.

1. Introduction

Master data is data about the key business objects in a company. Those are also unambiguously defined and uniquely identified across the organization [25]. Master data includes the business objects, definitions, classification, and terminology that constitute business information [35]. According to Loser [18], master data forms the basis for business processes.

Master data management (MDM) tackles data issues by concentrating on the business processes, data quality, and the standardization and integration of information systems (IS) [33]. MDM defines the most trusted and unique version of important enterprise data (e.g., customer, product, employee, location) [13].

MDM is often seen as a technical term, even though the literature states the challenges are mostly concerned with people in the organization [1]. MDM follows an application-agnostic approach trying to define and maintain consistent definitions of master data, and to enable its sharing across the organization's multiple IS [20].

Prior research has mainly observed MDM through the software implementation (e.g. [12]). Steps that should be taken before the implementation have received much less attention, even though some individual design areas, such as data governance [36] and data quality factors [15], have been studied. Even less attention has been devoted to the process of establishing a MDM function. Hence, there is a gap in understanding what should be done from the organization's point of view if the benefits of MDM are wanted to be achieved.

In this study we aim at identifying the steps for establishing a MDM function into an organization. Particularly we try to identify the whole process and how these steps are interconnected to each other. The study is based on a year-long project (a case study) where the attempts to establish the MDM function were ethnographically observed.

The first part of the study identifies the areas of the process that the prior research has found. The second part is the case study where we present our research methods and the findings. Finally, this paper concludes with discussion and presents some recommendations for future research.

2. Literature review

High-quality master data is a central prerequisite for companies to be able to perform as desired [26]. Master data can be identified with a help of a certain criteria [39] whose common features are its reuse [4], stability [27] and complexity [17]. Master data per se provides very little value, but it needs to be consumed by other applications or systems within the organization [13].

Master data has also an effect on transaction data. Transaction data describes relevant events in a company, e.g. orders, invoices, payments, and deliveries. If the master data is not correct, the transactions do not fulfill their intended purpose, because transactions use master data [11]. Skewed data appears as duplicates, missing attribute values and data value conflicts [5]. Data errors and inconsistencies lead to monetary and qualitative losses [35]. Also, maintaining many different data sets, perhaps for each and every IS, is an enormous cost. Yet the indirect costs are far more important than direct costs [6].

The need for MDM has been recognized after the amount of data has rapidly grown [37]. Currently the data is often stored in multiple ISs and databases. Particularly problematic is the fact that organizations typically have multiple information systems that hold the same data, because data has been developed and evolved in silos over the past decades [16]. Often a common starting point for MDM project is the refrain of data quality [22].

Although there is lack of academic research on MDM, industry experts (e.g. Gartner Group) have contemplated the subject from many angles. Academic research, professional reports, and practice all emphasize that MDM should be treated both as an organizational issues and a technical issue [40]. From the technical point of view, the MDM implementation process is mainly about implementing a technical solution [38]. Yet implementing MDM requires the organization to acknowledge that data is an important business asset and must consequently be treated and managed accordingly [23].

Introducing and further implementing MDM into an organization is a complex process with numerous steps and viewpoints [17]. MDM projects are often initiated by IT departments or are taken on by them [10]. Also enterprise resource planning (ERP) development is often a starting point for MDM development [20, 31].

Only a few researchers have contemplated the subject comprehensively. Radcliffe [30] proposed a model, which involved seven different design areas (MDM vision, strategy, governance, organization, processes, technology infrastructure, and metrics) that should be considered in developing master data management. Cleven and Wortmann [19] presented a model for developing MDM. They included five different areas (master data structure, master data systems architecture, master data governance, master data processes, and master data quality). Otto and Hüner's [26] model consists of three categories. Strategy category involves strategic aspects, for example, impacts on company goals, mandate, strategic scope and strategic action plan. Organization category includes controlling for master data (business case, metric systems), organization (accountabilities, roles, support) and processes and methods (master data lifecycle management, metadata management, standards and guidelines), while MDM systems category includes information architecture for master data (information object model, data distribution architecture) and application for master data.

These three models have focused on identifying the design areas that should be taken into account when planning a MDM function. Joshi [12] took a process perspective which also identifies the order that the steps should be executed. Her process for implementing MDM involves eight steps that should be followed in order to execute MDM successfully:

1. Defining the master data flow. Data owners identify the source and target systems of the master data.

2. Identifying the sources and consumers of master data. Applications that produce the master data and that use or consume the master data are identified.

3. Collecting the business metadata. For the applications identified in the previous step, it is essential to capture the details about the core entities, their attributes, and the data types of the attributes, constraints, and dependencies.

4. Defining the master data model, i.e. how the master record will look and how to map the current data source to the target master data model.

5. Defining the functional and operational characteristics of the MDM tool according to the organization's requirements for MDM.

6. Merging the source data to create a master data list or element. This is an iterative process where the source data passes through the set of business and transformation rules and matching algorithms. A lot of manual labor is needed from the data owners and business analysts to validate the mismatches.

7. Collecting and maintaining the metadata about technical and business rules. Master data testing should immediately follow master data generation to avoid any new errors in the generation process.

8. Publishing the master data or modifying the consuming/target applications. The actions taken in this step depend on the MDM approach the organization has chosen – either mapping or mastering. In the case of mapping, the master data has to be published to the consuming applications. If the organization has chosen to carry out this task using Service-oriented-architecture (SOA), Web services can be developed to publish the data, and all future updates and changes can be synchronized with the help of these Web services. In the case of mastering, the consuming applications must be modified to look up the new master data.

The design areas might intersect, parallel, or fall in between the steps in Joshi's [12] process model. Some are even prerequisites for Joshi's steps. Particularly governance and technical architecture have been observed more closely in the previous research [2, 3].

MDM vision creates the goal for MDM in the long run while MDM strategy defines how to achieve these goals [30]. Vision describes what MDM will look like in the organization and why it needs to be created. The vision should clearly state how MDM supports the organization's business vision with an explicit, sustainable, business benefit justification. MDM is affected by various business drivers, e.g., risk management, business process integration and standardization, and it must be considered as a company-wide endeavor [26]. It is essential to identify the business processes that need to be improved with master data [13]. MDM development should thus be designed like a business plan for a new company with a vision, mission, values and guiding principles [9].

Governance includes a formal process of roles and responsibilities that are commensurate with the levels of authority and accountability in the organization [30, 32]. Master data governance necessitates the definition of a clearly articulated prospects and the assembly of appropriate organizational structures. These include roles and stewardships, activities and decision areas, and responsibilities [19]. MDM governance sets the roles for every primary business owner for each master data being involved in the MDM initiative [34].

Organizations should also have well-understood and accepted processes for authoring, validating, enriching, publishing and consuming the master data [30]. These processes may differ depending on the type and complexity of master data. The main task for the master data processes is then to describe how the activities of creating, using, maintaining and archiving master data objects are executed [19]. These processes need also to be embedded into an organization's daily business processes [26] as they outline how communication, support and training for MDM is supposed to be conducted [19].

Master data will only be as useful and trusted as the source data being used to derive it [13]. Master data quality improvements thus require that data is analyzed and cleaned up [5, 19]. This can be done through, e.g., migrations and harmonization. Also defining the quality metrics, that are monitored continually, ensures master data quality [13]. All in all, MDM initiative can show the business value by adapting the metrics to which business stakeholders pay the most attention, e.g., key performance indicators that relates to key business processes [30].

3. Research method

Subject for the case study is a municipality of 213 000 inhabitants. The organization has approximately 15 000 employees. It consists of central administration, purchasing group, welfare services, municipal corporations and several subsidiaries. The MDM project was mainly conducted in the central administration, its administration and human resources center and its IT unit.

Centralized IT-unit has been in operation since 2007. Before that, information systems were largely acquired individually by the units, with the exception of some organization wide systems (e.g. ERP). Because of this, the number of information systems and interfaces is enormous. The MDM project described here is the first attempt to control the organization's master data in a centralized manner.

The year-long case study was executed in a MDM project that started in November 2010 and ended in October 2011. The project organization included three different groups: project group, steering group and expert group. Altogether, 32 persons were actively involved. They represented organizations' different support functions such as IT, human resources, business administration, procurement and all the core processes. Two experts were from municipal corporations, while two vendors were involved as a consulting party.

MDM Project

Motivation for starting the MDM project was seen in 2008 when evident dispersion and data quality problems with the data, considered of being organization's important core data were observed. At first, the most obvious problems were data duplicates and maintaining the data access.

Master data management was considered a solution that would deal with these problems comprehensively. It was assumed that the problems origin from both processes and applications.

The goal for the project was to study several issues: identify the organization's master data and issues that have an impact on the subsequent MDM development, and also how the development should proceed. The acquisition of a technical solution was excluded from the project.

Data collection

The study was conducted as an ethnographic research. Ethnography attempts to understand how the practices are taken and comprehended "in the field". It also enables more systematic theorizing [14]. As

Patton has pointed out [28], it is easier to understand and capture the context within which the people interact through observations and "living with the natives". Consequently the data for the study was collected in a MDM implementation project by participating in project group meetings, steering group meetings, kick-off and closing seminars, and other project-related meetings and informal discussions. The first author was actively involved in the project as member of the steering group and as a member of the expert group. This offered unique opportunities to observe and understand the project while also participating in it.

This can also be characterized as complete participation, where the researcher is a member of the group under observation [24]. The observer may see things that might routinely escape awareness among the people in the setting and has less need to rely on prior conceptualizations [28].

The researcher recorded her observations to a dairy at least weekly, and whenever she encountered issues that were related to MDM or its implementation. In addition, also project documentations were used in thus study. This included procurement documentation, project plan, monthly status reports, and different memos (working group, steering group, project portfolio group, stakeholder groups, kick-off and closing seminars).

The data analysis was conducted by adopting the principles of grounded theory. First the researcher familiarized herself with the data. The goal was to gain an impression of the material. The goal was to explicitly look at the process and its aspects and key factors. Due to this, grounded theory seemed as an appropriate analysis tool. Organizational context was wanted to be embraced for understanding the organizational aspects of MDM. According to Martin and Turner [21] achieving useful results requires that the complexities of the organizational context have to be incorporated into an understanding of the phenomenon, rather than being ignored or simplified. From this viewpoint, objective project documentation was analyzed through the subjective diary entries, and vise verse, subjective reflections were backed up by objective entries. All this provided a basis for being able to step back and critically construct a generalizable step-by-step model – still without losing the contextual understanding.

4. Findings

Before going to our step-by-step approach, at first general issues, having an impact on each and every step of MDM development, are presented. These were data security and privacy, linked development projects, and enterprise architecture.

Several concurrent development projects were in progress. Both ICT-projects and business development projects were observed from the MDM perspective. The goal was to take the needs from the projects into account and to apply MDM ideology to them.

Earlier research has recognized neither dependencies between the issues, nor any incidental issues. For example, security and privacy aspects have not been explicitly considered earlier as being a part of the MDM development process. Still, in our case they were considered important, because even legislation can place requirements for handling the data (e.g. patient data). They were seen as critical issues that must be emphasized in MDM development throughout the process of establishing a MDM function. Dreibelbis et al. [8] argument about their importance from the application point of view is thus too narrow – at least in the context of public organizations.

Also, it was identified already in the early stages of the project that MDM is linked with the enterprise architecture. This suggests that the design areas from the literature need to be taken into account. Due to this, MDM was conceptualized through four subsets of the organization's EA: conceptual level business architecture, including strategy, process map, processes, stakeholders and roles; information architecture from the logical level including modeling the master data; technology architecture, and applications architecture from the physical level, including integrations and MDM applications. Also governance was seen as a factor of the overall EA – and MDM respectively.

The identification of the steps was dynamic. Some were defined earlier in the project plan, such as identifying organization's core data, defining governance and forming a road-map for development, while some emerged retrospectively when analyzing the research data as what should have been done differently. Yet the following steps were identified crucial in establishing a MDM function.

Step 1: Identifying the need and objectives

The attempt to establish a MDM function started by mapping the MDM needs. These needs formed the basis for MDM development and also for the project. The interest was in understanding the changes that MDM could make in the business, and how to achieve this change. The emphasis was more in qualitative benefit than cost savings (Diary 10/2010).

The business objectives for MDM were identified first time in 2008. These were (Diary 10/2010):

- **More effective work:** streamlining work processes and the organization. For the MDM project, this means that the decisions on the data ownership should prevent the maintenance from more than one location.
- **Improved reporting:** Improving the accuracy, timeliness, and quality of the data. These properties are obtained by appropriate processes, roles and ownerships.
- **SOA interoperability:** MDM supports this by enabling service interfaces that the master data can be used with. MDM simplifies data retrieval, maintenance, and enables and implements the use of the terms and conditions.

Also some more generic objectives were set: to provide processes for data collection, integration, consolidation, quality assurance, and distribution to ensure data integrity, maintenance, and the application of information usage control mechanisms (Diary 10/2010).

Because the real state of the data and its quality were unknown until the step 2 had been taken, the exact need for MDM was not evident. This points out that this step needs to be done in parallel with step 2 as they seem to be enablers to each other – this was learned later. Even data issues had been recognized as a starting point for the development, national level development initiatives put pressures on the municipalities to quickly advance with the cultivation of MDM. Hence the original objectives and needs did not touch the data quality issues.

Step 2: Identifying the organization's core data and processes that use it

At first, there was a need to understand what master data is and how it differs, for example, from the transaction data. It was agreed that master data refers to the organization's shared data that often passes through different processes and units (Project group memo 17.5.2011).

Next, some general criteria for identifying master data were created, after which the data sets were classified against the criteria. The goal was to set criteria for master data to discover how many master data sets there are in the organization. The criterion was constructed by the general master data descriptions found from the previous literature.

In order to pick out the master data sets, all information systems and their data were analyzed (Diary 4.4.2011). This also gave an opportunity to map the number of applications that hold the same data. Also the organization's core processes were observed and divided into more precise ensembles to identify the information they used (Project group memo 17.5.2011). The processes and services being associated with the data were also observed. After all this background work, possible master data sets were compared against earlier created criteria. As a result, six different master data sets were identified.

Surely some challenges emerged. Several definitions of the MDM terms were missing. For example, the definition for the term "customer" was nonexistent. This resulted that it was very difficult to unambiguously identify the master data sets.

Evidently this leg work revealed that the organization had multiple master data sets that were duplicates. This also led to the first prioritization of MDM development as the data sets were divided into critical common master data sets and process-specific master data sets. It was decided that the MDM project first focuses on the former data set – common corporate master data (Steering group memo 24.5.2011).

Step 3: Defining the governance

Governance was defined in three levels: organizational level, support function level and data set level. Governance includes regulations, practices, procedures, data and concept ownerships, responsibilities and roles, and the descriptions of the roles.

This step aimed to identify the roles and responsibilities related to MDM. At first, different roles were identified. Naming them was not straightforward as it took several rounds of discussions about what kind of roles and responsibilities are needed. On the organizational level, a need for a MDM concept owner, who would take the lead in developing master data management, was evident. Yet it was more difficult to identify the organizational level and the unit where the role should be named and whether the role would be considered more as a sponsor or as a responsible party (Diary 19.5.2011). The organization considered that a responsible party is needed. This resulted that the role was associated with the CIO (Diary 5.7.2011). Also an operative role, leading the development and implementation of MDM was identified. This was also appointed to the IT-unit.

Data set ownerships were identified as essential. They would guarantee that the business units are involved in the MDM development, pointing towards the roles being associated with them. Common support functions identified were privacy and security, data quality control, information systems and integrations. Other roles were mainly seen as data set specific ones. These were, for example, roles responsible for the maintenance and the actual maintenance roles.

Step 4: Defining the maintenance processes

MDM processes refer to the processes that are needed for administrating and maintaining master data. This includes the responsibilities, methods and tools for collecting data (e.g. forms), defining workflows and guidelines for reviewing data in the workflows, and appropriate instructions for users and administrators. Also common operational models (e.g. service level agreements) between responsible unites had to be created. In the project, it was clear that well defined, documented, and approved maintenance processes are necessary.

This step was accentuated because current maintenance processes were dispersed (Diary 15.5.2011). In many organizations, the data maintenance is a costly and inefficient manual process that is done, e.g., by email, spreadsheets or phone requests [7]. This was also the case in our organization, where data quality issues, e.g., duplicates and errors in several master data sets were evident. This was also seen an area where wide qualitative and quantitative improvements could easily be made (Diary 5.7.2011).

Step 5: Defining data standards

Data standards define both the content and the model of a master data set on an attribute level. The data model was perceived as an enabler for making changes in the business environment. Consequently it contained the applications that, one way or the other, could utilize the data, and the reports that are produced by the applications. In particular, the problems with inconsistent and inaccurate reports were thought to be resolvable with better data structures. Earlier the data maintenance had been separated from the data and data structures. This resulted poor reporting. Information was simply not commensurate enough to the reporting purposes (Steering group 20.9.2011).

Also both a method for modeling master data and instructions how the data standard should be defined with every data set were considered. The instructions attempted to set standardized organizational level, process level and system level boundaries for master data. Hence the definition of the data set, its fields and attributes (e.g. a list of allowed values with explanations) were defined.

The step resulted as a template for future development.

Step 6: Metrics for MDM

Data quality describes how well the data serves the organization's demands. As this was one of the original goals of MDM, it was seen important to ensure that the methods and means for developing and monitoring data quality are identified.

First the data quality definitions were formed and some generic policies for developing data quality for master data sets as well as some specific data sets were identified. This provided a basis both for setting the data cleansing and migration strategies and for monitoring and measuring practices. Also some non-recurring measures, such as data cleansing and removing the duplicates, and some manual steps, such as data harmonization and data quality assessment, were identified.

The passion towards master data quality increased during the project. At the beginning, the interest was more on metrics. When the project proceeded, it came more evident that data quality issues should be approached more broadly. Similarly to data standard definition step (Step 5), also here the focus was on the future improvements and plans rather than setting tangible metrics for current data quality.

Step 7: Planning a MDM architecture

MDM is about both organizational issues and technologies. The MDM architecture was the first step in defining the technical part. The architecture was seen as an entity comprising processes and information systems for governing MDM. MDM architecture contains information about the applications involved, data flows between them, systems and data administration practices and points (centralized vs. decentralized), potential new acquisitions, and data security and data privacy issues.

After setting the principles for MDM architectural model, alternatives for the technology architecture for MDM were compared. Three models; repository approach, registry approach and hybrid approach (see [29]) were studied more closely. It soon turned out to be insufficient to use just one model, but all three models were needed, as their views complement each other (Diary 4.10.2011).

It was seen essential that all previous steps need to be studied first before proceeding with the technical issues (Diary 1.6.2011). They form a basis for policies how to employ and integrate the MDM applications into the organization. For example, the initial MDM compatibility requirement with SOA was needed to be considered in all applications and systems. This made it as a general level policy – even though more detailed requirements must be defined separately for every master data set.

Step 8: Planning the training and communication

Communications with all stakeholders was considered to be an important factor in the successful MDM adaptation. This enforced communications and training plans where items such as what, when and for whom the development of master data should be communicated.

As a result, the plan provided instructions how to communicate with the key stakeholders. This included the scheduling for particular events and meetings, and a plan how to organize training. Motivation, objectives, master data criteria and the common data sets were recognized as being the most important issues which need to be communicated. Also governance, objects and the key roles were seen important.

Formalized communication aimed at providing unified understanding of the master data throughout the organizations, promote the importance of data quality to appropriate stakeholders, and to support MDM development in the future (steering group 2.11.2011).

Step 9: Forming a road-map for MDM development

Some initial MDM (mainly project related) goals were set at the beginning of the project. However, during the project some primary sustainable goals, related particularly MDM and not just its development project, were set. These emerged as explicit problematic issues experienced by the business people. Also the organization´s strategy was considered as a factor influencing MDM development. All these issues were categories into development areas, which were used as a basis for prioritizing the development and for forming a long-term road-map. This road-map can also be seen as a MDM strategy.

Step 10: Defining MDM applications' functional and operation characteristics

The MDM applications are connected with the MDM architecture (defined in Step 7). Yet the MDM applications were considered individually with every master data set as their requirements differ – despite the fact that coordination between the applications and data sets is eventually essential. The analysis resulted that different components for the MDM applications were identified. These included user interface, workflow, MDM functionalities, such as data creation, editing, removal and reconciliation, data quality functions, database, and integrations to other applications.

In technical specifications, the data properties were defined in relation to standards and appropriate technologies. This also enabled the evaluation of whether to manage master data in a centralized or decentralized manner, making it possible to make the decision independently for every data set.

5. Discussion

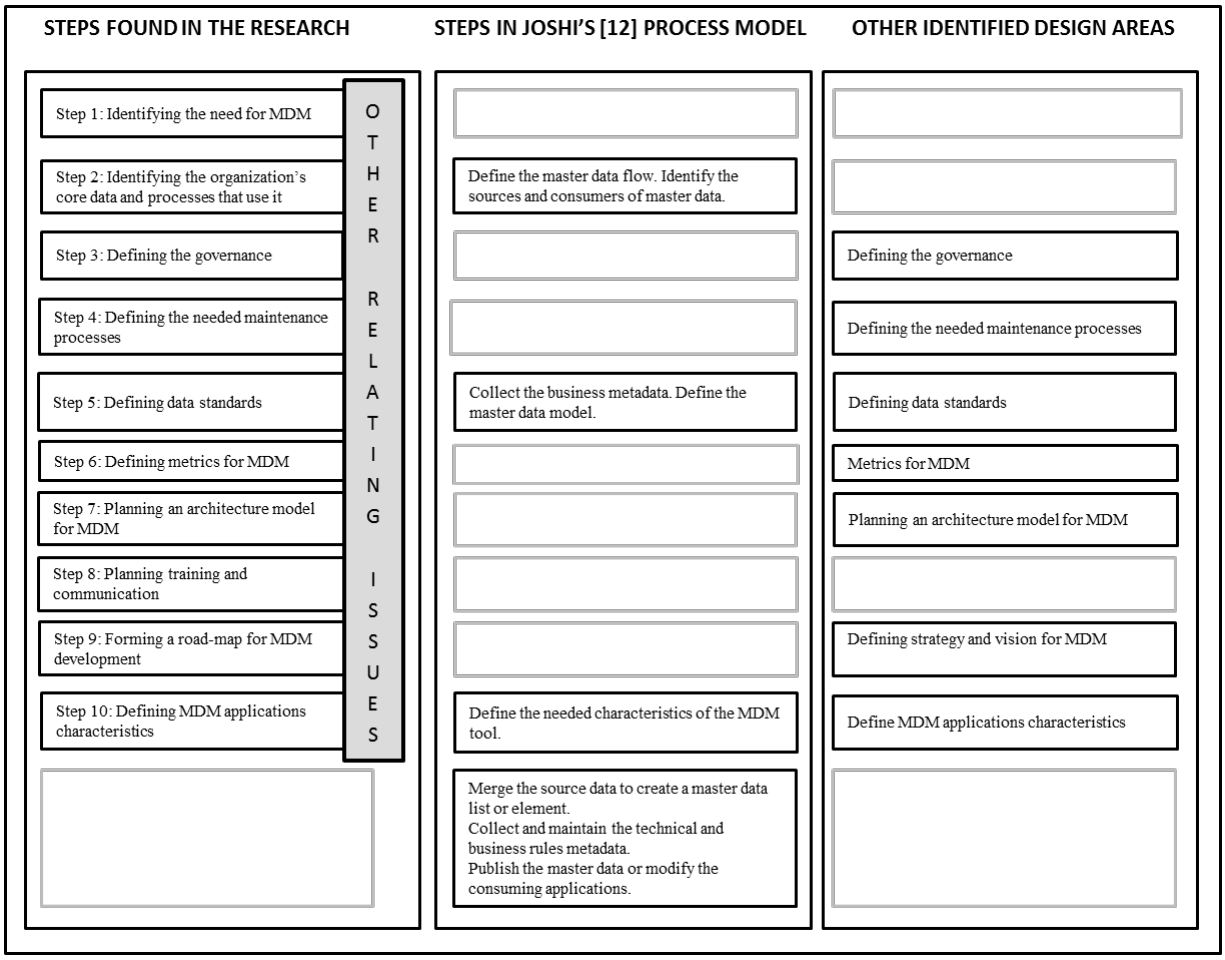
Previous research has identified the process for establishing MDM function in an organization on a general level. Also several main design areas were identified (e.g. [30]). However, we took the MDM establishment process further, and focused more closely on the content of the process; different steps, their activities, and relationships. We aimed at describing the process in more details by providing a step-by-step description that organizations could use a basis for establishing their own MDM functions. Our step-by-step process also indicates the order of the steps, in other words, how they influences each other. Some steps were identified as prerequisites for the others while some were seen as being parallel to each other. Next we will discuss each step in relation to prior research.

Our process started from the contemplation of the needs for a MDM function. This was considered as the first step as the initiative for the MDM development had come from the IT-unit. Before continuing, the business had to be engaged with the development. We argue that this step is crucial for the success of the MDM. Its ignorance will result ambiguity as the understanding of the MDM, what it is and what it is not, and what are it needs, are left unclear and undefined. Prior research implicates that the first step is MDM strategy and vision creation (e.g. [26]) while we see it as a successor of understanding the meaning of MDM for that particular organization.

Similarly, the second step of identifying organization's master data was acknowledged in the prior research (e.g. [12]). Yet the approach has been more technical. In our study, this step includes also the organizations processes in addition to technologies and information systems. Furthermore, we found out that before focusing on the processes and technologies, some kind of criteria for identifying the master data is needed. Very rarely all potential master data sets should be considered in the development. This emphasizes some commonly agreed criteria. In large organizations, as in our case, such criterion can be formed by studying whether the data is shared between the business processes.

The study also underlines the need for forming some basic definitions for MDM. This step should be executed at the very beginning of the MDM

Figure 1. Summary of the steps and similarities to prior research.



development in order to form understanding about what exactly the master data is for an organization and, what the current situation there is.

Prior research has identified governance as one of the most important factors in MDM success. Yet the phenomenon is not that straightforward. In our study, the governance is about governing the situation in three different levels: organizational level, support function level and data set level. Each of these levels necessitates different types of governance structures and practices.

Also defining data standards was observed as an important step in the MDM development. Data standards define the content of master data on an attribute level. Data models were seen as enablers both for the business environment changes and for comprehensive reporting. It has thus a consequential role.

A road map was important for future development. Also defining the architectural design was a phase that earlier literature has identified.

There is a shared view of the step for defining the functional and operational characteristics of the MDM tool. We argue that the needs of the organization towards MDM form the basis for technology. The characteristics origin not only from the technologies – even though they set some requirements – but also from the interplay between organizational needs, data sets and technologies.

We argue that MDM development is an organizational challenge more than technological challenge. This emphasizes the need for systematic training and communication. Those have to be planned in details, considering the whole MDM lifecycle. This means that their planning cannot be distributed to individual steps or else the coordination of the communication would be lost.

The comparison of our Step-wise approach to Joshi's [12] process model shows that the similarities are scarce (see Figure 1). Joshi's [12] process is very technically oriented, while we see the process for establishing MDM more as an organizational amendment process – which precedes the technical development. Our process involves roughly Joshi [12] phases even though they are mostly incorporated in the steps that deal with data standards, architecture models

and technical solutions. Also Joshi's [12] process involved maintenance steps for the applications, whereas our process ends in defining the characteristics for the application. In our case maintenance was not considered as a part of the MDM development process. The steps, other issues and comparison to Joshi's process model are presented in Figure 1.

MDM development is not only about technologies or data. Also the organization, its objectives and strategies should be taken into account more widely, for example, by observing how the MDM should be aligned with ICT and business development in a form of projects and enterprise architecture. These issues, other dependencies and incidental issues have not been studied extensively. They are thus subjects for further research.

Even though the research was conducted in a municipality, the process does not indicate that the steps differ from the ones that the prior research has presented. Also, there were no language or culture/nationality specific issues identified. We thus argue that the steps are applicable and generalizable to public and private organizations, and different countries and regions.

6. Conclusions

The paper sheds light on the process for establishing a MDM function in an organization by providing not only a step-by-step approach but deciphering the steps more closely and observing the links between them.

Earlier some of the phases and relevant factors in MDM development have gone unnoticed. Although MDM has been a subject of interest, the process for establishing the MDM function has been studied only marginally and from a technical perspective – even though MDM itself has been identified to be more than just technologies. Our process identifies the process, its steps and their order: some steps are taken in parallel while the others in a consequent order.

Common interdependencies that need to be acknowledged throughout the project were also identified. These were data security and privacy, connections to other development projects, and enterprise architecture. These were considered as issues that help to align the MDM development with the organization and its other goals.

Our study contributes to the academic debate by presenting a step-wise approach for establishing an MDM function into an organization. The details in each step also help us to understand the MDM phenomena little bit more as the literature is still scarce. Even the step-wise approach has evidently both practical and academic value MDM still needs to be studied much more. We hope our study is a (small) step to understand MDM phenomena better. By developing MDM in organizations we believe we can increase their data quality and how it is exploited there. By so doing the organizations would get more value from their information systems.

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II

MASTER DATA MANAGEMENT AND ITS ORGANIZATIONAL IMPLEMENTATION: AN ETHNOGRAPHICAL STUDY WITHIN THE PUBLIC SECTOR

by

Vilminko-Heikkinen, R. & Pekkola, S.

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III

ESTABLISHING A MDM FUNCTION: FIRST STEPS IN THE MASTER DATA MANAGEMENT ARCHITECTURE DESIGN.

by

Vilminko-Heikkinen, R.

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Establishing a MDM function: First Steps in the Master Data Management Architecture Design

Riikka VILMINKO-HEIKKINEN[1]
Department of Information Management and Logistics, Tampere University of Technology, Finland

Abstract. Public sectors need to manage data for internal and external use is growing. Master data management aims to manage the core data that affects generally the data quality in large extent. The objective of the research is to observe the factors that affect the architectural decisions when establishing a MDM function. This is done though prior research and a case study in a municipality. Business needs and the existing IT environment indicate the best usage scenario for MDM. Scenario indicates the suitable architectural implementation style and also helps the organization to comprehend what they should emphasize in their development.

Keywords. Master data management, MDM, data management, Business intelligence, Open data

1. Introduction

Open data, big data and the growing need for predictive analytics set demands for public sector. Better data management practices are needed to ensure high quality of data for internal use, external use, and re-use. Master data management (MDM) aims to manage an organization's core data (i.e., master data). It tackles the data quality issues through process improvement by using organizational and technical aspects.

The focus in prior research has been in implementation styles and application architecture on private sector. Establishing MDM and the first steps of MDM architecture

[1] Corresponding Author.

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design have gained less attention. MDM development is a relevant topic in public sector in Finland. From September 2011, the Act on the Direction of Public IT Governance has mandated the use of an Enterprise Architecture (EA) Framework. The National Enterprise Architecture (NEA) steers the EA development [8]. Also MDM is a part of the NEA and the National MDM reference architecture was finalized in 2013. The objective of the research is to observe the factors that affect the architectural decisions when establishing a MDM function. This is done though prior research and a case study in a municipality.

The paper is organized as follows. First, we identify how prior literature has observed the architectural questions in MDM. The research methods and settings are then described. Empirical part follows and concludes with a discussion and recommendations for future research.

2. Related research

MDM should be seen as a process improvement plan to identify, assess, and implement methods and tools for assuring good quality data for the decision process [6]. The usage scenario defines the method of use for MDM.

In an operational scenario [10], [5], all interactions and transactions are applied to the master version, and consistency requirements must be strictly enforced [10]. Analytical scenario is relevant when the need is primarily to produce and maintain master data for data warehouse (DW), reporting purposes, analytics, and big data systems [10]. Enterprise scenario combines analytical and operational scenarios [1] and is similar to reference information management. The focus is on the importing of data into the master data environment and the ways that the data is enhanced and modified to support the dependent downstream applications. The collaborative usage scenario emphasizes achieving an agreement on a complex topic among a group of people [5]. This usually includes workflows and multiple tasks. Social MDM is a more recent perspective on MDM. It focuses on providing a platform for gathering, integrating, and stewarding a wider set of customer and product data, and for making them available through-out the organization [13]. Some of the unique characteristics of each usage scenario are presented in Table 1.

Table 1 Unique characteristic of different usage scenarios for MDM

Usage scenario	Characteristics
Operational	— Operational systems must execute their transactions against the master data environment instead of their own data systems [10], [5] — Integrates operational applications (e.g., ERP, CRM) in upstream data flow [15] — Individual and application access is closely monitored [10] — The MDM repository is considered as the authoritative source [11]
Analytical	— Applications are more likely to use than create master data [10], [14] — Applications can effect classifications/categorization of master data records [10] — MDM systems key role is to be a provider of consistent data for BI [5], [11], [10] — Intersection between the MDM and BI [5], mainly for reporting purposes [17] — MDM systems may include some key features for analytics [5] — Classifying master data is done through analytics [10] — Resembles customer data integration (CDI) [1] — Uses a unidirectional flow of data to the master record, using extract, transform and load (ETL) processes before importing the data [14]

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	— Direct modifications to the master data can be made [10] — Least intrusive approach and most used [3]
Enterprise or reference information management	— Master records are created directly [10] — System coordinates users and systems to reach agreement on a data set [5] — Data in incorporated into the master environment, where it is available for publication to client applications [10] — Ensuring the quality of data in the entry [10] — Direct modifications to the master data can be made [10] — Classification made directly according to predefined rules [10]
Collaborative	— Collaborative authoring of master data: creation, definition, augmentation, and approval [8, 15]
Social MDM	— Analytics derived relationships [13] — Especially affiliated to big data capabilities [13] — Customer centricity (people and organizations) [13]

Repository, registry, and hybrid are common models for implementing MDM architecture. In repository, the complete collection of master data is stored in a single database [10]. The global attributes of the data set are always created in central master data system [9]. In registry model, data sets are created, maintained, and distributed by different applications [9]. The hybrid model includes features of both of these approaches [10]. Also a consolidation model has been identified [16]. Fragments of master data are authored in a distributed fashion and stored in the source systems, but the central MDM system creates a composite golden record. Architectural models complement each other, and several models are sometimes used to fulfill the needs of an organization [18].

Master data application architecture provides complete overview of how the architecture is deployed by using different applications [2]. It contains applications for creating, storing and updating instances of the master data attributes defined by the conceptual master data model [19].

Many of the case studies addressing MDM architecture design (e.g. [3, 20, 21, 23]) have been focused on the private sector, the target of this research is a municipality, which offers an interesting opportunity to observe the architectural design decisions in a public sector organization. The focus will be on different MDM usage scenarios that have not received much attention in prior research.

3. Research Methods

An ethnographic case study (following the instructions of Myers [12]) was conducted in a municipality comprising 220,000 inhabitants and approximately 14,500 employees. The case organization consists of central administration, purchasing unit, welfare services, municipal corporations and several subsidiaries. The MDM projects and development were mainly conducted in the central administration.

The data collection period lasted from November 2010 to June 2013. During this period, two MDM development projects were carried out, and MDM development became rooted as a part of routine operations. The data was collected by participating in all project-related meetings and informal discussions in both projects, and in the project preparation and procurement phases of the second project. The author was actively involved in the first project as a member of both the steering group and the expert group. In the second project, the author acted as a project manager and as a mem-

ber of the project group and the steering group. These positions offered unique opportunities to observe and thoroughly understand MDM implementation.

Diary entries were made weekly and whenever MDM-related issues were observed. In addition to observations, also questions that emerged and impressions were documented. To complement the diary, different kinds of project documentation were also utilized: procurement documentation, project plans, monthly status reports, and a set of memos from the working group, steering group, project portfolio group, stakeholder groups, and kick-off and closing seminars. Between the two projects, memos from the IT development group and the architecture group were also used. Finally, some internal documents were utilized, such as information management strategy.

The data was analyzed by following the interpretive research approach and the principles of Klein and Myers [7]. The data was re-viewed by observing it throughout and identifying what kind of objectives were presented during the process for establishing the MDM function. These objectives were categorized under several themes. Then these themes were used to review to data again. This time all issues supporting the themes were gathered. As a result, a list of the objectives was formed and discussion around these objectives was analyzed.

Ethnographers need to balance subjectivity and objectivity. Ethnographies are expected to meet standards of objectivity even when ethnographic research is highly dependent on the individual's unique knowledge and experience, and his/her actions as a thinking agent who brings his/her subjectivity to bear on the construction of information and knowledge [20]. All materials were analyzed in their entirety at the end of the overall data collection in June 2013. The idea was to gain some distance between the researcher and the context, and to keep data entries as neutral as possible so that they were not limited or affected by the analysis of earlier entries. This was done to minimize unintended entry manipulation, as one may easily make subconscious decisions about what to record.

4. Findings

The organization's centralized IT unit has been in operation since 2007. Previously, the units acquired information systems separately, with the exception of some organization-wide systems (e.g., Enterprise Resource Planning, ERP). As a result, it has approximately 400 information systems from different operating areas. The motivation for starting the MDM process was problems with data quality in main business processes. It was assumed that the problems originated from both maintenance processes and applications. The business objectives for MDM were identified for the first time in 2008. These were more efficient work, improved reporting, and service oriented architecture (SOA) interoperability.

The organization has several different external stakeholders (e.g. government agencies) that the organization is obligated to report regularly and also ad hoc (diary: 1/12). Data quality was considered one of the barriers to generating high-quality reports (BI report: 1.2.13). One of the clearest objectives became first supporting internal and external reporting (Diary 11/11) and later on supporting the BI comprehensively (Diary: 2/13).

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MDM also had a role in harmonization of data structures, which would ease the difficulty in combining information (Diary 9/11). The last of the business objectives "service oriented architecture (SOA) interoperability" was not current later on in the development. The organization made the decision (EA principle) not to use SOA in the development of new applications in general.

The organization has been struggling with problems regarding data maintenance. Formal processes were inadequate and employees had invented additional ways to maintain the data to solve problems. One of the basic objectives is to simplify the process for data life-cycle management and to automate functions that had been performed manually. A large amount of the master data was still stored manually in Excel sheets, making maintenance difficult and error prone (diary: 3/12). For example, organization's products and services are managed manually (Diary 10/11).

Several steps should be followed when creating, changing, or deleting data (Business Workshop: 27.9.12). It is important that checkpoints for changes are in place and those checkpoints are automated (Diary: 1/12). Workflows are particularly important when there are several tasks in the workflow or when a task is performed less frequently (Diary: 4/12). The data quality validation should be done while creating the data. History of the data should be also stored. Data standards were seen as an important issue in tackling data quality issues (Steering Group memo: 11.10.11). Several roles were identified to enable a finely divided control of the data. Roles were strictly limited to the need to make changes (Security and Privacy Work-shop: 13.9.12).

The organization's master data included sensitive attributes. The ongoing situation was that this information is often in several applications and there were problems with access management. Data is also imported from external sources. Usually this was done separately to the individual applications and the data would be obsolete in this respect in other applications (Diary 4/12). MDM should support compliance and provide a reliable foundation to support changes and updates in policies to help avoid penalties or other regulatory actions (Diary 8/12). The MDM system´s log should make it possible to identify problems relating to data misuse or other issues. For example, there are examples about data of organizational unit being deleted incorrectly (Diary: 9/11).

Organization´s master data domains include several hierarchies. Maintenance of these should be coherent (Diary: 1/12). The hierarchies should match those used at government level, and the maintenance should be synchronized (Project Group memo: 30.1.12). Master data is also affected by the definitions of government and government agencies and the need for a change often comes from a stakeholder. These affect the modification needs of the data models, attributes, and also the metadata (Business Workshop: 27.9.12). Master data objects should be categorized in different ways to present the perspectives that the data is used and observed. This serves especially the needs of the BI.

Several ways for enhancing data quality were identified (IT Workshop: 28.8.12, 4.9.12, 7.9.12, and 18.10.12). External sources should also be used for validating the data (IT Workshop: 28.8.12). The need for methods to continuously monitor the data quality was also identified (Project Group memo 28.9.2011; Diary: 4/12; Diary: 9/12).

The organization outlined an initiative to open data in a machine-readable format as part of their operations (Diary 5/12). Master data has high value in terms of re-use (also for commercial use) (Diary: 10/11) and in making the organization's operations transparent. It was seen as a problem that the data was scattered. For this purpose the

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structure of the data as well as easy access was essential. Master data often includes attributes that cannot be opened, it is important that there is attribute level access control that helps to control what data is published and by whom. Also, the understanding in the organization about this is part of the data governance and data privacy (Diary: 4/12; Security and Privacy Workshop: 13.9.12).

5. Discussion

The case organization's business needs were observed and classified. These were categorized under different usage scenarios. Summary is presented in Table 2.

Table 2 Business needs categorized by usage scenarios

Reference/Enterprise	Analytical	Operational	Collaborative
Control and formalize data creation	Automate infrequent tasks	Streamline work processes and the organization	Workflows, approval points
Function-oriented instead of system-oriented doing	Generate automatic reports of changes for stakeholders	Control and formalize the creation of data, Reduce errors in data entry	Decentralized data creation
Reduce errors in data entry	Automated and secure publishing	Access control to sensitive data	Divided control of the data
Direct data entry through one UI	Publishing machine-readable open data	Comply with security and data privacy rules	
Easier master data quality management and enhancement	High quality data source for DW (relationships between the concepts)	Better interoperability and view of the organization's core data	
Supporting data maintenance	Data classification	High-quality data for processes	
Data standards, classification based on predefines rules	High-quality data for reporting and enabler for BI	Easier master data quality management and enhancement	
Modification of metadata		Improve the data quality	
Data categorization		Use of data standards	
Detect errors before they affect functions		Approval function and formal process for maintenance	
Comply with security and data privacy		Supporting the maintenance of data	

Many of the objectives responded to analytical scenario's characteristics. Despite this; it was also quickly evident that the scope was wider. Reporting was seen as an important area, but the main problems affecting it were issues with data quality in operational systems. The development of BI was ongoing and the clarifications in the BI development also shed some light to MDM development. Big data development was observed in the last phase of the data collection. The analytical scenario was not efficient for the organization in long run. As seen in Table 2, business needs support almost all of the scenarios in some extent. Collaborative scenario seemed very separate from the other scenarios. It seems to be more a perspective on the other scenarios than a distinct method of use. Social MDM approach would acquire a more mature phase of big data development and use. The vision for BI included, e.g., idea to use social media data to enrich the customer data, but it there was no clear development plan for big data.

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Number of the objectives supporting the scenario was not adequate to refer to the suitable scenario. Cervo and Allen [3] emphasize indirect objectives, such as cost savings, as assessment criteria, but in the case organization these were not considered at this stage. Cost savings were much more seen as a result of the business needs, instead of a separate factor. Because of this, organization and IT-landscape were also observed as factors that emphasize the suitable scenario option.

The model of centralized IT would support the operational scenario. Organization's IT environment is complex and for the legacy systems, publication to other applications as defined in reference architecture would be more interoperable with these. Operational usage scenario seemed to echo to the business needs and IT environment most. Because of this and the needs for analytical usage, the organization's usage scenario was enterprise MDM.

The MDM usage scenario narrows the options for architectural implementation styles. Certain styles respond better to certain usage scenarios [3]. At the final stage of the data collection, the organization decided the hybrid model as an implementation style. This style is suitable when the organization is looking for a method to improve and manage the data quality, completeness and consistency of master data across several systems and the organizational commitment and the re-sources support proper data governance activities [16]. Dreibelbis et al. [5] have also identified the characteristics of legacy systems as constrains for choosing an architecture pattern for MDM. The organization's ERP was seen as a master system for two of the identified master data domains. Hybrid model has been identified as a good fit for ERP environments [11].

The current IT-landscape was the main influencer for making the decision of the MDM application architecture. The large number of legacy systems was one of the reasons why MDM architecture included a separate MDM system. The organization struggled to make the decision between a dedicated MDM system and an operational system converted to a master data source. The amount of the existing applications was the reason why they were reluctant to acquire a new system. Also the cost of a new solution was seen problematic. In the end, the extent of the desired MDM development resulted in the need for MDM system to enable the required elements and functions.

Prior research has not addressed MDM in the public sector or especially in the municipalities, nor has it made generalizations about the common or distinguishing features between the public sector's and private sector's MDM. The type of the organization affected the MDM development in many ways, but did not seem to affect significantly the first choices made with the architectural design. However, the MDM application architecture was affected by the existing IT-landscape.

6. Conclusions

The objective of the research was to observe the factors that affect especially the first architectural decisions when establishing a MDM function. The prior research names three layers in the MDM architecture design. First step includes identifying the method of use for MDM. Second step is to determine the right architectural implementation style for MDM. Last step, the application architecture, defines the technical architecture in detail. The first step has gained less attention and because of this, it was observed more closely through the case study.

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The factors affecting the first architectural decisions were complex. The maturity stage of the organizations BI responded well to analytical usage scenario. For an organization that has higher maturity, social MDM could respond well to the needs. Operational view contemplated the demands for streamlining work processes, and enhancing data quality in operational systems and processes across the organization, and the needs that open data places. It also responded well to the data security and privacy demands. Because there were characteristics of multiple of the approaches, the usage scenario could be identified as enterprise MDM. Business needs should indicate primarily the chosen architectural scenario, but also other factors have an effect. IT environment was the final factor in identifying the suitable usage scenario. This also indicates that the architectural implementation style should respond to different use scenarios.

The MDM architectural design is complex and challenging to design. To start the process by identifying the usage scenario for MDM through business objectives and IT environment sets the architectural path to right direction. Usage scenario indicates the suitable architectural implementation style and also helps the organization to comprehend what they should emphasize in their development. MDM usage scenarios have been dismissed in prior research for not being elaborate (e.g. [14]), but it seems that they present a good starting point for designing MDM architecture. Usage scenarios imply the applicable architectural styles and further on also the suitable application architecture. They also clarify how objectives are translated into design decisions for the organization.

Public sector's master data management practices have gained very little attention in research. Still, these should be emphasized more, because their data is transforming into public data. Public sector organizations set interesting research settings because of their complex IT landscapes and diverse data domains. MDM has some unique characteristics when established in public sector (e.g. data privacy issues). This research was a single case study, and caution should be exercised with regard to generalizations. For future research, there are several different paths to explore. The effects of usage scenarios to the design of governance might offer interesting perspectives on the overall concept of MDM. The social MDM in big data development also offers an interesting viewpoint.

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IV

PARADOXES, CONFLICTS AND TENSIONS IN ESTABLISHING MASTER DATA MANAGEMENT FUNCTION.

by

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PARADOXES, CONFLICTS AND TENSIONS IN ESTABLISHING MASTER DATA MANAGEMENT FUNCTION

Research

Vilminko-Heikkinen, Riikka, Tampere University of Technology, Tampere, Finland, riikka.vilminko-heikkinen@iki.fi

Brous, Paul, Delft University of Technology, Delft, The Netherlands, p.a.brous@tudelft.nl

Pekkola, Samuli, Tampere University of Technology, Tampere, Finland, samuli.pekkola@tut.fi

Abstract

Managing master data as an organization-wide function enforces changes in responsibilities and established ways of working. These changes cause tensions in the organization and can result in conflicts. Understanding these tensions and mechanisms helps the organization to manage the change more effectively. The tensions and conflicts are studied through the theory of paradox. The object of this paper is to identify paradoxes in a Master Data Management (MDM) development process and the factors that contribute to the emergence of these conflicts. Altogether thirteen MDM specific paradoxes were identified and factors leading to them were presented. Paradoxes were grouped into categories that represent the organization's core activities to understand how tensions are embedded within the organization, and how they are experienced. Five paradoxes were observed more closely to illustrate the circumstances they appear. Working through the tensions also sheds light on the question of how these paradoxes should be managed. This example illustrates how problems emerge as dilemmas and evolve into paradoxes.

Keywords: Paradox, Tension, Change, Master data management, MDM, Data management, Data governance.

1 Introduction

Managing change invariably requires balancing paradoxes (Nasim and Sushil, 2011). Development activities introduce changes, but reactions and outcomes are context and organization dependent. Master data management (MDM) development for instance ignites changes in technology, management practices, responsibilities and roles – resulting conflicts and tensions between different factors in the organization. Understanding these conflicts and tensions would help the organization to manage their MDM function more effectively, and avoid possible pitfalls.

MDM aims to ensure that organization's master data is reliable and available. Master data are those entities, relationships, and attributes that are critical for an organization and foundational to key business processes (Berson and Dubov, 2007). It forms the foundation of the company's business purpose and must therefore be used unambiguously across the entire organisation (Otto, 2012). This underlines the needs to organize MDM as an organization-wide function (Baghi et al. 2014). MDM function involves different organizational factors that contribute to the success of the development (Vilminko-Heikkinen and Pekkola, 2012). It necessitates cooperation among internal and external stakeholders, also changing existing processes and roles. These changes cause conflicts between different parties and their viewpoints, which have not been studied in the MDM development context earlier.

This paper observes how paradoxes are identified in a MDM development process and what the factors are contributing to the emergence of these conflicts. The ethnographical study is conducted by observing an organization's development process for establishing a MDM function. MDM, as an organizational function that requires organizational and technical changes, offers an interesting setting to understand organisational conflicts and tensions. In order to study paradoxes in details, we utilize a theoretical lens by Smith and Lewis (2011). Paradox is often seen as a common label for the organizational complexity, ambiguity and equivocality accentuated by change (Lüscher, Lewis, and Ingram, 2006). Smith and Lewis (2011) categorized paradoxes under four themes, which are learning, organizing, performing and belonging. The themes help to understand the characteristics of the paradoxes and to understand the mechanisms that contribute to the formation of these paradoxes.

This paper is organized as follows. Section two reviews the theoretical background by viewing how paradoxes have previously been studied and also briefly introduces the concept of MDM. Sections three and four present the research setting and research methods. Section five presents the findings of our analysis, and section six discusses the implications of our findings in relation to the literature. Finally, section seven offers some conclusions.

2 Theoretical background

2.1 Tensions, conflicts and paradoxes

Paradoxes are contradictory, yet interrelated elements that seem logical in isolation, but absurd and irrational when appearing simultaneously (Lewis, 2000). The Oxford Dictionary defines paradox as *"A seemingly absurd or contradictory statement or proposition which when investigated may prove to be well founded or true"*. Instead of paradoxes terms such as "contradictory tensions" (Smith and Lewis, 2011) or "underlying tension" (Andriopoulos and Lewis, 2009) have also been used. The concepts of paradoxes, conflicts and tensions have been studied mainly in organizational and management studies and especially with regards to the management of change (e.g. Vince and Broussine, 1996; Kan and Parry, 2004; Lüscher and Lewis, 2008; Smith and Lewis, 2011; Smith, Gonin, and Besharov, 2013). Paradoxes have been also studied in change management in information system development (e.g., Salmimaa, Hekkala, and Pekkola, 2015a).

In theory of paradoxes, Smith and Lewis (2011) propose that paradoxical tensions are studied as being *both* intrinsic *and* socially constructed yet often researchers view them as being *either* intrinsic *or* social (e.g. Lüscher, Lewis, and Ingram, 2006). Opposing yet interrelated dualities are embedded in the

process of organizing and are brought into juxtaposition via environmental conditions. Paradoxes offer a view of change. Through paradoxes it is possible to discover the link between opposing forces and to form a framework that gives meanings to contradictions (Vince and Broussine, 1996).

Other theoretical perspectives on tension include, for example, institutional theory and contingency theory. Institutional theory focuses on the relationship between organizations and their environments. It offers insight into tensions of performing and organizing (Smith, Gonin and Besharov, 2013). Contingency theory assumes that organizational systems are most effective when they achieve alignment between internal elements and external environment. Contingency theory explores the conditions that drive choices between exploratory and exploitative (Tushman & Romanelli, 1985), cooperative and competitive (Deutsch, 1968), and centralized and decentralized (Siggelkow & Levinthal, 2003). However, our focus is on conflicting views, not on organizing or performing, or condition that drive different choices.

The paradoxical tensions that arise within individuals and between different individuals and systems can and need to be addressed rather than excluded as being unimportant (Vince and Broussine, 1996). According to Lüscher, Lewis, and Ingram (2006) communication patterns appear as a primary source of contradictions. Related paradoxes arise through mixed messages given at different levels of communication. Managing paradoxical tensions also helps individuals, groups, and firms to be more flexible and resilient, and fosters more dynamic decision-making (Smith and Lewis, 2011). Management of tensions is probably one of the key managerial challenges for future IS businesses (Smith, Gonin and Besharov, 2013, Salmimaa, Hekkala, and Pekkola, 2015b).

Smith and Lewis (2011) categorize paradoxes under four themes: learning, organizing, performing, and belonging. These categories of paradox represent core activities and elements of organization's knowledge, identity/interpersonal relationships, processes, and goals (Smith and Lewis, 2013). Performing tensions emerge from divergent outcomes—such as goals, metrics, and stakeholders (Lewis et al., 2013). Often stakeholders' differing and conflicting demands are a source of the tensions (Donaldson and Preston, 1995; Margolis and Walsh, 2003; Denis, Langley and Rouleau, 2007; Smith and Lewis, 2011). Organizing paradoxes surface when complex systems create competing designs and processes to achieve a desired outcome (Smith and Lewis, 2011). These tensions emerge from divergent internal dynamics, such as cultures, practices, and processes (Lewis et al., 2013). *"Structuring and leading foster collaboration and competition, empowerment and direction, and control and flexibility"* (Adler, Goldoftas, and Levine, 1999; Denison, Hooijberg and Quinn, 1995; Flynn and Chatman 2001; Ghemawat and Ricart Costa, 1993; Lüscher and Lewis, 2008; Siggelkow and Levinthal, 2003; Smith and Lewis, 2011). Belonging tensions, i.e. tensions of identity (Smith and Lewis, 2011), emerge from divergent identities among subgroups, and between subgroups and the organization (Lewis et al., 2013). Identity fosters tensions between the individual and the collective and between competing values, roles, and memberships (e.g. Badaracco, 1998; Brewer, 1991; Markus and Kitayama, 1991; Pratt and Foreman, 2000; Smith and Lewis, 2011). Learning paradoxes surface when dynamic systems change, renew, and innovate foster tensions between building upon and destroying the past to create the future (Senge, 1990; March, 1991; Smith and Lewis, 2011).

Tensions operate between and within these categories. They also appear on different levels: individual, dyad, group, project, and organization (Smith and Lewis, 2011). Similar tensions can exist across each of these levels (Smith and Lewis, 2013). Smith and Lewis' (2011) framework (illustrated as Figure 2 later on in the paper) describes both the inherent and socially constructed features of organizational tensions, and integrates management strategies of acceptance and resolution. According to Smith, Gonin and Besharov (2013) the theory of paradox should be used to observe how paradoxical tensions surface in organizations.

2.2 Paradoxes, conflicts, and tensions in MDM development

MDM is a function in data management practices that aims to ensure data quality in an organization by managing its master data. MDM tackles data issues by focusing on business processes, data quality,

and information systems (IS) standardization and integration (Silvola et al., 2011). It is a collection of data management practices that are orchestrated by key stakeholders, participants, and business clients (Loshin, 2008). MDM is consequently an ensemble of methods that target fragmented data stored in numerous databases and siloes in the organization (Poolet, 2007).

MDM utilizes business applications, information management methods, and data management tools to implement policies, services, and infrastructures to support the capturing, integrating, and sharing of accurate, timely, consistent, and complete master data (Vilminko-Heikkinen and Pekkola, 2012). MDM defines the most trusted and unique version of important enterprise data (e.g., customer, product) (Karel et al., 2006). The areas of development when establishing MDM function are identifying the needs and objectives for the development, identifying organization's master data, designing a governance model, planning maintenance processes, identifying data standards and metrics, deciding on an architecture model, forming a training and communication plan, and a road-map and defining the application architecture (Vilminko-Heikkinen and Pekkola, 2013). Establishing a MDM function is thus about changing the ways master data has been managed and maintained. MDM should be seen as a process improvement plan to identify, assess, and implement methods and tools for assuring good quality data for the decision process (Fung-A-Fat, 2007). Dreibelbis et al. (2008) describe MDM through data governance as a political process of changing the organization's behaviour to enhance and protect data as a strategic enterprise asset.

Organizational challenges in MDM have been studied (e.g. Vilminko-Heikkinen and Pekkola, 2012). Yet paradoxes in MDM development have not received much attention in academic research. They, nevertheless, offer an interesting way to observe the changes in establishing different cross-organizational functions and actions. Understanding these tensions and factors that contribute to the emergence of these paradoxes helps to steer different development endeavours to right direction.

3 Research Lens

This study observes the paradoxes as intrinsic and socially constructed. This way we can concentrate on the factors that render latent tensions salient to organisational actors and observe the tensions in detail. We use Lüscher and Lewis's (2008) process for working through paradox as a tool for identifying and forming the paradoxes from the case study. The model was chosen, because it explicitly describes how the paradoxes are identified, and how they can be evolved in to a workable certainty. The starting point (a mess) presents the issue at hand, which is more specific (the problem). The next stage "dilemma" creates a sense of paralysis, because it implies that a choice must be made between dualities. Paradoxical thinking is spurred by recognizing a dilemma in which no choice can resolve the tension because opposing solutions are needed and interwoven (Lewis, 2000). Moving from a mess to a paradox encourages a deeper exploration at each stage towards a more workable certainty (Lüscher and Lewis, 2008). The last step of working through the paradox is challenging simplistic solutions to motivate on-going experimentation. The process is presented in Figure 1.

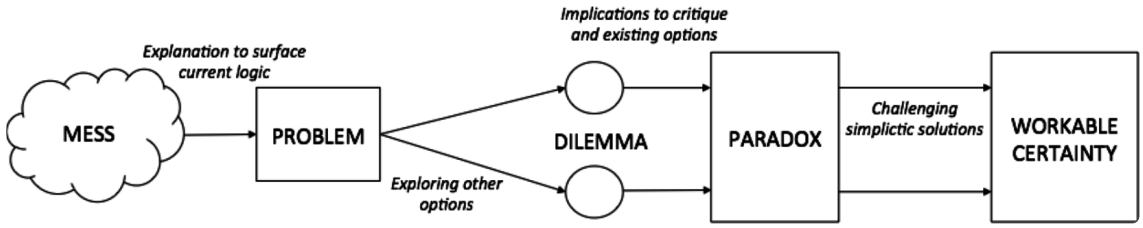

Figure 1 Process for working through paradox (Lüscher and Lewis, 2008)

Smith and Lewis (2011) present the dynamic equilibrium model, which offers the basis for a theory of paradox by providing common definitions, assumptions, mechanisms, and outcomes. The theory presumes that tensions are integral to complex systems and sustainability depends on attending to contradictory yet interwoven demands simultaneously. In addition to the four basic categories, the model

includes the six categories: tensions between learning and organizing, performing and organizing, performing and belonging, learning and belonging, performing and learning, and belonging and organizing that form tensions between the first four categories.

The theory observes the paradoxes as intrinsic and socially constructed, contemplating its two components: underlying tensions, i.e. elements that seem logical individually but inconsistent and absurd when juxtaposed, and responses that embrace tensions simultaneously (Smith and Lewis, 2011). Consequently paradox-lens offers an extensive framework to observe them in detail without ignoring the organizational context. This is a fruitful starting place for observing the conflicts in MDM development. We use the model as a theoretical framework for observing and classifying the paradoxes from the case study.

Smith and Lewis (2011) propose that several primary questions should be asked when studying an organizational phenomenon, e.g., (1) what tensions are embedded within organizations, and how and why are they are experienced and (2) how are these paradoxical tensions managed? In this study, we focus on these questions as they emphasize the mechanisms of how the paradoxes are formed and should be worked through.

4 Research Methods

An ethnographic case study (following the instructions of Myers (1999), (Randall, Harper, and Rouncefield, 2007) was conducted in a municipality comprising of 220,000 inhabitants and approximately 14,500 employees. The municipality's services are produced using the multi-provider model, in which external companies and communities provide services alongside the city's own service providers. This operational model separates service purchasers from their providers. The case organization consists of central administration, purchasing unit, welfare services, municipal corporations and several subsidiaries. The MDM projects were mainly conducted in the central administration's IT unit.

The data collection period lasted from November 2010 to June 2013. During this period, two MDM projects were carried out, and MDM development became rooted as a part of routine operations. Data was collected by participating in all project-related meetings and informal discussions in both projects, and in the project preparation and procurement phases of the second project. The first author was actively involved in the first project as a member of both the steering group and the expert group. In the second project, the author acted as a project manager and as a member of the steering group. These positions offered unique opportunities to observe and thoroughly understand the implementation.

Diary entries were made weekly and whenever MDM-related issues were observed. In addition to observations, also questions that emerged and impressions were documented. Also different kinds of project documentation: procurement documentation, project plans, monthly status reports, and a set of memos from the working group, steering group, project portfolio group, stakeholder groups, and kick-off and closing seminars were also utilized to complement the diary. Between the two projects, memos from the IT development group and the architecture group were also used. Finally, some internal documents were utilized, such as information management strategy.

Ethnographies are expected to meet standards of objectivity even when ethnographic research is highly dependent on the individual's unique knowledge and experience, and his/her actions as a thinking agent who brings his/her subjectivity to bear on the construction of information and knowledge (Schultze, 2000). Although the first author made systematic entries to the diaries and annotated the documents throughout the project, all materials were analyzed at the end of the overall data collection in June 2013. The idea was to gain some distance between the researcher and the context, and to keep data entries as neutral as possible so that they were not limited or affected by the analysis of earlier entries. This was done to minimize unintended entry manipulation, as one may easily make subconscious decisions about what to record. However, because of the characteristic of ethnographical research (Randall, Harper and Rouncefield, 2007), the method remains quite subjective. The researcher being a data collector, an ethnographer, and a data analyzer is beneficial as in-depth contextual

knowledge helps one to consider emerging issues in the right context. This adds depth to the data analysis.

Because of the long data collection period and separate, intensive data analysis periods, data analysis can be regarded as content analysis, in which an external researcher makes his or her own interpretations. However, since the researcher also collected the data and "lived with the tribe," she was able to complement and interpret it within the organizational context. This made it easier to understand the organization's culture and social structures and their impacts, and to theorize the subject more richly and in more complex ways (Kemmis and McTaggart, 2005).

The first researcher analyzed the data by following the interpretive research approach and the principles of Klein and Myers (1999). The data was observed on an iterative basis, and issues were identified that could be categorized as *problems* and the context was identified as *mess* according to the paradox process model (Lüscher and Smith, 2008). Second, identical issues were grouped according to categories. These categories were then observed more closely, i.e. similarities and differences between the problems under same themes by applying the process model; the problems identified from the data are formulated into dilemmas by specifying the problems through the issues found from the data. Then these findings were collaboratively discussed among the authors of this paper. Finally, these findings were reflected against the literature.

5 Findings

To observe how the paradoxes appeared in the organization, our field study is reported as a vignette (Orlikowski, 2006). A vignette is a short description of the process for identifying a paradox in a certain situation. Vignette describes how the paradoxes appear during one development phase of MDM development. This phase defines the governance model, which took place from April to October 2011. Data governance development includes the changes in roles and responsibilities. The paradoxes presented as a vignette were chosen from the development of data governance, because such paradoxes were divided evenly over the whole development period. This enables us to gain a diverse perception of the different phases of the development.

5.1 Vignette: Defining the governance model

Paradox 1: Need to identify data owners, yet people remain committed to group specific functions and not to organization-wide development

Before the year 2007, units acquired their own applications. This resulted in large number of applications in the organization, but also unit specific data management practices. Similar data was generated in several places. Only few organization-wide information systems and common data maintenance practices were accomplished. The most prominent one was enterprise resource planning (ERP), which was implemented in 2006. This resulted that finance data and HR data were maintained in a centralized manner. However, the concept of data owner was not used. Consequently these two data sets were organized by process owners, responsible for the processes that produced the data.

In the first MDM project, the governance model was defined. It was planned to be implemented when the development proceeds. The ownership of data domains was one of the first defined issues. Several challenges were identified. Master data was produced in several places. The producers considered themselves as responsible for the data they generated. The concept of data owner was introduced to the project personnel. The concept was seen to be problematic, because finding a single responsible party was seen difficult. Project personnel and the steering group also discussed the possibility that the owner could be a group, instead of a person. The concern was that a group would not genuinely take the responsibility. On an individual level, it was unclear from which organizational level the person represent (executive management, unit manager, team lead etc.). It was also unclear how the process of formally recognizing the ownership would proceed and who would be able to appoint the responsibility. It was seen as important in the project steering group that all appointments were done through

official decisions and guidance, following the practices in the municipality. From the basis of the discussions, the problem "How could the data owners be recognized and formally pointed to the role?" was identified.

In some cases, an obvious data owner was not indicated. The data was produced in several places and this did not indicate the owner clearly, and several other aspects needed to be considered. These were, e.g., who is responsible for a function that uses the data primary and who gets the biggest advantage of the development. Master data was perceived to be bound within IS. At one point, it was proposed that the owner should be the IT service centre that administered the application associated with a data domain. The aim was to make as little changes to the organizational structure as possible. It was discussed that for some domains, it would be difficult to identify an evident solution but alternatives should be identified. The motivation was another factor under discussion. The business people involved in the project were worried that the role would be pretentious and the owner would not be responsible for the development of the domain in question.

The paradox was identified on the individual, group and organization levels. Commitment to group-specific functions and commitment to organization-wide development was identified as a tension between learning and belonging. The organization's units were siloed and each operating area had evolved their own data management functions over time. As a result, there were strong opinions of how things should be done. The units were ready to participate in the MDM development and even saw it as beneficial, but were reluctant to change their own practices that had evolved over time. When leaders consider the time horizon for their actions, they face learning tensions between looking forward and looking backward (Smith and Lewis, 2011).

Managing the uncertainty should have been done by identifying the individuals and groups that would benefit most through overall development of the data domain in question. MDM development should not be separate from function specific needs. By demonstrating the effect on their functions and how these effects cumulate into other functions in the organization, the owner is more motivated to the role. It is important to discuss what the role includes. The data owner has decision rights with regard to business requirements, use and definition on master data (Otto, 2012).

Paradox 2: recognized need for data governance, yet tasks and responsibilities are often avoided

Some of the units seemed to think that their input should only respond to their needs for the data and that "somebody else" should be responsible for the organization-wide data management. This indicated that the role should be on a level of the organization that could adopt the organization-wide perspective in addition to function-specific view. Some of the possible data owners were worried that they could not take responsibility for the data domain development. At this point, it was seen important to define the role more closely to clarify that the role was not operative. The role was identified as an individual on the executive or manager level. Some possible titles to measure the demands were also identified to help the implementation phase. The original problem was transformed into a dilemma: How can we ensure that data owners accept their responsibility and perform the tasks expected of them – will the owners accept responsibility or is a form of control required?

The issue of adopting the responsibility was considered by linking the options of taking responsibility and allocating it to others. Usually it is not an operational role (Bitterer and Newman, 2007). The officially named data owner has to take extensive responsibility of the data domain in question. Data owners are an important role when making changes to the existing responsibilities. This results again to the question of what the role includes. The organization should have a shared definition for the role. The data owner is typically from the management (Otto, 2011) and does not necessarily know, e.g., how the data is used in other functions of the organization. Because of this, responsibility should be allocated to others, e.g., management teams or data quality management (DQM) teams (Weber, Otto and Österle, 2009) can be used to share the responsibility.

Paradox 3: Recognized need for an organization-wide vision of master data, yet individual views remain the order of the day

A third problem that occurred when defining the governance model was a project related issue. Several of the people involved in the project were worried that they did not have the right kind of expertise that the project would need. Also the project steering group brought up the issue. The challenge was to define what kind of expertise was needed, because the project was introducing a new organization-wide data management function and there was practically no experience of such functions. The problem of identifying if the right people are involved in the project was recognized.

At the beginning of the first MDM project, the organization had not identified its master data domain or the responsible parties associated with them. Because of this, it was not clear who should be involved and what kind of expertise was needed in a certain domain. The assessment was made on the basis of the initial knowledge of the organization's core data and participants had been selected to represent these. It was acknowledged that this might emphasize some data areas more than others. This formed the problem into a dilemma: Is the organization and data domains presented in the group of participants or are there people representing only some of the domains and the scope will emphasize these? The paradox was formed by examining implications to critique of extensive knowledge and too specific knowledge.

This was categorized as tension between learning and belonging. Too detailed information could impede the discussion about the needed changes. These tensions are conflicts between the need for adaptation and change and the desire to retain an ordered sense of self and purpose (Smith and Lewis, 2011; O'Mahony and Bechky, 2006). The paradox seemed to be linked to the phase of the development and could be identified on all of the levels in the organization. The organization was only starting to establish the MDM function. A different level of information is needed throughout the process, but at this point it was better to maintain the discussion on a more generic level to understand the larger entity. There were not many who could understand, e.g., the situation of a certain data domain. With the missing data owners, the knowledge was scattered in units and operating areas. Later on, also more detailed knowledge was needed when the development continued to more specific areas.

Paradox 4: Manage the change from top-down and bottom-up, Paradox 5: Change and stability

The last two problems were identified in the final phase of developing the governance model. At this point, it had become more evident what the new roles and responsibilities would be. Up to this point, organizational practices for updating the data and creating new data entries had evolved differently in different business units. System administrators updated the data according to business units and their requests. The organization's management was reluctant to implement new roles and responsibilities, because units and individual employees or managers feared that the responsibilities would be added to the current workload. New responsibilities were seen as extra work and not as activities to improve processes and data quality. Also, some of the practices and efforts had become customary and personified. Under the circumstances, all attempts to change the situation would be perceived as negative. From the basis of these observations, the following problem was identified: How can we change the customary ways of working in maintaining master data and allocate the responsibilities? There were two different perspectives that could be identified from the dilemma. What was the best way to introduce to new responsibilities into existing roles and how the change should be managed to maintain the motivation. First perspective positions on the category of tension between learning and organizing, the latter on the category of organizing. Because of this, two paradoxes were formed: Manage the change from top-down and bottom-up, and change and stability.

With missing organization-wide data management practices, people responsible for maintaining data had developed their own ways of working independently. Implementing the new ways of working was seen problematic, but also maintaining them was seen challenging. This way managing the change was the most important aspect. The paradox occurred on the individual level and the organizational level, which also emphasized the polarization, i.e. how an individual sees himself or herself as part of the organization. If they feel that their work is an important part of the larger ensemble, it might be easier to motivate them. Tensions between learning and organizing are about the balance between control and flexibility (Smith and Lewis, 2011). In many occasions during the observation it was clear that

people producing and updating the data did not see how it would affect anything else except their own units work and functions. Because of this, it was only necessary to make sure the data would respond to these needs. This resulted in, e.g., using incorrect fields in applications because they were easier to use. Larger effects on functions such as reporting were not considered. These siloed functions had evolved into unit specific routines, and also created organizing paradox of tensions between routine and change (Flynn and Chatman, 2001; Gittell, 2004; Smith and Lewis, 2011). The proposed changes to form new roles and implement them to practice were seen as problematic, but there was agreement that change was needed. Managers may call for new routines, but cling to the comfort of extant practices (Lüscher, Lewis, and Ingram, 2006). New processes and the responsibilities that they positioned set a competing design for the customary ways of maintaining data. This sets a conflict between routine and change (Smith and Lewis, 2011; Flynn and Chatman, 2001; Gittell, 2004) and can be identified as an organizing tension.

5.2 Summary of paradoxes

The analysis revealed several issues that could be categorized as problems according to Lüscher and Smith's (2008) paradox process model. Problems occurred most often when the change efforts were discussed. They caused conflicts or misunderstandings. Similar issues were paired and observed simultaneously. Problems were observed and formed into competing choices, i.e., dilemmas, each with advantages and disadvantages. Dilemmas became paradoxical when options are contradictory and interrelated such that any choice between them is temporary and tension will resurface. Thirteen paradoxes were identified from the basis of the problems found from the data. These are presented in a chronological order in Table 1. The paradoxes that were observed more closely as vignettes, are highlighted in bold.

Mess	Problem	Dilemma	Paradox
The concept of master data is unclear	Responsibilities for managing the quality of master data have not been clarified	Who should manage the quality of master data – IS operations or business processes?	Enhancing data quality through business processes is recognized as being important, yet data quality management is still often left to be resolved (only) by regular IS operations
Only few people are involved in, or aware of MDM	Only IT-people participate in the MDM project?	Should MDM be clearly an IT-project or is the IT unit the wrong place to manage the project?	MDM is recognized as being a business function, yet is still profiled as an IT project
Ownership of master data is unclear	**It is difficult to recognize and appoint data owners**	**How can data owners be recognized and formally appointed to the role – should data owners be domain specific or cross-domain?**	**Need to identify data owners, yet people remain committed to group specific functions, not to organization-wide development**
Governance of master data is unclear	**People do not know how or do not want to perform responsibilities associated with ownership**	**How can we ensure that data owners accept their responsibility and perform the tasks expected of them – will owners accept responsibility or is a form of control required?**	**Although, there is a recognized need for data governance, yet tasks and responsibilities are often avoided**
It is unclear which knowledge and capacity is required for an MDM project	We do not know if we have the right people working for the MDM project.	Do we have the right people working on the MDM project – is it important that the participants represent all the data domains or are only a few domain	MDM is recognized as being an organization-wide project, and people involved have extensive knowledge about their own domains, yet often

		experts required?	not all domains are represented
The goals of MDM development are unclear	There is no mutual understanding regarding the goals of MDM development	How can mutual understanding of the goals of MDM development be achieved - do all of the participants understand the overall effects that the development could have or are they focused on the ones that affect their area on interest?	There is a recognized need for a specific MDM function, yet it remains unclear how MDM differs from regular data management practices
Executive management are inadequately aware of MDM	It is unclear how the executives should be informed	How should executives be informed - should single business cases or overall data enhancement be emphasized?	It is important to keep executive management informed, yet communication with the executive branch remains minimal
The organization-wide master data domains are not fully understood	**There is no mutual understanding of the organization-wide master data domains**	**Are there too many unit specific opinions of additional master data domains, or should the attempt be made to incorporate all opinions?**	**There is a recognized need for an organization-wide vision of master data, yet individual views remain the order of the day**
Master data criteria are not enforced	The organization is not committed to the master data criteria.	How can the organization be committed to the master data criteria - is the criteria understood and approved or should there be changes made to it?	Although the organization needs to commit to the master data criteria, yet people are still unwilling to demonstrate that commitment
It is unclear how to deal with partisanship in the organization	Will IT work as a neutral operative owner	Is IT unit neutral enough or will the unit's role as an owner of IS interfere?	Neutrality is an important aspect to MDM, yet partisanship is a real threat to MDM
Allocating new roles and responsibilities for MDM	**How can we allocate the new responsibilities?**	**Should the responsibilities be allocated through management or should we try to discuss with the employees about new tasks first?**	**Manage the change from top-down and bottom-up,** **Change and stability**
The maturity levels of the organization regarding MDM are uncertain	It the organization is mature enough for an organization-wide MDM	Is the organization mature enough for organization-wide data enhancement or are the units still too siloed?	Recognized need for mutual MDM practices, yet siloed functions continue unchecked

Table 1 Problems, dilemmas and paradoxes, the vignettes are bolded.

6 Discussion

6.1 Categorized paradoxes

The summary of paradoxes categorized under ten categories presented by Smith and Lewis (2011) is presented in Figure 2. Several similarities could be identified of the found paradoxes. Some of the problems were similar and surfaced under the same themes. These were presented as individual problems; the differences could be distinguished later on in time when the problems were formed into dilemmas and eventually to paradoxes. Themes to classify the initial problems were identified in order to assess how paradoxes that emerge from these problems would later on be categorized using the ten categories according to Smith and Lewis (2011). In other words, would there still be similarities between the paradoxes that initially emerged from similar problems.

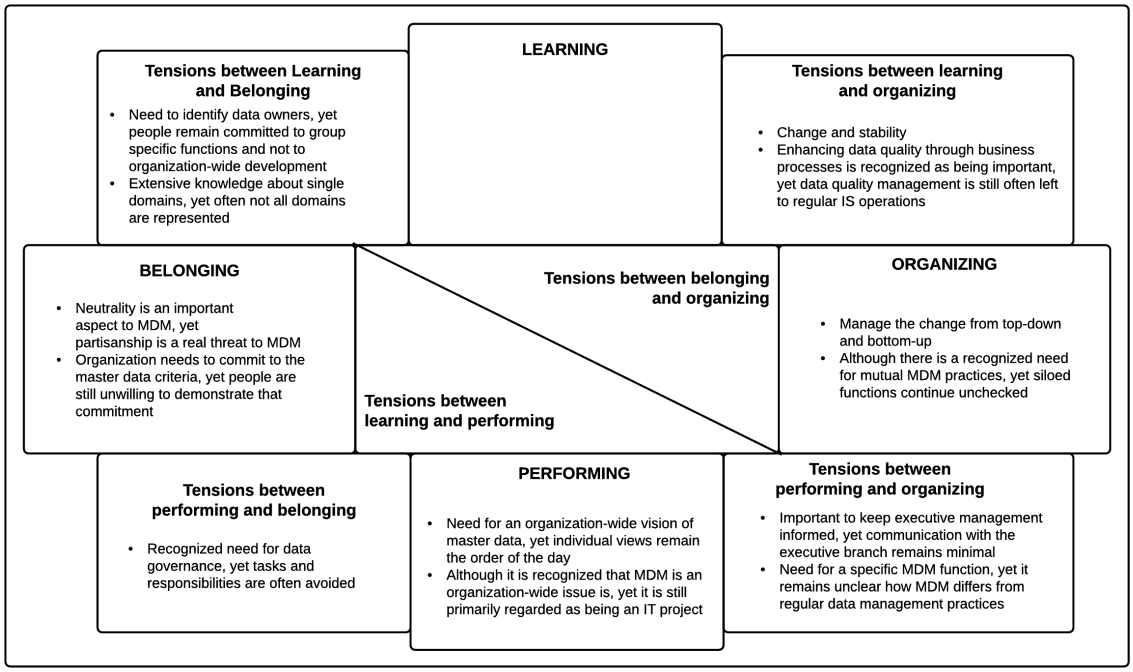

Figure 2 Categorized paradoxes

Other groups of problems were related to roles and responsibilities: 1) it is difficult to recognize and appoint data owners, 2) if the IT is named as an operative owner, will it be neutral, 3) master data governance is unclear, and 4) how should new responsibilities be allocated? The problems look similar, but several sub-themes, such as the level and sharing of responsibility, and the roles of the operative owner and management, differentiate them. The categorization of the paradoxes shows that they occur in different areas. They were scattered under four categories: learning and belonging, belonging, Organizing, and learning and organizing. Three were identified in the main tensions of learning, organizing, and belonging. The remaining problems were separate.

6.2 The emerging levels for paradoxes

The categorization and level classification were used for working through the tensions, as summarized in Table 2. Paradoxes emerge on different levels of the organization: individual, dyad, group, project and organization (Smith and Lewis, 2011). Paradox emerges in the interaction between individual and organisational levels (Fiol, 2002). Each of the paradoxes was identified from a certain context. The level demonstrates how the tensions are embedded within the organization, and how they are experienced (following Smith and Lewis, 2011). Forming the paradox to a more workable certainty is done by strategic questioning (Lüscher and Smith, 2008). Smith and Lewis (2011) argue that paradoxical tensions should be embraced by the strategy of "working through", and they should be resolved by iterating responses of splitting and integration continuously. Strategies for coping with the paradoxes become often paradoxical (Stoltzfus, Stohl, and Seibold, 2011). Thus working through the paradoxes is emphasised as the engagement, not avoidance, with the paradox is associated with organizational effectiveness (Cameron and Quinn, 1988; Poole and Van de Ven, 1989).

Paradox	Level*	Working through the tensions
Enhancing data quality through business processes is important, yet data quality management is still often left to regular IS operations	I,O	Plan and implement the new processes by using the current applications. Demonstrate how the existing application infrastructure will be part of the MDM and will also evolve as a result of the development.

MDM is recognized as being a business function, yet is still profiled as an IT project	P	Find clear areas of expertise needed in the project; use these areas for engaging people, instead of talking only about MDM project that can seem ambitious. Build the business cases on different levels and show the dependencies between the cases.
Need to identify data owners, yet people remain committed only to group specific functions and not to organization-wide development.	I, G, O	Identify the individuals and groups that could achieve the most through overall development of a data domain in question. Tie the function specific development to the overall MDM development and demonstrate how they could affect the development as an owner.
Need for data governance, yet tasks and responsibilities are often avoided	I	Data owner's responsibility can be partially allocated to others. Management teams or DQM teams (Weber, Otto and Österle, 2009) can be used to share the responsibility.
Extensive knowledge about single domains, yet often not all domains are represented	I, D, G, P, O	The use of experts should be scheduled to respond to the phase of development. A different level of information is needed throughout the process.
Need for a specific MDM function, yet it remains unclear how MDM differs from regular data management practices	I, O	Present how a single data maintenance tasks accumulate (especially if there is a mistake in the data) in the organization and how large the amount of data is that should be managed.
Important to keep executive management informed, yet communication with the executive branch remains minimal.	I, D, G, P, O	Clarify both, the data governance and application development objectives. Emphasizing the application might distort the objectives and seem irrelevant.
Need for an organization-wide vision of master data, yet individual views remain the order of the day	I, G, O	Demonstrate the effects of common master data groups to units and emphasize the importance of function specific data and its own data manage practices.
Need to commit to the master data criteria, yet people are still unwilling to demonstrate that commitment.	I, G, O	Motivate people to understand the need to identify mutual master data sets by demonstrating how this kind of data affects mutual processes.
Neutrality is an important aspect to MDM, yet partisanship is a real threat to MDM	G, O	Take into account the potential bias and try to emphasize the other aspects. Assemble DQM-team representing other areas of MDM to support the operative owner's work.
Manage the change from top-down and bottom-up	I, G, O	Create optimal conditions where management and teams willingly take on new responsibilities.
Change and stability	I,G,O	Changes in the roles and responsibilities streamline the processes and reinforce the stability.
Need for mutual MDM practices, yet siloed functions continue unchecked	I, D, G, P, O	Use the units practices to form mutual processes for MDM

*Table 2 Managing paradoxes and the level that they occur on (*I= Individual, D = Dyad, G=Group, P=Project, O=organization)*

In Table 2, the level of analysis illustrates what organizational level should be considered when working through the tensions. The existence of a paradox does not automatically generate change; they can also paralyze and lead to inaction (Fiol, 2002). Yet, the development often needs changes to proceed. Working through the paradoxes helps to ensure the success of the change progress. Many of the paradoxes, such as paradoxes of *managing the change top-down and bottom-up*, *recognized need for an organization-wide vision of master data, yet individual views remain*, and *organization needs to commit to the master data criteria, yet people are still unwilling to demonstrate that commitment* were related to conflicts between an individual or group and the organization. Many emerged from individual values that clashed with the intended changes. When more people see themselves mirrored in their organization, the organization's identity becomes more salient and member identification is enhanced

(Fiol, 2002). Individual and social defence mechanisms are unconsciously utilized to defy change (Vince (1996). Still there were no paradoxes in the category of belonging and organizing, which is often seen as a source of tensions between the individual and aggregate (Smith and Lewis, 2011). Another surprise is that there were no paradoxes in the category of learning and performing, which Smith and Lewis (2011) describe as building capabilities for future while ensuring success in the past.

Independent units in the organization explain the tensions in the changes in responsibilities and in the master data concept. For example, many units had certain applications they preferred. They refused to exploit organization-wide IS, or if obligated, used them only for the minimum requirements. The units were possessive about their specific applications and data that were usually used only by few units. Working through the tensions sheds light to the question of how these paradoxical tensions are managed. Workable certainty could be navigated further on to sense-making. Jay (2013) argued that sense-making is affected by paradoxical outcomes, organisational identity, and external perspectives.

7 Conclusion

The purpose of this study was to identify paradoxes in a MDM development process and the factors that contribute to their emergence. Thirteen paradoxes and their causes were identified. Most paradoxes could be labelled under the core concepts of MDM, such as governance or maintenance processes. One phase from the development process, data governance development, was chosen to study paradoxes more closely. This was done to understand the mechanisms that lead to paradoxes. Five paradoxes were observed closely, using a vignette as an illustrative example. This analysis demonstrates how they emerge as problems that evolve into paradoxes.

Identifying the level of analysis for the paradoxes foster the working through process. Most of the paradoxes emerged on the individual, group or organization level. This emphasizes the impact of MDM on different organizational levels. It also implies that MDM is actually multi-dimensional, bridging several traditional functions. The identified level helps to understand the polarization and how the paradoxical tension should be resolved. Paradoxes were identified from most of the categories (organizing, performing and belonging) and also tensions between them were identified. This emphasizes MDM as an organizational function.

The identified tensions can point out the problematic areas of development and working through these indicates what should be done to overcome the conflicts. In this way, it offers practical guidelines to manage certain area of the function. For example, the organization lacked a group that would be responsible for the data quality management. Many of the paradoxes were related to conflicts with responsibilities. Such a group could support the operative owner, data owners and process owners to accomplish what the organization MDM requires.

This paper offers new insights into research and use of theories of paradoxes. The research is an interesting example of how to use the process model for data analysis for identifying the paradoxes. Instead of discussing and forming the paradoxes, the questions were used as a tool for the data analysis. Also using the tensions between the main paradoxes of learning, belonging, organizing, and performing offers new insights to the process model. On the practical level, it offers insights for public sector or private sector professionals that are planning to introduce MDM or already have MDM projects underway.

This research was a single case study, and caution should be exercised with regard to generalizations. A limitation of the present study may be its focus on the public section, with the result that the findings may not be extrapolated to the private sector. For future research, there are several different paths to explore. It would be interesting to observe more closely the similarities and dependencies between the paradoxes. From the MDM research perspective, an organization in a more mature phase could offer new insights and it would be particularly interesting to observe whether similar results to the present study are found in a private sector organization. As a fairly new framework, the theory of paradoxes could be observed in several different contexts and thereby defined further on.

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V

CHANGES ON ROLES, RESPONSIBILITIES AND OWNERSHIPS IN ESTABLISHING ORGANIZATION'S MASTER DATA MANAGEMENT FUNCTION.

by

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Changes in Roles, Responsibilities, and Ownerships in Organizing Master Data Management

Riikka Vilminko-Heikkinen

Department of Information Management and Logistics, Tampere University of Technology

riikka.vilminko-heikkinen@iki.fi

Samuli Pekkola

Department of Information Management and Logistics, Tampere University of Technology

Abstract:

Master data management (MDM) is a data management practice which attempts to increase data quality and data use across business processes throughout the organization. This paper observes how data ownership, responsibilities, and roles change during MDM development. Sociomateriality was used as a theoretical lens to identify the factors that influenced the change, and to analyze the change as a result of the intertwined social and material factors. We derive ethnographical data from two MDM projects in a municipality over a time period of 32 months, and describe how data ownership and data governance roles and responsibilities were perceived, and how they evolved during the development. As a result, MDM data ownership is emphasized, and has distinct features in relation to roles and responsibilities. Ownership had on impact on how the development proceeded, and how the roles and responsibilities evolved.

Keywords: sociomateriality, imbrication, critical realism, affordances, constrains, material agency, human agency, master data management, MDM, data governance, data ownership

1 Introduction

Organizational change has been studied intensively over the past decades (Burke, 2014). In the information systems (IS) context, socio-technical change is widely used to explain the changes in IS development (ISD). The socio-technical change model (Leavitt, 1965) and the punctuated socio-technical information systems change model (PSIC) (Lyytinen and Newman, 2008) both explain different elements of change, with the latter also emphasizing the change process. Van de Ven and Poole (1995) explain the processes of change in organizations through concepts of life cycle, teleology, dialectics, and evolution to distinguish the level and mode of change. Very often IS-related change is studied in development projects, which induce changes in the technology and in the ways in which the work is done (Leonardi, 2011). This also implies that the change has an impact on technologies, people, processes, and data.

It has been noted that changes also affect the technology, process, and ownership of data, and the corresponding roles and responsibilities (Burke, 2014). Nevertheless, a large part of the research ignores these by focusing on the change itself, or on the change process (Burke, 2014). Understanding the factors affecting and contributing to change could consequently offer new insights. In particular, studying different roles and responsibilities that are significant in ISD as they bind the IT artifact to the organization could be a fruitful approach (Avgerou, 2001).

Orlikowski and Scott (2008) presented sociomateriality[1] as an approach to observe the relationship between technology and work practices. Sociomateriality challenges conventional views of technology, and observes organizational and technological change as interwoven (Leonardi 2011). Sociomateriality takes the sociotechnical approach a step further and observes how changes occur in technology and routines, and identifies the material and social agencies that accelerate it. This also emphasizes the roles and responsibilities within the change process, making sociomateriality an appropriate lens to analyze the change. In addition to sociomateriality, theories of change are also discussed in order to understand the change mechanism before observing the factors affecting it.

This paper consequently studies how the changes in ownership, roles, and responsibilities evolve in a development project, aiming to improve data management practices in an organization. We use sociomateriality as a theoretical lens to identify the factors influencing the change, and to observe whether the change is a result of intertwining social and material factors. The study is based on an ethnographical observation of a development process, where an organization is establishing a master data management (MDM) function. In particular, we observe the phases where data ownership, roles, and responsibilities are changed and evolve. MDM aims to ensure that organization's core data is reliable, available, and usable across the organization. It requires an organization-wide approach to development, underlining not only the

[1] We acknowledge different views on sociomaterialy. In this paper, we will rely on Leonardi's (2011) interpretation as it offers a practical framework for observing the data governance phenomenon by considering the material and social agencies through the metaphor of imbrication, where the social and material are interwoven.

technological development but also the understanding of people, work processes, governance and management structures, and data and information (Baghi et al. 2014). The connection between MDM and ownerships, roles, and responsibilities is clearly evident.

The paper is organized as follows. First, we review previous literature. Next, our theoretical lens; Leonardi's (2011) approach to sociomateriality, is briefly presented. We then describe the research case and research methods. The next section provides empirical findings. The paper ends with discussion and concluding chapters.

2 Background

2.1 Master Data Management (MDM)

The amount of data has long ago exceeded organizations' ability to manage it. This is because the complexity of managing data increases when data volumes increase (Watts, Shankaranarayanan and Even, 2009). The data is usually also spread out to numerous systems and databases, making its management even more challenging.

Master data management (MDM) is a data management practice. It aims to ensure the quality of data in the organization by managing the organization's core data, referred to as "master data." MDM tackles data issues by placing the focus on business processes, data quality, and IS standardization and integration (Silvola et al., 2011). It is a collection of data management practices that are orchestrated by key stakeholders, other participants, and business clients (Loshin, 2009). MDM is consequently an ensemble of methods that target fragmented data, stored in numerous databases and siloes within the organization (Poolet, 2007).

MDM utilizes business applications, information management methods, and data management tools to implement policies, services, and infrastructures to support capturing, integrating, and sharing accurate, timely, consistent, and complete master data (Vilminko-Heikkinen and Pekkola, in progress). MDM defines the most important, trusted, and unique version of enterprise data, and very often this data comprises information about customers, products, employees, or locations (Karel et al., 2006).

Establishing an MDM function is not a synonym for acquiring an MDM system. Research as well as professional reports and practices all emphasize that MDM is both an organizational issue and a technical issue (Vilminko-Heikkinen and Pekkola, 2012). In fact, MDM development is an organizational challenge more than a technological challenge (Vilminko-Heikkinen and Pekkola, 2013), similar to any alignment attempt in an organization (Radcliffe, 2007).

2.2 Change in Ownership, Roles, and Responsibilities

Change has been observed from different perspectives; for example, organizational change (e.g Orlikowski, 1993, Van de Ven and Poole, 1995), IS change (e.g., Robey, Ross and Boudreau, 2002), management of change (e.g., Aladwani, 2001), and technical change that was eventually observed to be socio-technical

change (e.g., Doherty and King, 2005). Socio-technical change observes the change through the continuous, intertwined interaction of technology and people. After Leavitt's (1965) socio-technical change model and its four interacting elements (actors, task, technology, and structure), Lyytinen and Newman (2008) developed a punctuated socio-technical information systems change model (PSIC) to understand the change in ISD. They view change as a socio-technical change process in which technologies, human actors, organizational relationships, and different tasks all change, seeking equilibrium. In addition, IT-enabled organizational change has received a lot of attention (e.g., Benjamin and Levinson, 1993; Markus and Benjamin, 1997; Markus, 2004). There the emphasis has been on the IT artifact, i.e., technology, and how it is linked to people, tasks, structures, and leadership processes.

The change can be observed through the content (what), which provides the overall direction for the change, and through the process (how), which describes the implementation, development and adoption of change (Burke, 2014; Van de Ven and Huber 1990). Van de Ven and Poole (1995) have presented life cycle (regulated change), teleology (planned change), dialectics (conflictive change), and evolution as four basic theories to explain processes of change in organizations. The process models differ in terms of whether they apply to single or multiple organizational entities and in the mode of change, i.e., whether the change process follows a prescribed sequence or is constructed as the process unfolds (Van de Ven and Sun, 2011). Burke (2014, 21) defines two types of organizational change: revolutionary and evolutionary change. Revolutionary change requires dramatic modifications, while evolutionary change makes incremental improvement measures. The form of organizational change can be identified as radical, incremental, or punctuated equilibrium, when described in terms of the magnitude and pace of change (Boudreau and Robey, 1999). The radical view describes organizational change as fundamental and discontinuous, the incremental view as consisting of minor improvements or adjustments, and the punctuated equilibrium view combines elements of both, treating change as alternating between radical and incremental periods (Boudreau and Robey, 1999).

In order to succeed in any change endeavor, it need to be managed properly. This underlines ownership, roles, and responsibilities, which have been studied from different perspectives. In the IS field, the emphasis has been on IT governance research (e.g., Rau, 2004) and ERP-related research (e.g., Al-Mashari, 2003). Roles and responsibilities have been studied, especially in projects (Al-Mashari, 2003) or as IT leadership roles (e.g., Chun and Mooney, 2009). Changes in ownership, roles, and/or responsibilities have been studied especially from the change management perspective (e.g., McAdam and Galloway, 2005), where the emphasis is on the management aspect, not on understanding the change phenomenon or its factors.

In the context of MDM, ownerships, roles, and responsibilities are emphasized. Those are usually considered through data governance, which aims to set policies and procedures to support building and maintaining master data (McKnight, 2009). Dreibelbis et al. (2008) see data governance as being a part of MDM. They describe it as a process of changing the organization's behavior to enhance and protect data as a strategic asset. Therefore, data governance provides a process and structure for managing information as an organizational asset (McGilvray, 2006; Cleven and Wortmann, 2010). This requires the abandonment of different business siloes and creating intensive collaboration between business and IT units, which in turn

places MDM in the core of social processes in the organization. Data governance addresses both organizational and technical perspectives, demanding leadership, authority, control, and allocation of resources (Lucas, 2010). This emphasizes responsibilities and tasks assigned to different roles. Otto (2011) includes organizational transformation, which includes the transformation process and organizational change, in the conceptual framework of data governance organization.

Identifying a primary business owner for any data item or domain is one of the key issues in MDM initiatives (Smith and McKeen, 2008). The term data owner has been criticized, as it suggest that data "is owned" by a certain function or division, contradicting the view of data as a company-wide asset, owned by the enterprise as a whole (Otto, 2011). However, the definitions for data ownership are often inadequate or completely lacking (Silvola et al. 2011). Data ownership can thus be regarded as the CIO's task, as data is associated and stored in certain IS. Yet data is used by the business people in business processes, indicating that ownership should be associated with the business processes. Nevertheless, several decisions by the data owners require explicitly defined responsibilities (Moss, 2007). These decisions are related to domains and valid values, data availability and accessibility, different timescales and actors, security policies, and the frequency of updates. Unclear data ownership might result, for example, in inadequate process definitions, which hamper data maintenance (Silvola et al. 2011).

MDM roles from earlier research are listed in Table 1. Many roles relate to data governance in general, but here they are considered in the MDM context.

Table 1 Roles in MDM

ROLE	DESCRIPTION	REFERENCE
Executive sponsor; MDM operational owner	Provides sponsorship, resources, and strategic direction for MDM.	Weber, Otto and Österle, 2009; Vilminko-Heikkinen and Pekkola, 2012
MDM concept owner, Chief steward, Director of data management, Master data coordinator	Responsible for MDM development.	Vilminko-Heikkinen and Pekkola 2012; Weber, Otto and Österle, 2009; Dyche and Levy 2006; Swanton, 2005
Data owner	Data owners are responsible for the data domain assigned to them. They make the final decisions regarding the data set, its maintenance and development.	Hüner, Ofner and Otto, 2009; Khatri and Brown, 2010; Smith and McKeen, 2008; Silvola et al. 2011; Weber, Otto and Österle, 2009; Loshin, 2009, Otto, 2012
Data steward (IT)	Provides standardized data element definitions and formats, technical perspective on data flows and application details.	Weber, Otto and Österle, 2009; Loshin, 2009
Data steward (business), Information steward	Governs data standards and policies for his/her data domain from business perspective.	Smith and McKeen 2008; Weber, Otto and Österle, 2009; Loshin, 2009, Smith and McKeen, 2008; Knolmayer and Röthlin, 2006; Karel, 2006; Silvola et al., 2011; Otto, 2012; Khatri and Brown, 2010
Data governance council, Data quality board	Controls the data governance framework development and implementation.	Otto 2011; Weber, Otto and Österle, 2009; Dyche and Levy 2006

Despite the evident importance of the topic, changes in ownership, roles, and responsibilities in MDM have not received broad attention in academic research. Still, they are a significant part of organizational change, such as establishing an organization's MDM function (Vilminko-Heikkinen & Pekkola, 2013). We will observe

how they evolve during the MDM development process, and which factors contribute to this change. We will adapt sociomateriality as a lens, as it consists of both the social aspect of MDM (processes, practices) and its material component (data). In particular, adopting Leonardi's model (2011) of imbrication of human and material agencies helps us to dissect the contributing factors.

3 Theoretical Lens

Sociomateriality can be seen as a perspective or a research stream (Orlikowski, 2007) or as a meta-theory (Mueller and Raeth, 2012). Orlikowski and Scott (2008) see that the social and the technical are inherently inseparable and can be separated only analytically, but they do not explain how this analytical separation can be carried out in practice (Kauz and Blegind Jensen, 2012). Different lenses can be used, and in this research, our interpretation of the sociomateriality lens is based on the theory of critical realism. This study draws on lens of the 'affordances and constraints', where affordance assume that possibilities for action are not pre-defined, but are dependent on the technological properties that can be offered as the material and enacted with the intent of human actors (Leonardi, 2011).This allows us to view social and material entities separately, illustrating an analytical difference between human and non-human agencies (Mutch, 2013; Leonardi, 2013), and that they are distincts elements of overlapping patterns (Leonardi, 2011). Leonardi (2013) suggests that the researchers using sociomateriality and critical realism need to specify what they mean by "social" and "material," and how these become the sociomaterial. He also emphasizes the role the actors play in the creation of the sociomaterial over time. In the MDM context, data can be seen as a material agency, while activities, processes, practices, and people form a social agency. Data is created, modified, interpreted, and used by and within those social actors and processes. This means the actors are crucial elements in the evolution of the sociomaterial assemblage.

There is a mutually constitutive relationships between the social and the material (Leonardi 2011; Leonardi and Barley 2008). All materiality is social because it is created through social processes, and it is interpreted and used in social contexts (Anaya, 2013), but all social actions are possible because of some materiality (Leonardi, 2011). Human action is consequently not just dependent on materiality and material artefacts, but is constituted by them. Organizational practices are thus sociomaterial practices (Doolin and McLeod, 2012). Leonardi (2012) suggest that sociomateriality is not a property of a technology but of its recognition, since the technology is enmeshed in a variety phenomenon (e.g., decision making, strategy formulation, categorization) that are often defined as "social." Understanding, changing, and studying individual technological components will thus be extremely difficult because they are integral parts of sociomaterial assemblages (Hedman, Srinivasan and Lindgren, 2013).

Leonardi (2011) proposes using the metaphor of imbrication to understand how the material and the social are brought together to form the sociomaterial. The term imbricate means arranging elements in overlapping patterns so that they function interdependently (Leonardi, 2011). Hence, imbrication accepts the separability of the social and the material but sees them as interlocked or interwoven (Kauzt and Blegind Jensen, 2012; Leonardi 2011). The social and the material become sociomaterial as people imbricate social and material agencies (Leonardi, 2013). The concept of affordance explains why and how human and material agencies

become imbricated (Leonardi, 2011); although the material properties of a technology are common to each person who encounters them, the affordances are not. They are unique to the particular ways in which an actor perceives materiality (Leonardi, 2011). People's goals are formulated by their perceptions of what a technology can or cannot do. Those perceptions are shaped by different goals, which are reconciled with the materiality of a technology according to their personal goals. Perceptual affordances and constraints are actively constructed and used in imbricating social and material agencies (Leonardi, 2013).

Leonardi (2011) describes affordances as "not exclusively properties of people or of artifacts...[but] constituted in relationships between people and the materiality of the things with which they come in contact." Volkoff and Strong (2013) define the term affordance (originated with Gibson, 1986) to refer to what is offered, provided, or furnished to someone or something by an object. This means materiality exists independent of people, but affordances and constraints do not (Leonardi, 2013).

4 Research Settings

This case study is conducted in a municipality of 213,000 inhabitants and approximately 15,000 employees. The organization consists of a central administration, a purchasing group, welfare services, municipal corporations, and several subsidiaries. The MDM development was mainly conducted in the central administration, in the IT unit.

The study follows the ethnographic research approach (Randall, Harper and Rouncefield, 2007). Ethnographic research is one of the most in-depth research methods, as it enables the researcher to obtain a deep understanding of the people, the organization, and the broader context within which they work (Myers, 1999). Compared to case studies or interviews, ethnography adds the dimension of personal observation (Brown, 2014). This can enable the level of detail in data collection that is not available through other data collection methods (Brown, 2014). Ethnographic research can provide IS researchers with rich insights into the human, social, and organizational aspects of ISD (Harvey & Myers, 1995, p. 22). The method can be appropriate for understanding the implementation of a new ICT artifact, and the clashes of culture and values either within the organization or with other stakeholders that the change can cause (Brown, 2014). For example, studies of system implementation and adaptation have traditionally been ethnographical (Lyytinen and Newman, 2008, Miscione, 2007, Schulze 2000; Schulze and Boland, 2000), research of developing IS has relied on ethnography (e.g., Myers and Young, 1997, Orlikowski, 1991, Preston, 1991, Lee & Myers, 2004), and the relationship between IS and organizations has been studied through ethnography (Orlikowski, 1991; Orlikowski & Robey, 1991).

Ethnography attempts to understand how the practices are taken and comprehended "in the field." Ethnographers seek to place the phenomenon studied in its social and cultural context (Myers, 1999). The researcher's role can be identified as what Walsham (1995) has describes as "involved researcher." This offered unique opportunities to observe and understand the development while also participating in it. The strength of the method is that the researcher is able to gain an in-depth understanding of the people, the organization, and the broader context of the phenomenon (Myers, 1999). In order to achieve useful results,

the complexity of the organization should be incorporated into an understanding of the phenomenon instead of being ignored or simplified (Martin and Turner, 1986).

Ethnography is never neutral, because the researcher has a significant role in the interpretations (Blomberg et al., 1993). Ethnographers need to balance subjectivity and objectivity. Ethnographies are expected to meet standards of objectivity even when ethnographic research is highly dependent on the individual's unique knowledge and experience (Schultze, 2000). In this study, an attempt was made to keep the data entries as neutral as possible, not limited or affected by the analysis of earlier data entries. The aim was to minimize unintended entry manipulation caused by subconscious decisions about what to record.

Research data was collected during the time period of November 2010 to June 2013. The data collection period bridges the timespan of two MDM projects. The first project, to establish the organization’s MDM function, started in November 2010 and ended in October 2011. The first author was actively involved as a member of the steering group and the expert group. In all, 32 persons were actively involved from the organizations’ different support functions (IT, human resources, business administration, and procurement) and all core processes. Two experts were from municipal corporations, and two vendors were involved as a consulting party. The second project, to acquire a technical solution for MDM, started in April 2012. The first author acted as a project manager and as a member of the project group and steering group. 14 persons were actively involved from different functions of the organization (e.g., IT, HR, finance), and a vendor was involved as a consulting party. The timeline for data collection is presented in Figure 1

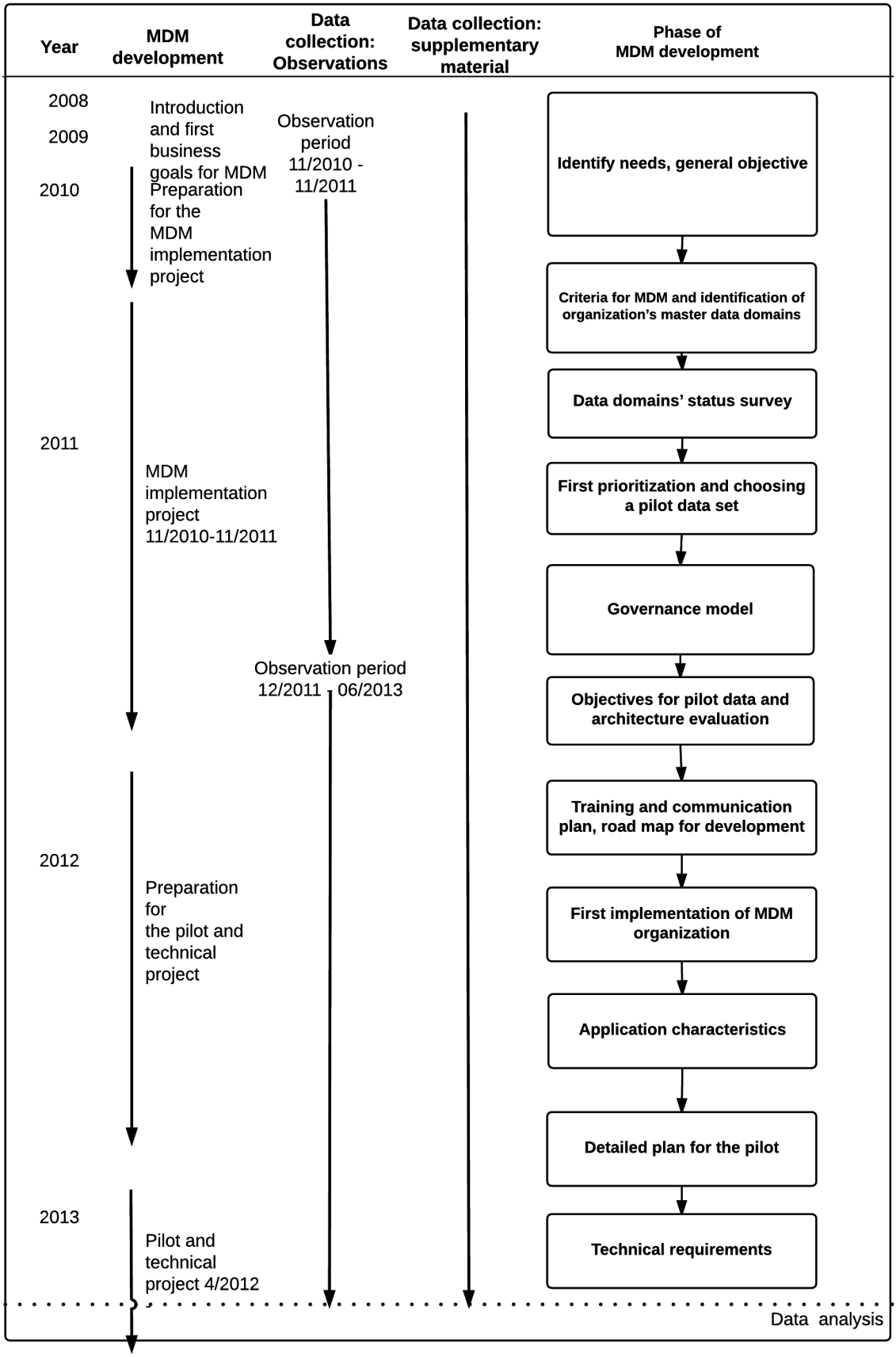
Year
MDM development
Data collection: Observations
Data collection: supplementary material
Phase of MDM development
2008
2009
2010
2011
2012
2013
Introduction and first business goals for MDM
Preparation for the MDM implementation project
MDM implementation project 11/2010-11/2011
Preparation for the pilot and technical project
Pilot and technical project 4/2012
Observation period 11/2010 - 11/2011
Observation period 12/2011 - 06/2013
Identify needs, general objective
Criteria for MDM and identification of organization's master data domains
Data domains' status survey
First prioritization and choosing a pilot data set
Governance model
Objectives for pilot data and architecture evaluation
Training and communication plan, road map for development
First implementation of MDM organization
Application characteristics
Detailed plan for the pilot
Technical requirements
Data analysis

Figure 1 Timeline for data collection and development process

Consequently, in the spirit of ethnography, our data consists of the first author's diary on significant daily events and a set of documentation (emails, plans, minutes, etc.) to support the diary. Summary of the data collection is presented in Table 2.

Table 2 Summary of data collection

Observations	
- Project activities (first project)	Activities were observed around Request for Information (RFI) document preparation, project management, project plan preparation, project implementation, and vendor engagement and evaluation.
- Project activities (second project)	Activities were observed around project plan preparation, Request for Information (RFI) document preparation, project implementation, and vendor engagement and evaluation.
- Field notes/diary	Observations were recorded weekly from formal and informal discussions. 137 formal meetings (236 h) were observed, including vendor meetings and demonstrations, project-related meetings, and workshops for defining requirements.
Documents	
- Project documentation (first project)	This included procurement documentations, project plan, monthly status reports, different memos (working group, steering group, project portfolio group, and stakeholder groups, and kick-off and closing seminars), and emails. Project documentation reviewed included RFI document, vendor RFI responses and product information, tendering documentation, vendor evaluation reports, monthly reports, project-related emails, and the final report of the project.
- Project documentation (second project)	Project documentation reviewed included RFI document, vendor RFI responses and product information, vendor evaluation reports, monthly reports, and project-related emails.
- Organizational documentation	IT-strategy, BI status report and working materials of the status report, Enterprise architecture (EA) documentation
- Public documents	Public documentation of the organization

The data analysis was conducted in summer 2014, more than three years after the first data collection had begun. This was chosen to minimize subconscious entry manipulation. An interpretative research approach was adopted; this acknowledges that the researcher can never assume a value-neutral stance, and is always implicated in the phenomena being studied (Orlikowski and Baroudi, 1991). The following process was followed in the data analysis: First, the phases of the MDM process were identified and mapped into a timeline, and several themes were identified. Next, similar themes were grouped. Third, the themes' ownership, roles, and responsibilities were used to identify related issues about and around them. These themes were also presented in a timeline, and compared to the actual MDM process timeline. This enabled us to identify the development phases where the themes were significant. Sociomateriality and the definition of social agency and material agency were used to examine the relationships and imbrications between them and the themes.

After these steps, we re-examined the data critically and drew new meanings from it. This allowed us to form an in-depth understanding about the ownership, roles, and responsibilities, and about their evolution,

in the context of MDM. This approach made it possible to analyze the data systematically, even though it originated from different sources (observation notes, several documents).

5 Findings

5.1 Phases of MDM Development

The process for establishing and developing the organization's MDM function, and how ownership, roles, and responsibilities evolved there are presented in Figure 2.

Identifying needs and general objectives

The motives for the MDM development were data quality problems with core data that was used by all the main business processes. The most severe issues were duplicate data and data access. It was assumed that these problems originated from both processes and applications. In addition, several business objectives for MDM were identified. These were more effective work (streamlining work processes and the organization), improved reporting (improving the accuracy, timeliness, and quality of the data), and enhancing SOA interoperability. Lastly, some more generic objectives, such as providing processes for data collection, integration, consolidation, quality assurance, and distribution to ensure data integrity, maintenance, and the application of information usage control mechanisms, were recognized.

Establishing an MDM function was started by mapping the MDM needs. These needs and objectives formed the requirements for the first MDM development project. A new requirement was the need for data owner. Different responsibilities were considered throughout the processes, but were not clearly managed earlier. In particular, the roles for managing and maintaining the data were not defined. Data maintenance was typically defined per information system, not per data domain. Several process owners were also included in the MDM project.

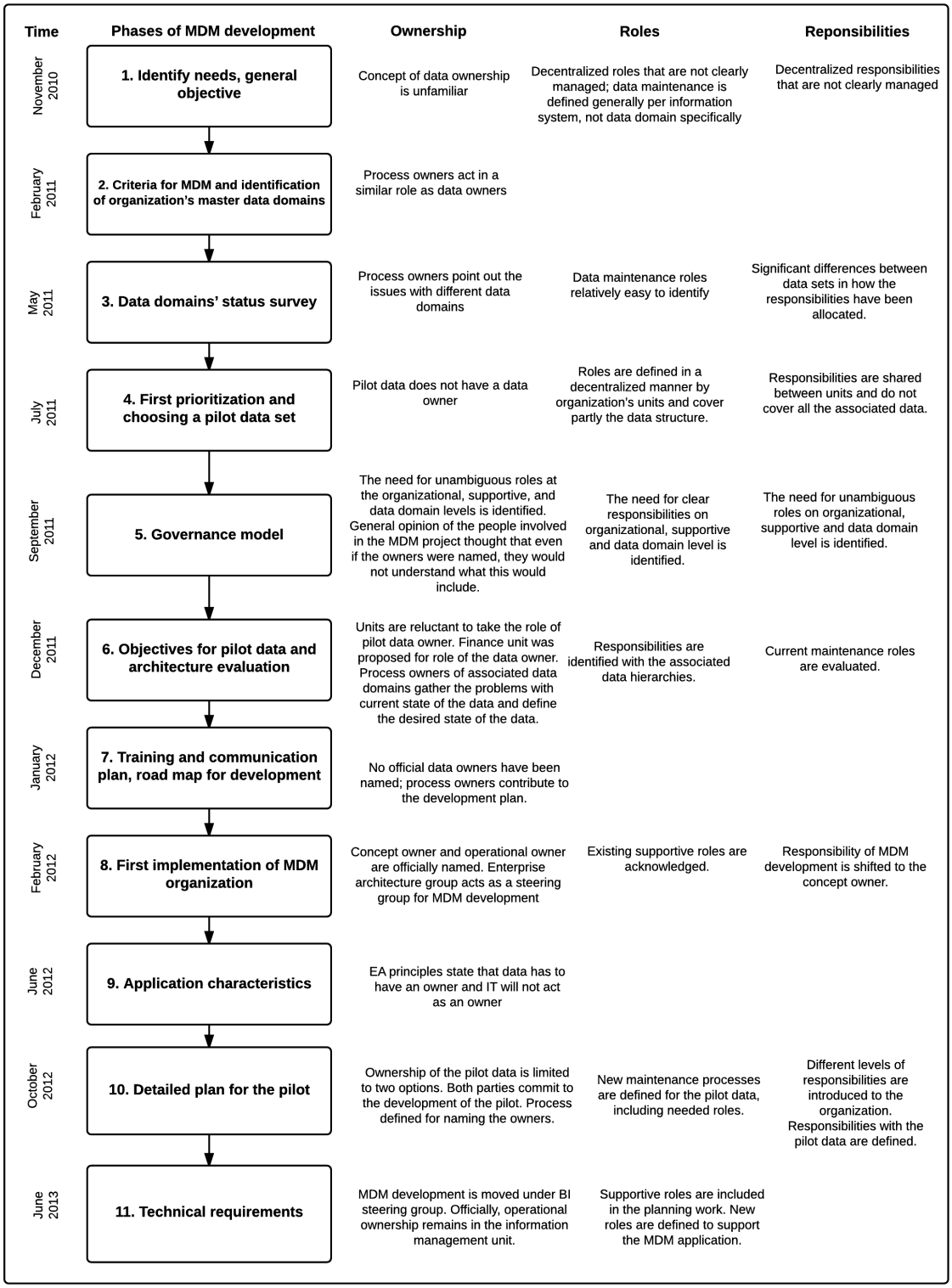

Figure 2 Process for Establishing and Developing the Organization's MDM Function and Evolving Ownership, Roles, and Responsibilities

Identifying the organization's master data, data status survey, and pilot domain (Steps 1-4)

There was a need to form general criteria for identifying master data. The plan was to assess the organization's against these criteria. It was decided that the MDM project would first focus on critical common master data sets. Their status sets were surveyed on a high-level; this resulted in the first rough prioritization, and the selection of the pilot data set. Process owners assessed master data sets against the criteria, and indicated problems with the data. For example, there were data problems with reporting and their effects on basic operations. When the data sets had no process owners, the problems were identified by people working with the related IS (developers and administrators). Other persons from IT or reporting also pointed out issues causing poor quality master data.

Data set responsibilities were not unambiguous. Some master data sets, e.g., financial data, had explicit, centrally-defined and managed responsibilities and roles. Data owners were not officially named, but were otherwise acknowledged. Some data sets, such as organization data, had partly well-defined responsibilities although the roles and ownership were undefined. Some, e.g., human resources, had outsourced master data ownership and responsibilities to IT management.

Shaping a general governance model (Step 5)

A general governance plan was developed. Governance includes regulations, practices, procedures, data and concept ownerships, responsibilities and roles, and role descriptions. Governance was defined in three levels: the organizational level, support function level, and data set level. Some support functions, such as privacy and security, data quality control, and IS and integrations, were also identified. Other roles were mainly seen as data–set specific ones. These were, for example, the roles responsible for the maintenance and the actual maintenance roles.

Many of the support functions already existed. Data security and privacy were part of the information security manager's and data privacy officer's role. Each IS had a person responsible for its usage and development. These roles were considered significant for the MDM development. However, data quality at large did not have clear roles and responsibilities. The general governance model in the municipality suggested that the responsibility of managing the master data quality would be appointed to the financial unit. This was not done, because of lack of resources.

Often, the process owners were considered responsible for the data generated in their processes. This was seen being related to IS. Unambiguous perceptions about the responsibilities for the data shared by several processes did not exist, but was constantly debated. For the data that was mainly produced and used within one organizational function, this was clearer: ownership was in that unit, and more precisely, lay with its manager. The lack of defined responsibilities and ownerships resulted in data quality being seen as an IT-related issue. Business process owners did not recognize themselves as responsible for enhancing the quality of data associated with their process.

Data set ownerships were identified as essential. Data owners would guarantee that the business units were participating in the MDM development. It was identified that data ownership also included the responsibility

of developing and maintaining a single master data set. However, generally, people participating in the MDM project thought that even if the owners were named, they would not understand the role requirements.

A group started defining the organization's data management process concurrently with the data set identification, and this work included the role of data owner. The role was described as identifying the information needs, prioritizing the information needs, producing the data structure and the data model, processing the data, maintaining and evaluating the quality of information, and publishing the information (Data management working group meeting memo 24.11.2011). The role of the owner was seen as parallel to the role of registrar in the organization. This differed from the description that was formed in the general MDM governance model: "Data owner is responsible for maintaining processes and their functionality, and data quality. He or she owns the content of the data" (Working group meeting memo 24.11.2011).

On the organizational level, there was an evident need for an MDM concept owner, who would be responsible for the whole MDM function and also be accountable for its development. A concept owner sponsors the development and promotes MDM to top management. However, it was very difficult to identify an appropriate management-level sponsor. This was partly because the lack of obvious candidates due to the organizational structure, and the lack of clarity of the desired level. Generally, the question was about first adopting and then owning MDM, and then acquiring resources and capabilities. Different parties were reluctant to adopt the role, yet it was regarded very significant, especially from the viewpoint of ensuring appropriate resources. The concern was finding a neutral party that would monitor the whole organization, and not just some segments. Finally, a few units from the central administration were proposed as MDM concept owner candidates. In particular, the IT unit was recognized as a strong candidate because of its evident role as owner of the organization's IS.

Objectives for pilot data and architecture evaluation (Step 6)

Next the objectives for the pilot data set were defined. This included identifying and evaluating the processes associated with the data set, the required roles and responsibilities, the objectives for data quality and development plan, the associated applications and IS, the principles for data sharing, and the regulatory requirements, metrics, and data standards. Data quality enhancement, one of the original goals, was also included in the pilot. Overall, the focus was on the future improvements and plans, not setting metrics for current data quality. In fact, minimum practices for monitoring the data in the pilot data set were used.

The pilot data set itself did not indicate its owner. The data bridged several levels and branches of organizational chart. Nobody perceived themselves as data owners. It was proposed that the ownership should belong to the IT service center administrating related applications. Data maintenance responsibility was distributed between the financial unit, HR unit, and purchasing unit. Data was also scattered to several IS. An overall view of the data was not easily available, but had to be gathered from applications to an Excel file. Reluctance to take the responsibility for the data maintenance as a whole was evident. Without a data owner, the responsibility could not be appointed.

The pilot data was used in evaluating the technical MDM architecture. The architecture was seen as an entity comprising processes and IS for governing MDM. After setting the principles for an architectural model, technology architecture alternatives were compared.

Training and development plan (Step 7)

At the end of the first project, it was seen important to define what, when, and for whom the development of MDM should be communicated. Data set owners were identified as a target group, and a communication and training plan was written. The plan included descriptions of what "ownership" entailed and how the responsibilities will be put into action and communicated. Other target groups, such as data maintainers, were also defined.

In addition to the original MDM objectives, a more detailed development plan was composed at the end of the first project as some explicit and problematic issues were found. Most of these were brought up by the process owners. The organization´s strategy was now also considered as a factor, which had a strong influence on MDM development. As a result, a long-term road map with an implementation schedule for roles and responsibilities in the organizational level and for the pilot data set was constructed.

For the second project, MDM development was combined with EA development. It was especially associated with the information architecture area, so the organization's EA group acted as a steering group for the MDM development. The MDM concept owner was included as a member of the group. However, the group was inactive and met only a few times. This resulted in the issues concerning MDM development not receiving an audience, and they were mainly reviewed between the concept owner and the operative owner.

First implementations of MDM governance (Step 8)

On the organizational level, the CIO was named as operational owner, responsible for sponsoring the MDM development. The Information architect acted as concept owner, overseeing and planning the development. No other owner was appointed, although a few data sets and their owners were discussed. Some ownerships, for example, the HR unit for employee data, were self-evident. Still, they were reluctant to be officially named as the data owners. In fact the list of data owner responsibilities was not adopted. This was despite the fact that the EA principles from August 2012 explicitly stated that the data ownership must be elsewhere than the IT unit (EA principles workshop 27.8.2012).

The second MDM project split the ownership and responsibilities for different levels. The data owner was responsible for the data set as a whole, although the responsibilities of maintaining and monitoring the data quality were delegated to others. This allowed the data ownership to be appointed at the manager level. In addition, the owners' responsibilities were redefined to also include other data types, such as geographical data, which needed an owner. It was seen that these owners should be determined on the organizational level.

Technical solution for MDM and detailed plan for the pilot (Steps 9-11)

An implementation plan for the pilot data set was first written in the second MDM project. However, there was still an unsolved issue relating to how the maintenance responsibilities should be named. The financial

unit was reluctant to keep certain maintenance tasks with them. Consequently, the decision was made to appoint maintenance to a separate IT service unit. This was because the data maintenance activities were bound up in the workflows, making the maintenance process more complex with several parties. At this point, the data owner was delimited to two options: HR and financial hierarchies. Both potential owners were involved in the project.

In general, the process for naming the data owners and assigning responsibilities was unclear and complex. It was seen as essential that the naming be made by official decisions and guidance, similar to any other role in the municipality.

Different components for an MDM application were already identified in the first project. The application with a pilot data set was implemented in the second project. Then eight use scenarios were defined in order to identify how the MDM application might affect the creation and maintenance of the pilot data and the control of data quality, and how specific issues could be resolved. Functional and technical requirements were defined from these scenarios.

After a year of the second project, in February 2013, MDM development was combined with BI (business intelligence) development. Since MDM was seen as a means to improve data quality, it was considered an area affecting BI and further reporting and analytics (Final BI Status Report 1.2.2013). MDM was introduced as an enabler for BI development, and as an efficient method to enhance data quality. This changed the MDM governance model. BI roles and responsibilities were already identified as an area of improvement. This obviously affected MDM development, as many roles were shared. However, new groups also emerged. For example, a shared steering group for BI development and MDM, and an operative development support group, were formed. An owner of the MDM development and MDM concept owner were members of the management team and the operative group, respectively. The owner of the BI initiative was a member of top management. From this perspective, MDM was subordinate to BI. Soon after the BI connections, in March 2013, the MDM development was ceased and re-evaluated. In May 2013, the decision was made for the project to continue.

6 Discussion

We studied the MDM development process in parallel to the development of its ownership, roles, and responsibilities. This way, we observed the changes through the content (what) and the process (how) (Burke, 2014), but also to add a new dimension to understand what affects the change (why) and the social and material factors that contribute to the change (i.e. affordances and constrains). In addition to technology, data acts as a material component throughout the process. Technology (IT and IS) is more in supporting role. The change process could not be explicitly identified as evolutionary, where the change occurs gradually, nor revolutionary, where change happens swiftly and affects all parts of the foundation. It was somewhere between the two, as there were phases where the change was small scale, and phases where the change was more fundamental. This analysis is presented by adapting the model of imbrication of human and material agencies (Leonardi 2011), in Figure 3.

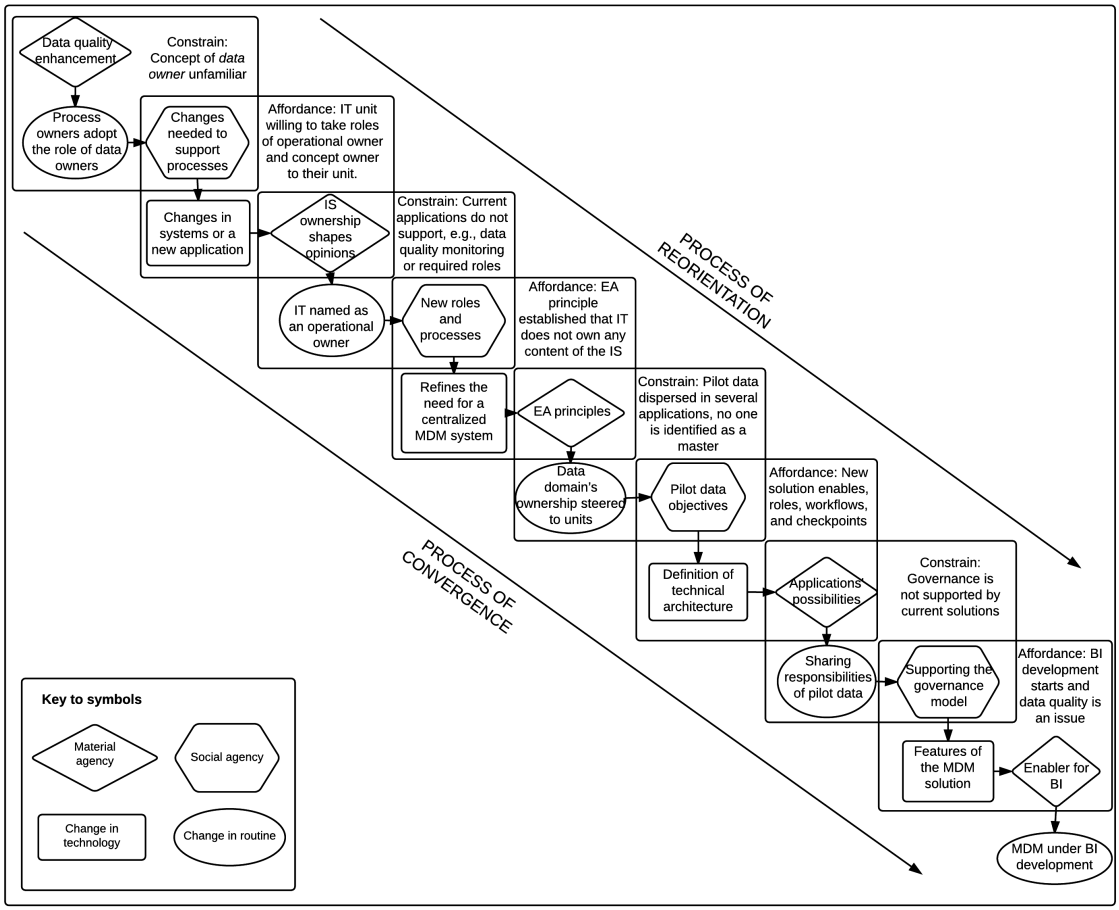

Figure 3. Changes and affecting factors in ownership, roles, and responsibilities

The process can be observed as incremental, as the changes in roles and responsibilities were a kind of scale adjustment. Yet there were some features that point to a punctuated equilibrium model of change. This was especially evident in terms of how the change itself affected social and material agencies, and shaped them. Establishing MDM was evidently a complex process and included an application. Yet it was not limited to an application. This initiates changes to the current roles and routines to exploit the MDM function more widely. This also had an impact on how the change progressed. As a result, changes in technologies and routines formed a process of convergence, with incremental change mechanisms. Their material and social agencies formed a process of reorientation, wherein the patterns of consistency are fundamentally reordered. According to Choi (1995), these two processes form the punctuated equilibrium model of change.

The data owner concept remained unclear throughout the MDM development. Two definitions, an operational role by the data management-working group, and a managerial role liable for development and resources by the MDM development group, differed significantly. This illustrates how differently they were perceived. It also explains why it was difficult to achieve common understanding about the data owner responsibilities.

Process owners brought up issues about the information systems and their certain master data sets, and also general functions such as reporting. For example, the data maintenance within different organizational units was poor and did not support work. Data quality errors and data availability problems with several master data domains showed that changes were essential to the maintenance processes and responsibilities; for example, the tools did not support data quality monitoring or appropriate roles. This introduced changes to several IS and data domains, initiating the need to acquire new technical solutions for MDM.

Operative owner and concept owner roles were new to the organization. Master data was strongly associated with IS and with systems owners. Process owners, the steering group, and top management perceived that the IT unit should be both an operative owner and an MDM concept owner.

IS administration was seen to steer the data ownership. Similar to the discussion on the operational owner and concept owner roles, data domain owners were also seen as associated with the IS ownerships and IS administration, yet the organization had set an EA principle that the IT unit did not own any content in IS. Data ownership was assigned back to the business units, and the development thus continued without an explicitly appointed data owner.

Once the objectives for pilot data were set, it was clear that major changes should be made to data maintenance processes, data input, and liabilities. This initiated the need to acquire a technical solution for MDM. Humans and materials interweave to create or change business routines, whereas in other cases, both the human and material components weave together to develop or modify technologies (Leonardi, 2011). Pilot data was used in evaluating the technical architecture. Technically speaking, it was very straightforward. The system integrations were not considered as a primary problem, as the emphasis was on enabling workflows and liabilities to ensure accurate and current data. This had implications to the technical architecture.

The responsibilities with the pilot data set were unclear, and the ownerships were yet to be defined. Potential data owners agreed that the development should proceed, and the responsibilities should be addressed. Assigning the responsibilities turned out to be far easier after the technical solution was decided, as it concretized the needs. The technical solution would bring opportunities to data input and maintenance processes, and support the data governance implementation. The responsibilities were divided between potential data owners; this was not seen as an ideal solution, but it allowed the development to continue. Technology (data as material entity) alone was not the cause of organizational change because social actors decide how they let their work be influenced by technology (Leonardi 2012).

Technical requirements were derived from the pilot data set and other data domains. The data governance model and different roles and responsibilities had implications for the technical requirements. For example, the governance model defined the data quality manager role on the organizational level. This set requirements for monitoring and assessing data quality. User roles also guided the technical requirements by defining the need to restrict how the changes can be made.

Business reporting was perceived as a technical function, where the data warehouse is central. This view stood out after the decision to acquire a separate MDM application. The organization emphasized the analytical side of MDM, seeing it mostly as an enabler for BI and data warehouses. The responsibility of MDM investments was assigned to the BI owner. This determined how the MDM development would proceed — or not proceed. Technology guided the development and resulted in changes in managing the MDM development. Even when there were no changes in the operational ownership, decision-making was shifted to the BI development steering group. MDM development received more attention as a BI enabler and made its development more visible.

6.1 MDM development driving the organizational change

The imbrication of the social and material entities demonstrates the continuous and intertwined process of ownerships, roles, and responsibilities in MDM development. The factors contributing to the change varied during the development process. The changes influence single or multiple organizational entities, but are constantly constructed throughout the development process. Therefore these changes can also be seen as dialectic (conflictive) or teleology (planned) change (Van de Ven and Sun, 2011). The constructive mode of change also supports the imbrication of human and material agencies, because many of the changes impacting the ownership, roles, and responsibilities were seen as a result of the interplay of the social and material factors. In fact, the changes were easier to identify when they were related to the ownership. This was probably because, without an owner, roles and responsibilities can be difficult to identify and assign (Smith and McKeen, 2008), and they are often not well organized. Although the ownership is merely a role, it differs significantly enough from the others that it is justified to treat it separately. However, roles and responsibilities were regularly observed as coupled terms. Often certain responsibilities were bound to a certain role and vice versa. Consequently it seemed natural to contemplate them together.

The goals were set at the beginning to meet the business requirements in the MDM development. The goals evolved over time, and also steered the process of change as it became evident what should be changed. The change was enforced by the business and IT units. The teleology theory of social change reflects the starting point of the development. The change was not linear, and it evolved throughout the development. Conflicts that occurred were often related to different viewpoints. When observing the MDM development process in parallel to the development of its ownership, roles, and responsibilities, the conflicts between the issues were explicit. Dialectic change theory offers insights for observing these opposing views and how they affect each other interactively to maintain the balance and to form the next phase to achieve the goals.

The first step in clarifying the ownership issue was the acknowledgement of the data owner role and responsibilities. In the organization, it was understood how the role affects the improvement of data quality, and that data quality problems were a result of current processes for creating and maintaining data. Roles and responsibilities were largely undefined and poorly managed. A lack of delegation of responsibilities for maintaining master data has the largest impact on master data quality (Haug and Arlbjørn, 2011). This was seen both as a high-level responsibility, in terms of missing data ownership, and as a technical problem.

Missing data ownership resulted in, for example, the fact that the policies and guidelines for creating data did not exist as no one was managing the data set as a whole.

The pressure from the MDM development induced the process owners to act as data owners. They worried that if they did not participate in the development, data which somehow affected their processes would not be regarded. These unofficial data owners had a significant impact on the development.

The understanding of the need for data owners emerged in the MDM development. MDM is not an application system, but rather an organizational function, which involves the ownership of master data (Otto, 2012). However, the issue was still the necessity of comprehensively understanding the organization. This was a problem, which especially emerged in the central administration, while elsewhere the data usually had named owners. This occurred because data was produced and used by the business units or single processes. However, as master data penetrates the processes and units, this demands a more complex management model (Cleven and Wortmann, 2010). In particular, understanding that data ownership was not an IT-related issue was difficult to gain. The organization debated intensively this. At some point, the discussion resulted in an understanding that IT unit should take the overall management of MDM in the form of operational owner and concept owner, yet their role as an owner of the IS was brought up regularly throughout the development. It was also a factor inflicting changes, as data ownership was strongly associated with IS. At the same time, data management emphasized information, i.e., refined data, which argues for the ownership not to be related to the IT unit. Information was not seen as to be strongly related to IS, while master data definitely was related (c.f. Vilminko-Heikkinen and Pekkola, 2013). This caused some tensions. However, open confrontations or conflicts are more likely to lead to expressions and debates of different opinions. This facilitates their resolution (Van de Ven and Sun, 2011; Jehn & Bendersky 2003; Peterson & Behfar, 2003). The organization acknowledged the data owner role and its existence in general, but they could not find an agreement on data owners — although a mutual agreement that IT should not be the owner was reached. This was also a change to the initial situation. It seems, and it was acknowledged, that gaining understanding on the ownerships issues simply requires a great deal of time — our three years was not enough.

The governance model, and its roles and responsibilities, and technical planning were strongly related. New maintenance processes, workflows, roles, and methods to monitor data quality were among the factors that induced changes in the technology. Dialectics, i.e., stability and change in terms of the relative balance of power between opposing entities, explains the tension between an established culture versus requirements for new practices (Romm et al., 1991). Initially, there was a need to make mandatory changes. Changing the operative systems was an option. When the processes were revised, also the need for a separate MDM application crystallized. The first substantial example in the pilot was the architecture; again, when the governance model was designed, more specific roles and ways to manage the data created requirements for that application. In turn, as the opportunities of the application in the form of workflows (for instance) were understood, the responsibilities in the governance model had to be redefined. This made their management more complex.

Our observations emphasizes that MDM should support both analytical and operational functions at the beginning. Later on, the analytical side gained more attention. Reporting and BI largely affected the development, such that it seemed natural to combine MDM development with BI development. This had other effects in addition to suspending the second project because the MDM concept was not understood. The roles of operational owner and concept owner remained in the IT unit, but development as a whole was moved under BI development. This separated the decision maker from the data owner, and caused doubts about the MDM application in spring 2013. The CIO was reluctant to make investment decisions as an operational owner when the responsibility had been directed to the top management in the BI steering group. Also, as the pilot data was lacking an owner, the pilot did not have an advocate in the management team either. Although potential owners were involved in the development, nobody took responsibility or an interest as a whole. After the re-evaluation, the project was introduced to the BI steering group, which approved the investment.

Combining MDM and BI development had also benefits to the MDM roles and responsibilities. The concept owner was emphasized and acknowledged as an organization-wide role. According to Karel (2006), concept owner ensures that ownership roles are defined throughout the organization, to not only provide the business requirements for the master data capability but also to assess and improve relevant business processes that affect the quality and usefulness of the master data. The new steering group was active, able, and willing to make decisions quickly, and to embrace the role by formally appointing the data owners. The operative BI group supported the MDM work by offering a channel to discuss the development with the business people from different units.

Data ownership was emphasized throughout the development projects. This can be explained by the MDM experiences: the organization was merely implementing and establishing the MDM practices, processes, and structures, so the ownership was an obvious issue. In fact, data ownership is often considered to be fundamental for MDM (Smith and McKeen, 2008). As presented in Figure 1, ownership was more emphasized in the changes, while roles and responsibilities were seen more as having impacts on social issues that initiated technical changes.

Although MDM development can be seen to resemble IS development where an organization initiates a change process to deliberately transform their information processing (Lyytinen and Newman, 2008), MDM is significantly different. First, even though the technology was inseparable part of the MDM development process, it is still a means for development and change rather than the object of the development. Also, MDM development does not necessarily mean the development of any application (Ambler, 2007) but can simply be focused on the processes, roles, and responsibilities. In technical terms, MDM development can also be about improving the current IS, although here the MDM development focused on acquiring a new technical solution. Still, this was not considered to be a key success factor in the process (see also e.g., Smith and McKeen, 2009;, 2008; Haug and Arlbjørn, 2011). The emphasis was on the process, and the changes in ownership, roles, and responsibilities. IS development is similar. Consequently, IT governance issues could be linked in a more profound ways to observe how different roles and responsibilities are formed or set in the IS development, and how the organization changes during the development.

Leonardi's (2011) imbrication model emphasizes the intertwined nature of change. The change in the development affects social and material agencies, and they mutually affect the change. The process is continuously reforming in development situations, and in the organization where the development occurs. This emphasizes MDM functions as sociotechnical entities.

7 Conclusion

The goal of this paper was to observe how the data ownerships, responsibilities, and roles change during MDM development. Sociomateriality was used as a theoretical lens to identify the factors that influenced the change, and to observe if the change was a result of the intertwined social and material factors. In addition to the change itself, the factors contributing to the change were also observed. The imbrication of human and material agencies (Leonardi, 2011) served well as a model to do this, because instead of emphasizing the change itself, it underlines the factors that ignited the change and tries to explain what affects the change.

The ownership role clearly impacted development in terms of investments. When there was ambiguity about ownership, the organization was reluctant to invest in the development. The organization's development project policies required a named owner for the project. Even though the operational owner was officially appointed, the lack of data owners and changes in the steering groups seriously affected the development, at least by causing ambiguities.

Certain issues regarding the data owners surfaced regularly. Common understanding of the importance of the data owner was evident. Even when the data owners were not officially appointed, people responsible for the business processes wanted to be involved and steer the development. This had an impact on how the development proceeded, and how the roles and responsibilities evolved. This seemed to reflect the maturity level of the data governance in the organization. Although the development process lasted the whole data collection period (almost three years), the organization was not able to define the concept of "data ownership." While the understanding of the term was missing, an individual development project could not implement the role. Still, the development project was able to start the clarification of roles and responsibilities.

In MDM, data ownership differs from the roles and responsibilities. While roles and responsibilities could be observed as related terms, ownership had some distinct features. For example, it was often the object of change, while roles and responsibilities acted as factors initiating the change.

We have described how the ownership, roles, and responsibilities are perceived, and how they change and evolve during development process. This offers new insights into the research and use of sociomateriality. We have tested the theory and whether it explains the change, which indeed it does. Leonardi (2011) demonstrates the idea of imbrication with a simple process. We have shown an equally simple process with MDM development. Our emphasis was to observe three angles of development, namely, ownership, roles, and responsibilities, and their changes in the development project. Even at the beginning, it was evident that development would be a versatile and eclectic process. We did not want to simplify it, as several of the

social factors could be overlooked. We also wanted to observe the changes and affecting factors in detail. It is difficult or even impossible to explain, predict, and control the process of change (Burke, 2009), but understanding the factors that contribute to change help practitioners manage it. This way the research also offers practitioners insights into how to prepare and manage the change in the MDM development process.

In addition to MDM insights and demonstrating the use of sociomateriality as an analytical tool, we contribute to research by proposing possibilities for further research. First, it would be interesting to determine whether similar results are found in a private sector organization, and with different kinds of material entities, such as technologies, documents, frameworks, and other types of data. Second, to observe data ownership, roles, and responsibilities in more mature organization could offer different insights. Third, the role of data owner has not been the subject of much academic research. The role is concurrent, especially in the public sector, where open data obligates the organization to understand who is responsible for a certain data, and to assess whether it meets the open data conditions. Lastly, it could be interesting to study how the role of data owner was perceived in different organizations.

An obvious limitation is our focus on a public sector organization. This means that the findings may not be extrapolated to the private sector. This was also a single case study, and caution should be exercised with regard to generalizations.

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About the Authors

Riikka Vilminko-Heikkinen, MSc, works as a Service architect at Gofore Ltd, Finland. She has graduated from University of Tampere with a MSc in information studies. She has a research interest in organizational aspects of master data management.

Samuli Pekkola, PhD, is Professor of information systems at Tampere University of Technology, Finland. His research focuses on users in different manifestations of information systems, information systems management, particularly enterprise architectures, and information systems acquisition. His has published approximately 80 peer-reviewed articles in leading information systems journals and conferences. He is Associate Editor in Business Information Systems and Engineering, and was editorial board of Scandinavian Journal of Information Systems 2009-2012, and Editor in Chief in 2012.

Tampereen teknillinen yliopisto
PL 527
33101 Tampere

Tampere University of Technology
P.O.B. 527
FI-33101 Tampere, Finland

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