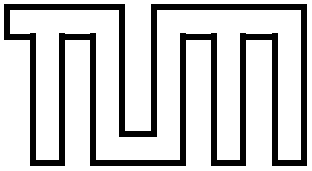


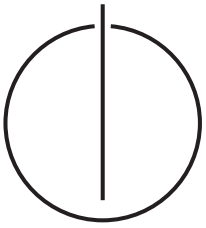
FAKULTÄT FÜR INFORMATIK

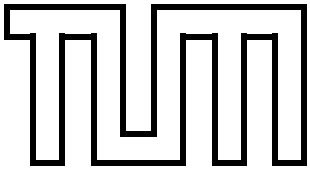
DER TECHNISCHEN UNIVERSITÄT MÜNCHEN

Master's Thesis in Wirtschaftsinformatik

Designing a method for identifying organization-specific goals for Master Data Management

Andreas Mirbeth





FAKULTÄT FÜR INFORMATIK

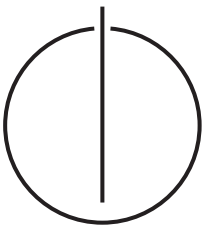
DER TECHNISCHEN UNIVERSITÄT MÜNCHEN

Master's Thesis in Wirtschaftsinformatik

Designing a method for identifying organization-specific goals for Master Data Management

Entwicklung einer Methodik zur Identifikation organisationsspezifischer Ziele für ein Master Data Management

Author:	Andreas Mirbeth, B.Sc.
Supervisor:	Prof. Dr. Florian Matthes
Advisor:	Dipl. Inform-Univ. Ivan Monahov
Submission date:	October 7, 2013



I assure the single handed composition of this master's thesis only supported by declared resources.

Munich, October 7, 2013 Andreas Mirbeth

Abstract

Master Data Management (MDM) as an application-independent process for the description, ownership and management of core business data entities has recently become a hot-topic for practitioners as well as researchers. It strives to enable a consistent, shared, and contextual use of core business data entities across systems and lines of business. MDM is considered a complex and multidisciplinary task comprising of design activities on a strategic, organizational and information systems level. In practice, MDM initiatives often focus exclusively on the information systems level. As a result, initiatives struggle to sufficiently engage and retain management stakeholders due to the lack of a clear vision, strategy, and roadmap as part of the strategic level.

The thesis at hand aims at providing the foundation for these strategic activities by proposing a method for the identification and documentation of organization-specific goals as a means to demonstrate the usefulness of MDM initiatives as well as to increase management involvement. Following the guidelines of Design Science Research, the method is developed, applied and evaluated at a financial services provider, thereby incorporating the practical experience of data management professionals. Furthermore, this work comprehensively sums up current research and literature on MDM to foster an overall understanding regarding the aforementioned design activities and their interrelations. The thesis concludes by providing a critical reflection and topics for future research.

Table of Contents

1. Introduction

The notion of "data as an asset" is growing in popularity, as data is increasingly more recognized as having business value, tangible or intangible, and as a constituting factor for competitive advantage [Int09, p.53], [Red95]. In line with this, data has to be carefully managed to ensure smooth operations and trustworthy reports that both depend on timely, accurate, and reliable data. This is especially true for core data entities, called *master data* (e.g., customer, product), since they constitute the foundation for all an organization's business activities [KW09]. However, many enterprises find their master data to be scattered throughout business applications, each with similar but inconsistent data values in differing formats [Int09, p.171]. Accordingly, organizations engage in *Master Data Management* (MDM) as a "critical business capability and technology foundation" [Kar11] that strives for a consistent and relevant version of the truth about master data entities across business applications and lines of business [Int09, p.171]. Nevertheless, before embarking on an MDM initiative, one needs to understand the current state of the organization and be able to articulate why the organization needs MDM [DHM+08, p.490]. Understanding the dependencies and design areas involved with MDM is also a critical success factor [SM08]. According to this, the thesis at hand aims to provide guidance for an organization thinking about engaging in Master Data Management by delivering a comprehensive summary on MDM as well as developing a method applicable to explore and define organization-specific goals for MDM.

The remainder of this introductory chapter details the motivation, specifies research questions and approach, and presents related work. Chapter 2 begins by defining the terms *master data* and *Master Data Management* before providing a comprehensive summary on the benefits, risks, design areas, and dependencies involved with MDM. Subsequently, two selected case studies from literature are presented. Chapter 3 explains basic principles for approaching Master Data Management (Section 3.1) and, based on this, outlines a method for identifying and documenting organization-specific MDM goals. To demonstrate its practical use, the designed method is applied at an industry partner from the financial services sector (cf. Chapter 4) and evaluated in the course of an expert survey among data management professionals (cf. Chapter 5). Chapter 6 concludes this work with a summary of the central results and an outlook towards possible future research.

1.1. Motivation

1.1.1. Problem statement

Master Data Management is a complex and multidisciplinary task comprising of design activities on a strategic, organizational and information systems level [OO11], [BD11, p.37]. This requires setting up a medium- to long-term initiative based on a sound vision and organization-specific goals [SGZ12, p.38] as well as communicating the need and payoff of MDM clearly [BD11, p.39]. Practical approaches to MDM often neglect these requirements and set up projects for implementing information technology rather than devoting the necessary time and effort to define the concrete potential MDM has for their organization in order to lay the groundwork for the definition of a comprehensive MDM vision, strategy and roadmap as well as senior management commitment [Rad09], [SM08], [OR10], [Kar06], [Los10, p.237], [BD11, p.37], [WO08b], [DHM+08, p.490]. Initial investigations at the industry partner showed similar mistakes: no project concerning the topic of MDM was able to sufficiently capture the business justification by defining goals that leverage the Information Technology (IT) and business strategy. Therefor, the involvement of business stakeholders and management attention remained low resulting in the discontinuation of projects. The need to identify and document business-oriented and measurable goals as part of the strategic design area and therefor as a prerequisite for senior management commitment and the further planning of an MDM initiative is recognized by the research community [Rad09], [SGZ12, p.38], [RS08], [Los10, p.238], [Int09, p.172], [BD11, p.39f & 285ff]. Nevertheless the issue of guiding practitioners along this process and explicitly describing techniques how to identify, document and monitor goals has not been taken up so far by the research community. Only Scheuch, Gansor, and Ziller [SGZ12] provide a method base for the initial phase of an MDM initiative but lack a description how to consistently document identified goals and related influencing factors. This thesis aims at filling this gap and thereby providing a foundation for achieving and sustaining required business engagement for MDM endeavors. The ensuing research questions and contribution is described subsequently.

1.1.2. Research questions and contribution

The thesis at hand addresses a current gap in the IS community as it aims at finding answers to the following questions:

1. How does a method to identify organization-specific MDM goals look like?
2. How can MDM goals be documented in a structured manner?
3. How can the achievement of MDM goals be measured?

The answer to these research questions results in the creation of a method to identify and document organization-specific and measurable goals for MDM. By explicating the research process and delivering the method as "a system of principles, practices, and procedures applied to a specific branch of knowledge" [Sou13], this thesis makes a contribution to advance the scientific body of knowledge as a baseline for future research. Additionally practitioners benefit from the proposed method because they can apply it during a preliminary assessment of MDM or during the early phases of an MDM initiative in order to form the required business rationale.

1.2. Research approach

As the outlined research questions are of interest both to the practitioners' and the scientific community, this thesis follows a design-oriented research approach. Design Science Research (DSR) is focused on delivering artifacts that contribute to the scientific body of knowledge and simultaneously benefits practitioners [HMPR04]. In order to develop the research artifact, a method for identifying and documenting MDM goals, the thesis at hand follows the *Design Science Research Methodology* (DSRM) as proposed by Peffers et al. [PTRC07]. The DSRM is the result of a synthesis of papers discussing design science research ([Arc84], [TVY90], [NJC90], [ER91], [WWES92], [Ake04], [HMPR04], [CPRS05]) and helps to guide the application of a design science approach in the context of information systems research. It comprises of six activities (cf. Figure 1.1) that are addressed within the thesis at hand as explained by the following listing:

- **Identify Problem & Motivate:** This activity requires the researcher to define the specific research problem as a means to justify the value of a proposed solution. As described in Section 1.1.1, the research was mainly motivated by studying current literature on MDM and investigating former unsuccessful (master) data management approaches at the industry partner, thereby identifying a problem relevant for the practitioners' as well as scientific community.. Section 2.4.1 further explains the challenges and problems associated with justifying the need for an MDM initiative.

- **Define Objectives of a solution:** The goal of this activity is to describe the objectives of a solution based on the problem statement and knowledge about what is possible and feasible. The objective of this research is to define a method for identifying and documenting organization-specific MDM goals (cf. Section 1.1.2) as a means to provide practitioners with proper guidance for assessing the concrete potential of MDM for their organization. Specific design principles that a proposed method has to include are defined in Section 3.1.

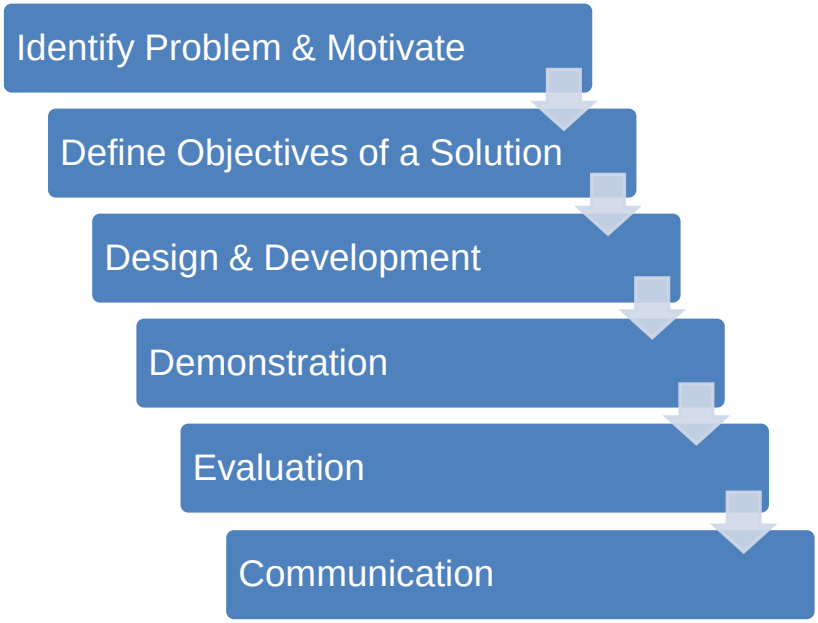


Figure 1.1.: Research activities according to [PTRC07]

- **Design & Development:** During this activity the actual design research artifact such as a model, method, or construct is created. Chapter 3 details the design process and describes the developed method for identifying organization-specific goals for MDM.

- **Demonstration:** The goal of this activity is to use the developed artifact to solve one or more instances of the problem. Chapter 4 elaborates on the application of the created method at a financial services provider and presents the results.

- **Evaluation:** In order to observe and measure how well the developed artifact performs, this activity requires an evaluation. Chapter 5 describes the chosen evaluation approach as well as the ensuing results.

- **Communication:** This activity is about communicating "the problem and its importance, the artifact, its utility and novelty and its effectiveness to researchers and other relevant audiences such as practicing professionals" [PTRC07]. During the design and evaluation phase, communication about the problem and the proposed method took place with practicing professionals from the industry partner. Further communication efforts will follow in the form of presentations to professionals from the industry partner as well as to the scientific audience.

1.3. Related work

The thesis at hand deals with the identification of organization-specific goals for Master Data Management. To the best knowledge of the author, only Scheuch, Gansor, and Ziller deal with this specific topic in their book "Master Data Management: Strategie, Organisation, Architektur" [SGZ12, p.305ff]. They propose a method base for developing MDM goals, an MDM strategy, and an MDM roadmap based on their practical experience as MDM consultants. However they lack guidance on how to document identified goals in a structured manner and how to arrange MDM goals in order to be measurable.

More general approaches on how to initially assess and plan an MDM initiative can be found in the books from Dreibelis et al. [DHM+08, p.490ff], Berson & Dubov [BD11, p.285ff], and Loshin [Los10, p.237ff]. However, the descriptions remain on a very high level and thereby only provide a rough guidance for practitioners.

Concerning research on the topic Master Data Management in general, the Competence Center Corporate Data Quality[1] (CC CDQ) needs to be mentioned. The CC CDQ is a consortium research group coordinated by the Institute for Information Management of the University of St. Gallen dealing with research on the quality of corporate data. Amongst others the research group published process and functional reference models for MDM (cf. Chapter 2).

Schneider, Schulz and Matthes engage in research on goals in the context of Enterprise Architecture Management [MSS13] which is also considered a strategic initiative like MDM. Based on a comprehensive literature review and their industrial EAM experience they identified common goal properties and proposed a template for documenting EAM goals.

1.4. Writing conventions

To avoid confusion, the following writing conventions are made explicit for the thesis at hand:

- The terms 'organization' and 'enterprise' are used synonymously as generic terms covering enterprises, public organizations, companies, etc.
- The term 'master data' is written in lower case as it refers to a specific class of data. 'Master Data Management' is written with capital letters as it refers to an established term.
- A citation in line or at the end of a sentence before the period is only valid for this sentence. If one or multiple citations are found at the end of a paragraph after the period, these citations are valid for the entire preceding paragraph.

[1] `cdq.iwi.unisg.ch/en/`, accessed 14.08.2013

- Important and established terms are highlighted in *italics* at their first occurrence. Exceptions from that rule are only made when the usage of the term without highlighting would cause ambiguities or would result in hardly readable sentences. Throughout Chapter 3, highlighting in italics is also used when referring to specific design principles.
- In Section 3.2 the thesis incorporates the description of a conceptual model. To distinguish between a modeling concept and a real object, the term referring to the modeling concept is highlighted in `typewriter` to avoid confusion.

2. Theoretical background

After briefly defining the terms master data and Master Data Management, this chapter provides a comprehensive summary on questions, issues, and dependencies involved with MDM. This includes a view on the benefits and risks of MDM (Section 2.3 and 2.4), information on MDM design areas and options (Section 2.5), and the presentation and analysis of two case studies from literature (Section 2.6).

2.1. Defining master data and Master Data Management

2.1.1. Master data

In literature a clear differentiation between data, information and knowledge exists. Data is formed of characters using a syntax, thereby describing attributes of objects from the real world. By contextualizing data through e.g., analyzing, interpreting or structuring, data turn into information (e.g., the interpretation of a certain character sequence as an amount of money in US Dollar). By processing information (e.g., connecting, comparing), knowledge is finally generated (for example the comparison of exchange rates to calculate an exchange fee). A detailed discussion on this differentiation is given amongst others by Davenport & Prusak in [DP98].

Regardless of this precise theoretical differentiation, practitioners use the term 'data' in a broader sense in the context of information systems [OH09]. Data is not just a set of values using a syntax but already inherit a certain structure and interpretation (e.g., a customer record with attributes like postal address and telephone number would be considered 'data').

As evident from Figure 2.1, no data class is as fundamental to an organization as the class of master data [KW09]. The term in general describes basic entities that are very consistent and typically reused in a variety of different business transactions [OH09]. Prominent examples are business partner data (customers / suppliers) or product data. Master data objects can be seen as the foundation for all business transactions and are therefor highly valuable assets to its owning organization although this class of data may comprise only a small percentage of the overall amount of data [BD11, p.6]. They are furthermore not dependent on any other data classes, e.g., an order (transactional data) can not exist without a cus-

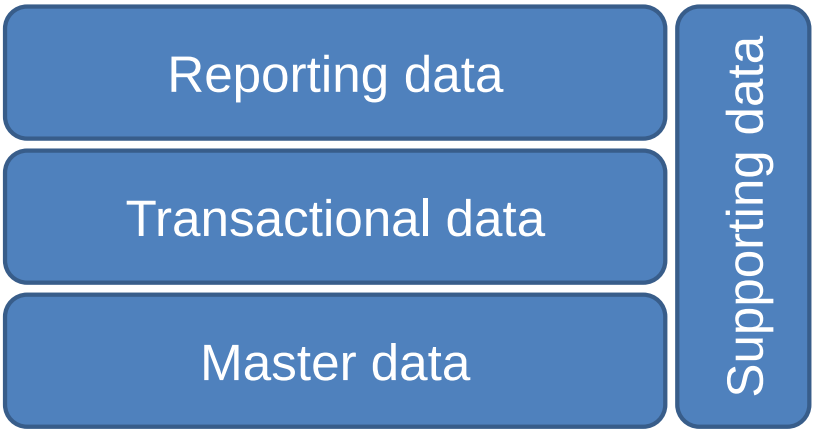


Figure 2.1.: Categorization of data classes

tomer (master data) it refers to but the customer can exist independent from the order. This leads to the perception that improving the quality of master data also leverages the quality of all other data respectively information and has a dramatic impact on an organization's confidence about its own data [Int09, p.177].

Master data can be further characterized as follows [SGZ12, p.30f]:

- Master data possess a well defined and organization-wide accepted semantic,
- are stable, change not frequently and have a long lifecycle,
- describe business objects that are relevant across all lines of business,
- constitute a reference for other data classes.

The lifecycle of a master data object starts with its creation during a business process and ends with its deactivation and / or archiving after it is not required for business transactions anymore [OH09]. In between the master data object may be changed or extended. Compared to other types of data this lifecycle is significantly longer and therefor requires dedicated resources (cf. Section 2.5.2).

Figure 2.2 depicts an example for the structure of the master data domain 'party', which collectively comprises of people and organizations [DHM+08, p.13]. A master data domain represents the top of the hierarchy and logically groups several types of data objects. The master data objects are further defined by segments that logically group multiple attributes. The number of possible attributes is very high compared to the number of possible domains as indicated by the pyramid visualization. Typically only very few domains of master data exist (e.g., party and product) [DHM+08, p.13f].

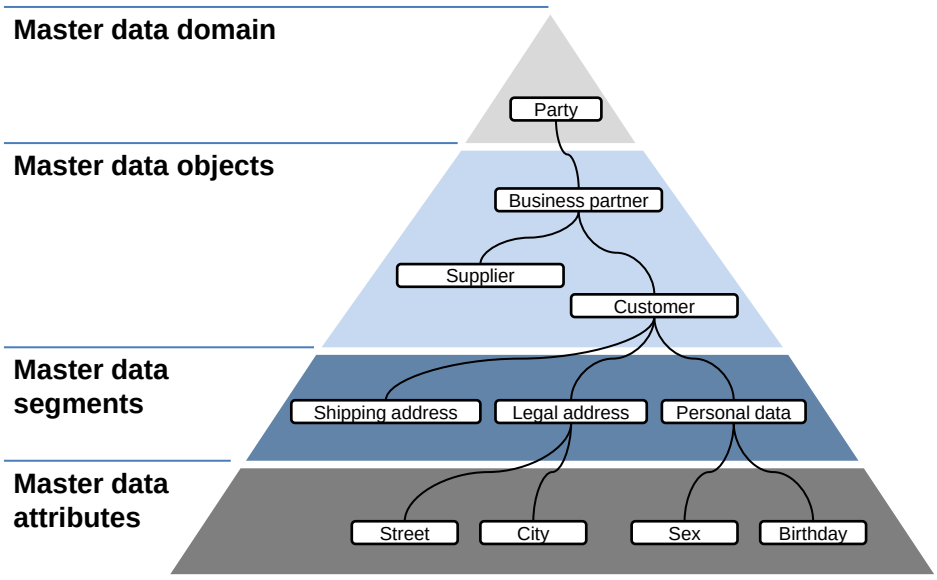


Figure 2.2.: Example structure for master data domain 'Party'

Depending on the industry an organization is operating in, different master data domains respectively objects are in focus. The following subsection gives some background information on the master data needs of a financial services provider.

2.1.1.1. Master data at financial services providers

Financial services providers offer virtual products that are very complex and change frequently. Business partners in their role as customers and their very unique needs dictate these product offerings. Also other business partners like banks or other financial institutions play an important role in the business of financial services providers as their products are often bundled with own services to serve customers to their fullest needs. Furthermore the party model of these business partners is typically very complex and comprehensive. Oftentimes it includes formal and informal organizational entities such as mutual funds, informal investment groups, trusts, and other entities representing more than one customer. The relationships with these complex party structures are an extremely valuable asset and bear the potential of growing revenue by cross- or up-selling if managed properly [SGZ12, p.17], [BD11, p.58]. Therefor the focus of Master Data Management at financial services providers is on managing master data of business partners and organizations which can collectively be subsumed by the master data domain 'party'. Managing this kind of master data is particularly challenging due to

- the complexity of roles and relationships played by individuals and organizations,

- the high number of data sources concerning party master data that are scattered across the enterprise,

- the business importance and potential impact of the data [Int09, p.179].

2.1.2. Master Data Management

Master Data Management can be described as an "application independent process for the description, ownership, and management of core business data entities" [ROO13] and is perceived to be a key discipline to achieve and maintain high quality enterprise data [KW09]. According to the *DAMA*[1] *Guide to the Data Management Body of Knowledge* [Int09, p.171] the goal of MDM is to enable a consistent, shared, and contextual use of the most accurate, timely, and relevant version of the truth about master data entities across systems and lines of business. The challenge is to locate the most accurate master data entities among potentially conflicting entities and to use these 'golden records' consistently in the means of having a single view of an organizations' most valuable data entities [SM08], [Int09, p.177]. MDM further comprises of all activities for creating, modifying or deleting a master data attribute, or a master data object and strives to leverage master data to improve business processes and decision making [OH09], [SM08].

Master Data Management is not a new idea and has emerged from different *Data Management* disciplines as for example Data Quality Management (cf. Section 2.1.3). Also it wraps existing management disciplines like *Customer Data Integration* (CDI) or *Product Information Management* (PIM) which have key similarities [DHM+08, p.13]. Hence depending on the domain of master data managed, MDM for customer data is often also referred to as CDI and MDM for product data is also called PIM [Int09, p.178], [DHM+08, p.13].

As already mentioned, MDM is an application independent process. Nevertheless people often refer to MDM solely as a class of information systems and thereby a technical topic, neglecting the organizational questions and challenges an MDM approach involves. Furthermore an MDM approach comprises of design activities on a strategic, organizational and information systems level (cf. Section 2.5) having strong relationships to Data Governance and Data Quality Management (cf. Section 2.1.3) [OR10], [OO11]. Another common mistake that comes from the perception of MDM as a technical topic is the understanding that Master Data Management can be delegated to IT alone. But without proper support, sponsors and data owners from business any MDM approach will inevitably fail [SM08], [Whi10].

[1] `http://www.dama.org/`, accessed 25.09.2013

2.1.3. MDM in the context of other Data Management disciplines

Master Data Management is not an isolated discipline and dependencies to other Data Management disciplines exist. A comprehensive overview of Data Management disciplines according to [Int09, p.12] is illustrated in Figure 2.3.

Figure 2.3.: Data Management disciplines according to [Int09, p.12]

One particular critical Data Management discipline is *Data Governance* [Int09, p.37]. The fact that many people from IT and business work with the same data objects implies the necessity of a common language and an overall management to govern who has to do what and how. *Data Governance* refers to the roles, decision rights, accountabilities, rules, and processes for an organizations' decision making about data assets [KB10], [Gro13], [ROO13]. Some decisions about Data Management can be made relatively risk free by individual managers, but the need for shared decision making, risk control and the opportunity for all stakeholders to be heard are significant drivers for most organizations to implement a representative form of Data Governance [Int09, p.41]. Often, Data Governance is initially implemented to cope with data-related regulatory compliance [Int09, p.49]. Thereby it is important to distinguish between Data and IT Governance: IT Governance aligns enterprise goals with IT strategies and is primarily about making decisions on IT investments, IT project portfolio, and the application portfolio [Int09, p.38].

Basic settings that Data Governance defines include the overall data strategy, data policies, data standards, data quality metrics, the business data names, and

business data definitions [Int09, p.42]. Therefor, effective Data Governance is a key capability to successfully implement and manage an MDM program as well as to prevent MDM from becoming another data integration utility within IT unable to hold up to the organizations' expectations [BD11, p.399], [DHM+08, p.489], [Kar11], [Int09, p.195], [Ott11], [Los10, p.15]. Especially the already mentioned strategic and organizational questions regarding MDM are closely related to Data Governance [OO11]. Additionally, having Data Governance with appointed roles for planning, designing and overseeing Data Management activities in place facilitates *Master Data Governance* which is required in the process of setting up a comprehensive MDM program (cf. Section 2.5.2.2) [BD11, p.404]. In practice, organizations tend to set up Data Governance and MDM programs together or at least closely integrated as a means to tackle the combination of organizational and technical issues in their entire (master) data ecosystem [Wad12], [Ric13].

Another Data Management discipline that is seen as an important root of Master Data Management is *Data Quality Management* (DQM) [Los10, p.87]. As a continuous process it aims at defining the parameters for specifying and ensuring acceptable levels of data quality to meet business needs [BCFM09]. It is therefor seen as a crucial support process in organizational change management as data are the basis for every decision. Activities include analyzing the quality of data, identifying anomalies, and defining business requirements and rules for asserting the required data quality [Int09, p.291]. Essentially all MDM programs are therefor specialized data quality improvement programs as MDM programs put a lot of emphasis on increasing the quality of master data objects (cf. Section 2.1.2) [Int09, p.172]. Also Otto and Reichert [OR10] find in a descriptive survey among 19 large organizations that Data Quality Management is an integral part of the MDM organization. Still, MDM is more than Data Quality Management. While data quality initiatives usually focus on improving data quality reactively within the scope of specific applications or specific lines of business, MDM tries to address data quality concerns in a more integrated approach throughout the enterprise [BD11, p.11]. On the other hand, particular preventive DQM that ensures data quality through a structured, iterative approach by measuring, analyzing, and improving data quality can help to structure an MDM initiative [OHO12]. Therefor, MDM and DQM have to be seen as two mutually supportive management disciplines.

2.2. Problems concerning master data in organizations

As mentioned in Section 2.1.2, MDM strives to enable a consistent, shared, and contextual use of core data entities across systems and lines of business. The heterogeneous growth of business applications throughout the past decades lead to IT landscapes with a variety of data storages and interfaces across the organization. This development was, amongst others, influenced by lines of business and even departments that act as alienated sub-organizations, each demanding its own ap-

plications and processes neglecting the fact that certain core information (master data) are relevant for and used by other departments or lines of business as well. Another influential factor was the introduction of packaged applications and solutions that are typically designed to only store and manage information for its own operations. Hence master data are scattered redundantly across various application silos throughout an organization lacking consistency, accuracy, completeness, proper control and integration. Also responsibility for master data is (if at all) only seen within the boundaries of these applications. Attempts to share master data are usually designed ad hoc and with a limited scope to a particular channel. The result is a complex application architecture interrelated with additional IT costs and business problems such as: underperforming marketing, compliance violations, inefficiencies in reporting, breakdowns in supply chain, and not achieving a complete and consistent view on master data. [OH09], [Kar06], [DHM+08, p.3ff]

Master Data Management serves as an approach to tackle these problems and to generate additional business benefits as discussed in the following section.

2.3. Business benefits of managed master data

The benefits of having a managed set of master data as a fundamental layer to proper and professional business are numerous. The ultimate goal of an MDM initiative is to increase the trust an organization has about its most valuable data assets. This is achieved by improving the quality of master data regarding the dimensions of *accuracy*, *completeness*, *consistency*, *relevance*, *timeliness*, and *accessibility*. The following listing further explains these aspects of data quality [DHM+08, p.37ff], [OE10], [Los10, p.89ff]:

- **Accuracy** represents the degree of conformity that a stored piece of information has compared to its actual (real-life) value. Accuracy of data is context dependent, e.g., the plain 'age' of a person may be sufficiently accurate for marketing purposes, a legal document may require the date of birth instead.
- **Completeness** is determined by the degree to which a master data object contains all relevant attributes and values required to represent the real-life construct.
- **Consistency** of master data is achieved when data collected from two different sources cannot contradict itself. It is also determined by the level of standardization, normalization, and validation that was performed on the data.
- **Relevance** is defined as the degree to which data satisfies the needs of the consumer and thereby is applicable for the intended task. Relevant master data captures all necessary information for the different consumers of the information and reduces unnecessary information to a minimum.

- **Timeliness** represents the extent to which master data correlates to the real world at a given point in time. Therefor, it gives an indication how up-to-date certain master data instances are.
- **Accessibility** indicates to which extent master data is available at a given point in time.

Aside these benefits regarding the quality of master data, additional business benefits exist and can be clustered according to the following subsections [SGZ12, p.23].

2.3.1. Operational efficiency

With unmanaged master data across various application silos it is not uncommon that master data attributes (e.g., name and contact details of a business partner) have to be manually re-entered multiple times along a single business process. This implies additional administrative effort because reuse of data (across applications, departments, or lines of business) is not supported. As a result errors in operational processes due to media breaks and a lack of data validation occur. Also, the underlying complex and inefficient application architecture and its lack of systemic controls increase the cost of IT maintenance and operations. [DHM+08, p.42], [BD11, p.35]

Properly managed and consistently provided master data helps to reduce media breaks and errors that result in additional administrative process costs and inefficiencies as well as support the streamlining and automation of processes. Also, ongoing costs for IT infrastructure and operations as well as costs for application development and integration can be reduced due to the standardization and reuse of master data that goes along with an MDM initiative. [DHM+08, p. 43], [BD11, p.35], [SGZ12, p.23]

2.3.2. Effectiveness

Another problem that arises from the current situation (cf. Section 2.2) is the inability to create a timely, consolidated single version of truth about an organization's basic, most valuable data assets (e.g., business partner data). This circumstance negatively impacts the capabilities of an organization. For example, organizations are usually unable to create a customer-centric (or business partner-centric) view on their business since they lack a consistent data base. This means that customer facing organizations (including commercial or institutional customers) only have an account-centric view on their business and thereby fail to calculate the value of a customer (e.g., by including all subsidiaries, divisions, and other organizational entities of a customer), realize up and cross-selling opportunities, and correctly evaluate (credit) risks. Collectively, this negatively impacts capabilities to improve

customer experience, service, and retention as well as to leverage customer relationships to ultimately grow revenue. [BD11, p.27ff], [DHM+08, p.48]

MDM supports this transition from an account-centric to a customer-centric business by facilitating the aforementioned consolidated single version of truth about master data that serves as a basis for effective Customer Relationship Management (CRM) (e.g., by providing consistent and relevant information about business partners and their hierarchical structures). In addition MDM provides an organization with the necessary elements of evidence for effective decision making in general since analytical *Business Intelligence* (BI) applications[2] profit from an upstream data quality approach. [SGZ12, p.25], [BD11, p.27ff], [DHM+08, p.48]

2.3.3. Compliance

Depending on industry and geography an organization operates in, a number of regulations that it has to adhere to exist. The amount of regulations increased steadily over the past [DHM+08, p.44]. Therefor, regulatory compliance is seen as a major driver for MDM [SGZ12, p.20], [BD11, p.49]. Subsequently, the following paragraphs present a selection of regulations (with focus to relevance for financial institutions) and its relations to MDM.

The USA Patriot Act's 'Know Your Customer' Provision Targeting the prohibition of money laundering, terrorist financing, and other unlawful activities the 'Know Your Customer' (KYC) compliance policy requires financial institutions to clearly identify their business partners and to obtain certain key information before doing business with them. For example they have to make sure that a business partner is not a known terrorist or money launderer by verifying that he is not on certain black lists (e.g., the Office of Foreign Assets Control's (OFAC) Specially Designated Nationals (SDN) List). Other aspects of KYC are the monitoring of high-risk accounts as well as risk management. [DHM+08, p.45 & 552 & 558]

An MDM system can be used to manage identifying pieces of information for business partner master data and to match business partner data from contributing systems to identify two parties as one and the same. Having this consolidated and comprehensive set of business partner master data in one place eases checks against mentioned blacklists and saves resources by not requiring multiple checks on (redundant) data sets from different sources. Potential risks and fraudulent activities are easier to detect and report with this overall picture that MDM creates of business partner master data. [DHM+08, p. 45], [BD11, p.48]

The Sarbanes-Oxley Act Implemented in the year 2002 as a United States federal law, the Sarbanes-Oxley Act (SOX) requires public enterprises to certify the

[2] Business Intelligence applications combine operational data with analytical tools to extract information for decision making (cf. [Neg04])

accuracy of financial information. Especially section 404 which requires additional internal controls over financial reporting, operations, and assets is of interest for financial institutions. The overall status (including strengths and weaknesses) of these controls have to be reported regularly which makes this task dependent on information technology. [DHM+08, p.555f]

MDM helps to improve capabilities to assure operational transparency and consistent reporting as well as to leverage master data quality which is the baseline for the information reported to the authorities. [BD11, p.48], [SGZ12, p.24]

The European Commission's 'Directive on the Protection of Personal Data' This compliance policy states eight principles of good practice for processing personal information (amongst others: processing only for limited purposes, data not kept longer than necessary, etc.). A directive that goes into the same direction is the German Bundesdatenschutzgesetz (BDSG). [DHM+08, p.45f & 541f & 546]

The verification of these principles is a challenging task requiring strict management and governance of concerning master data (e.g., employee master data). Data access needs to be restricted, requiring data entitlement and transparent authentication as well as authorization mechanisms. Furthermore, processes have to be put in place to handle this delicate data in compliance with the mentioned regulations. An MDM system helps facilitating these principles by providing centralized processes and functionality thereby reducing administrative overhead. [DHM+08, p.45f]

2.3.4. Flexibility

The current situation described in Section 2.2 goes along with a certain degree of laggardness regarding an organization's data assets. As data is usually seen as a strategic asset for an organization they have a high impact on its competitiveness as well as its future development [Int09, p.53], [Red95]. This is especially true for master data. It is therefor necessary to achieve flexibility with regard to these assets to accommodate and manage change. Bad product master data quality, for example, can negatively impact time-to-market[3] for a product since scattered and unmanaged master data can lead to inconsistencies and inaccuracies within the product development process where many parties (Research & Development, Production, Marketing, etc.) get involved [DHM+08, p.48]. For the same reasons, the ability to innovate (especially service process or business model innovation) may also be negatively impacted by the current situation in many organizations (e.g., inability to introduce innovative service processes because of scattered and incomplete customer master data) [DHM+08, p.49]. Additionally this inflexibility and

[3]Time-to-market is defined as the length of time it takes from a product / software solution being conceived until its being available for sale / for productive usage (cf. [KP04, p.173ff])

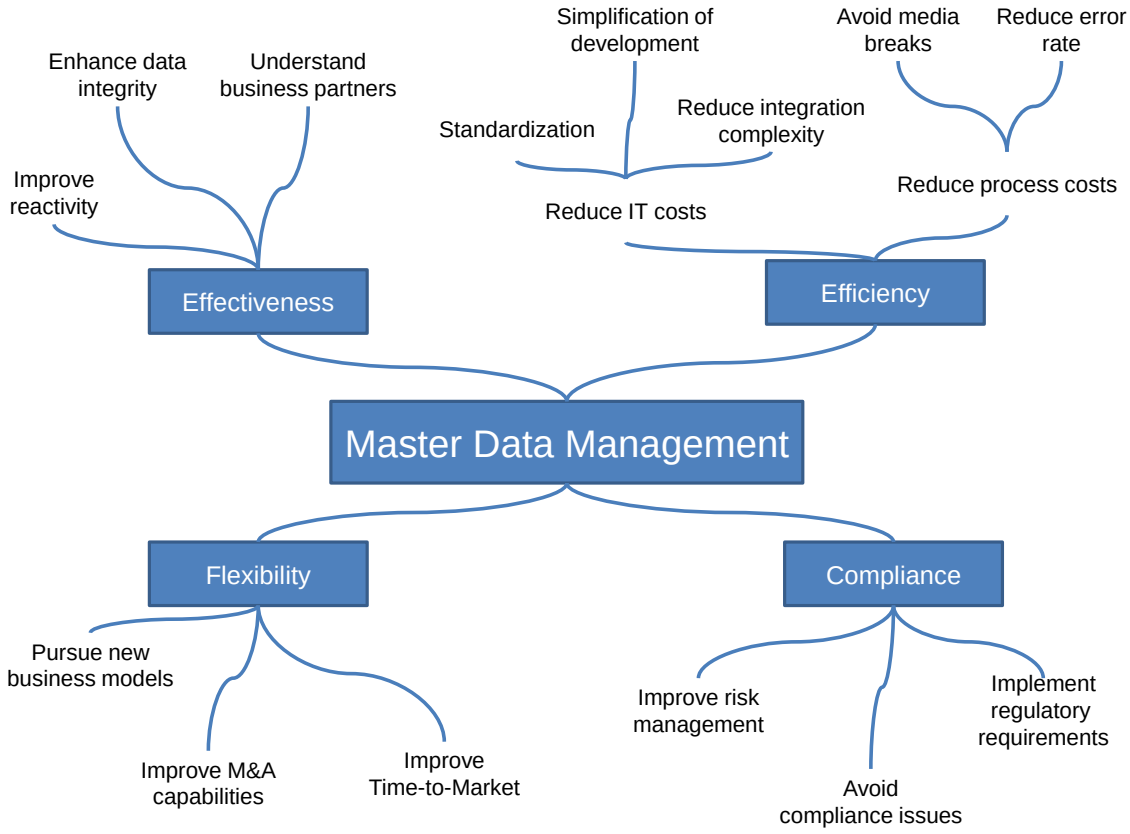


Figure 2.4.: Overview of MDM drivers (adapted from [SGZ12, p.23])

lack of responsibility (insufficient Data Governance) regarding master data assets poses a threat to accommodating Mergers and Acquisitions (M&A) [SGZ12, p.24].

By creating the already mentioned overall, complete and consistent picture of master data assets, MDM supports the flexibility and adaptability of an organization. Also the introduction of defined Data Governance practices (that are a prerequisite for MDM) help in accommodating and managing (business) change. The transparency and methods introduced through MDM initiatives furthermore drives the capabilities to accommodate data consolidation and integration against the background of M&A activities. [DHM+08, p.47ff] [SGZ12, p.24]

Figure 2.4 sums up MDM drivers categorized according to the aforementioned clusters.

2.4. Risks and challenges of MDM

The value proposition associated with generating a managed set of master data through MDM is extensive. Nevertheless, also risks and challenges are associated

with an MDM approach that need to be taken into account and managed properly in order to adopt and execute a successful MDM strategy. These challenges can be categorized into business oriented and technical challenges as detailed by the following sections [BD11, p.35]. One has to keep in mind that the impact of these challenges greatly depend on the characteristics and dimensions of an MDM initiative as explained in Section 2.5.1.

2.4.1. Business oriented challenges

As already explained in the motivation (cf. Section 1.1) for this thesis, attracting enough management attention for an MDM approach is a challenging task especially because MDM initiatives tend to take a long time and significant resources (cf. Section 2.5). Although the list of potential benefits of MDM is long, a clear and compelling value proposition is required to 'sell' the concept of MDM and rationalize the funding request that goes along [BD11, p.39 & p.448]. The challenge is to involve and motivate business stakeholders early in the process by presenting business benefits and measurable goals that can be achieved through MDM (e.g., articulating a tangible Return on Investment (ROI) by specifying applications that rapidly profit from an MDM environment) [SGZ12, p.118]. This thesis tries to address this specific challenge by developing a method to identify and document organization-specific MDM goals.

Another difficulty associated with large-scale initiatives (e.g., MDM) is sufficient change management and communication [SGZ12, p.119]. Berson and Dubov also talk about the 'socialization challenge' in this context and provide an illustration with three dimensions (cf. Figure 2.5) [BD11, p.41]: stakeholders, project lifecycle phase, and depth of interactivity. The roles of certain stakeholders change throughout the lifecycle phases and so does their level of interactivity. For example, business analysts who represent certain business units (stakeholders) may be involved heavily (depth of interactivity) during the initial planning phase and again during testing activities (phases of lifecycle) but are required to a lesser extent during the other phases. The socialization challenge is then to keep all stakeholders in the loop during the initiative and to renew their commitment to MDM on a regular basis. This challenge can be tackled by a balanced project communications plan [BD11, p.42].

A Master Data Management initiative is primarily not about implementing a technical solution but comprises of design activities on a strategic, organizational and information systems level [OO11]. This results in the challenge not to focus on the information systems level and thereby on vendors and their (technical) MDM solution offerings in early phases. Otherwise the initiative is prone to run into the risk of being influenced by a particular solution or vendor within the other design areas [SGZ12, p.116]. In order to avoid this risk, an enterprise has to make sure that the formulation and design of the MDM strategy, organization, functionality, and

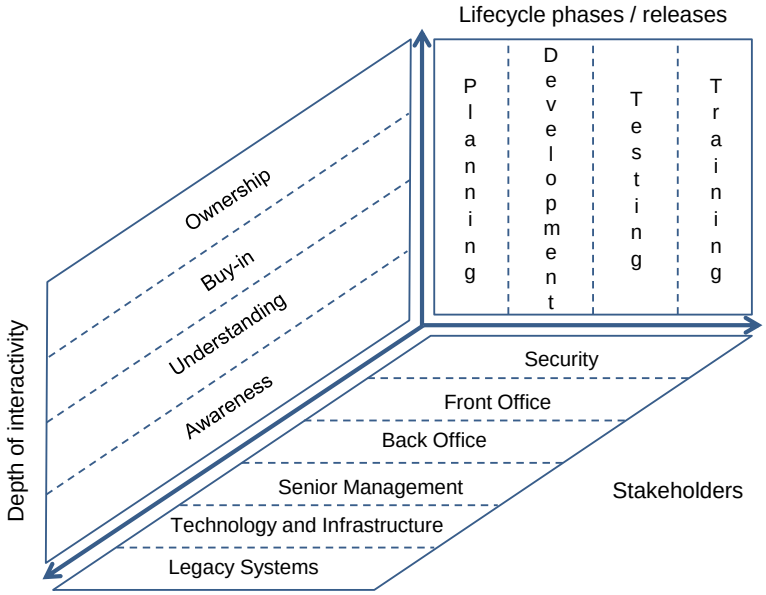


Figure 2.5.: The three-dimensional socialization problem according to [BD11, p.41]

systems architecture is done independently from any solution offerings available on the market.

In large and heterogeneous organizations also the need to define a unified glossary for business terms and the introduction of semantically consistent data definitions as a groundwork for MDM is recognized as a challenging task [BD11, p.37].

2.4.2. Technical challenges

Next to these business challenges for MDM also technical challenges exist. These originate mainly from the already mentioned complexity of the heterogeneous application landscape and its distributed and redundant master data silos. Supporting federated data stores with business-rule driven synchronization and reconciliation of data changes across applications is one example of such a challenging technical task in the context of MDM [BD11, p.37]. Also implementation cost and time-to-market is a risk associated with MDM since it requires significant effort to integrate and adapt legacy data stores or applications. Oftentimes, the time and issues associated with this task are underestimated in MDM project plans [SGZ12, p.118].

Other technically challenging tasks may arise due to global MDM implementations across enterprise sites. For example, country specific regulations may restrict information sharing across enterprise sites (e.g., in China a general prohibition on the export of personal information exists) and therefor require dedicated (technical) solutions in order to comply with these regulations. Also issues and addi-

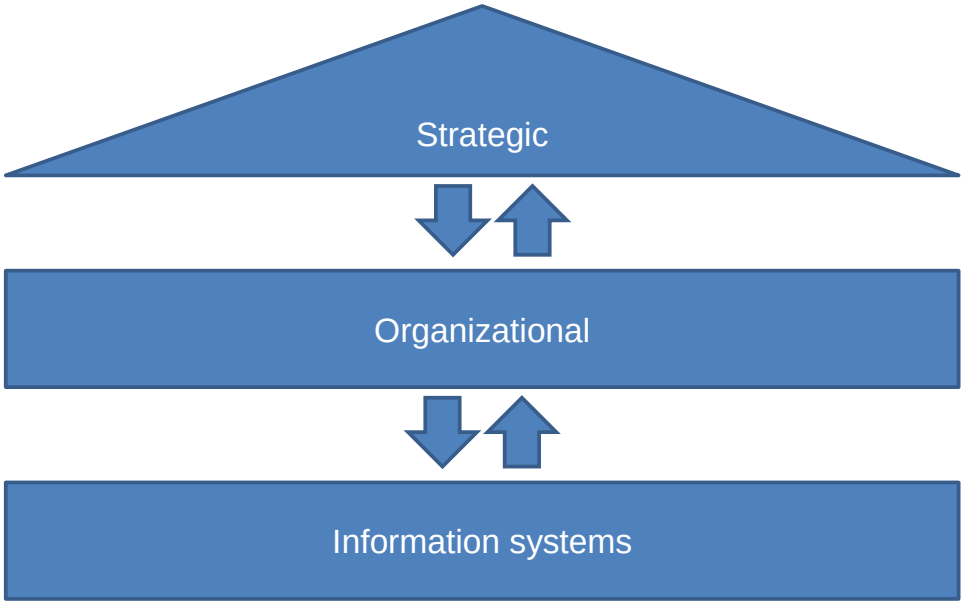


Figure 2.6.: Design areas for Master Data Management

tional complexities in the context of record matching may arise due to different character sets or encodings used worldwide. Additionally global MDM implementations raise the requirements regarding availability and peak performance of a solution. [BD11, p.51]

As already mentioned, these challenges are greatly dependent on the actual characteristics and dimensions of an MDM solution. Therefor, this summary of challenges is not exhaustive.

2.5. MDM design areas and concerning design options

Connected design areas provide a way of thinking about and understanding Master Data Management. The design areas presented in Figure 2.6 and detailed throughout the following sections are mainly based on the work from the *Institute for Information Management of the University of St. Gallen* (cf. [OH09]) that has also been the foundation for the MDM framework presented in [SGZ12]. These design areas follow the principles of *Business Engineering*, a scientific method developed by the same institute that divides business transformations into a strategic, organizational, and system level [OW03]. Additionally Gartner Research pursues a similar approach by dividing MDM into several building blocks that are comparable to the following design areas (cf. [Rad09]).

2.5.1. Strategic

Comprising multiple business drivers, stakeholders and technical concerns, MDM must be considered an organization-wide endeavor with an effect on every level of the enterprise [DHM+08, p.5]. Thus, MDM must be considered an initiative of strategic relevance [OH09]. As a medium to long term initiative to transform an enterprise, one has to make sure that information about the necessity of MDM and respective goals are communicated properly and attract enough attention among senior management (cf. 2.4.1) [SGZ12, p.38], [BD11, p.39]. For this reason, a clear business justification as well as an MDM vision and MDM strategy is required. A vision has to cover the answers to 'what' (goals and principles) an organization wants from MDM and 'why' (purpose of MDM), whereas a strategy is about 'how' (roadmap and milestones) to achieve the MDM vision (cf. [WAL08, p.196ff]). Both have to support and reflect overall business vision respectively strategy of the organization [Rad09]. The combination of MDM vision and strategy draft a target state for MDM in the organization. The thesis at hand supports the development of an MDM vision and strategy by providing a method for identifying and documenting organization-specific MDM goals.

As a prerequisite to defining an MDM vision or strategy it is essential to understand certain basic dimensions of MDM as presented throughout the following subsections.

2.5.1.1. Usage scenarios

In literature, three basic MDM usage scenarios are described. In practice, hybrids of these usage scenarios are usually implemented [SGZ12, p.75]. A simple way to think about these usage scenarios is to consider who will be the primary consumer of the master data [DHM+08, p.15].

Analytical usage This usage scenario is oriented towards BI. Data is extracted from multiple source applications, transformed, validated and loaded into a central repository to feed downstream BI applications which require meaningful and trusted data to improve the quality of decision making. Therefor, regarding this scenario, the main focus of MDM is to support the operational analytical processes. The primary consumer of master data in this scenario are downstream analytical systems. Accordingly, master data is not corrected in the operational source applications (where master data is usually created) but cleansed and enriched for the use in data warehouses. This usage scenario requires little modification to existing application systems but does not provide any benefits regarding the operational usage of master data. [SGZ12, p.76] [DHM+08, p.21f], [BD11, p.21]

Operational usage Supporting existing operational processes is in focus of this usage scenario. The goal is to maintain the semantic consistency of master data

throughout the operational processes. This can be achieved, for example, by providing stateless services that may be invoked by business applications or through an user interface. The advantage compared to a purely analytical usage scenario is that not only downstream applications profit from cleansed master data but the operational transaction processing business applications at the source (which are seen as the primary consumers of master data in this scenario). Nevertheless, achieving this scenario requires significant more modifications to the existing application landscape. [SGZ12, p.76], [DHM+08, p.19f], [BD11, p.21]

Collaborative usage The goal of this usage scenario is to coordinate a group of users and systems to reach a consistent set of master data. It requires the implementation of new processes in the organization to enable the consistent creation and maintenance of master data and associated metadata throughout the organization. Thus, the scenario requires a maximum of organizational change since a combination of workflow management, task management, and state management is needed. The primary consumer of master data in this scenario are the users who interact with master data. [SGZ12, p.77], [DHM+08, p.17f], [BD11, p.21]

Summing up, Figure 2.7 illustrates the three different usage scenarios and their organizational impact. Not only the MDM usage scenario influences the strategic level of an MDM initiative but also the domain(s) of master data addressed. The usage scenario and the domain of master data managed are thereby completely independent [DHM+08, p.17].

2.5.1.2. Domain scope

This dimension describes the primary master data domain that is affected by MDM. Across industries and organizations the kind of data, that is treated as master data, varies. Still it is possible to generalize master data into three different domains: party, location and product. These domains have interrelationships with each other that facilitate, if captured correctly, the answer to certain business questions (e.g., for a product it may be good to know which parties act as a supplier and in which locations the product is sold). An MDM approach may address one or multiple master data domains but the complexity of an MDM initiative rises with the number of domains considered: data models become more complex, more business applications are involved, and more master data objects have to be managed in total. For this reason, organizations should focus on the domain that is most relevant for their business to start out with. Otherwise the strategic scope required becomes too broad. [SGZ12, p.78], [DHM+08, p.13f], [BD11, p.21]

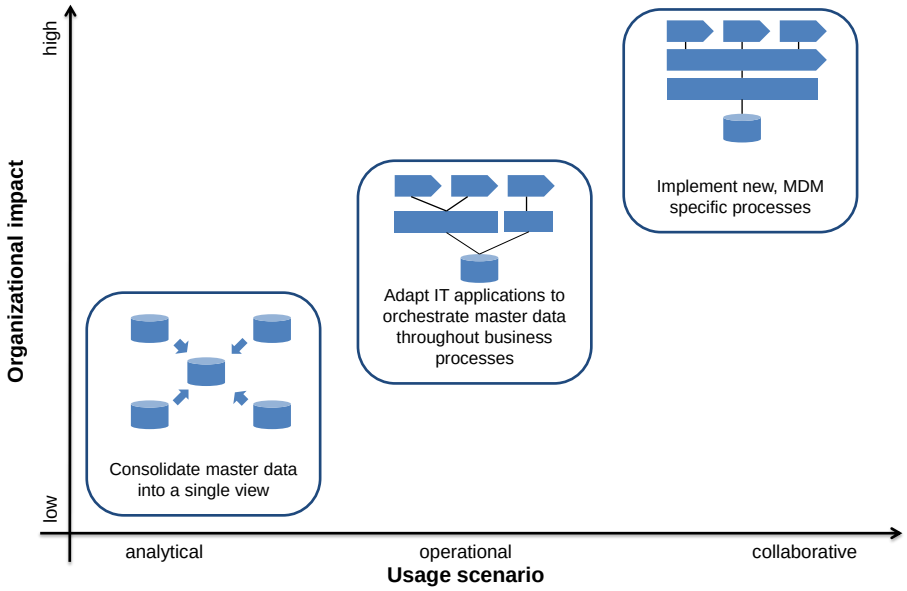


Figure 2.7.: Usage scenarios and organizational impact (adapted from [SGZ12, p.77])

2.5.1.3. Scope of distribution

The organizational scope of the distribution of master data is linked to the complexity of an MDM initiative. A distribution over multiple lines of business and possibly throughout the borders of an enterprise increases complexity. First, because the organizational aspects (cf. Section 2.5.2) increase and second because more business applications have to be integrated on an information systems level (cf. Section 2.5.3). With respect to the scope of distribution of master data, a differentiation is possible regarding functional MDM (within one department or branch), in-house MDM (within the enterprise), enterprise-wide MDM (comprising all enterprises in a network), and cross-enterprise MDM (inclusion of other partners such as suppliers). Figure 2.8 shows the relationship between the complexity of an MDM initiative and the scope of distribution of master data. [SGZ12, p.73f]

2.5.2. Organizational

Since Master Data Management impacts an organization as a whole, it is vital to coordinate functions, processes and structures of MDM across departments, business units, or enterprises [OH09]. In order for this to work, MDM requires its own organizational structures, processes and controlling system.

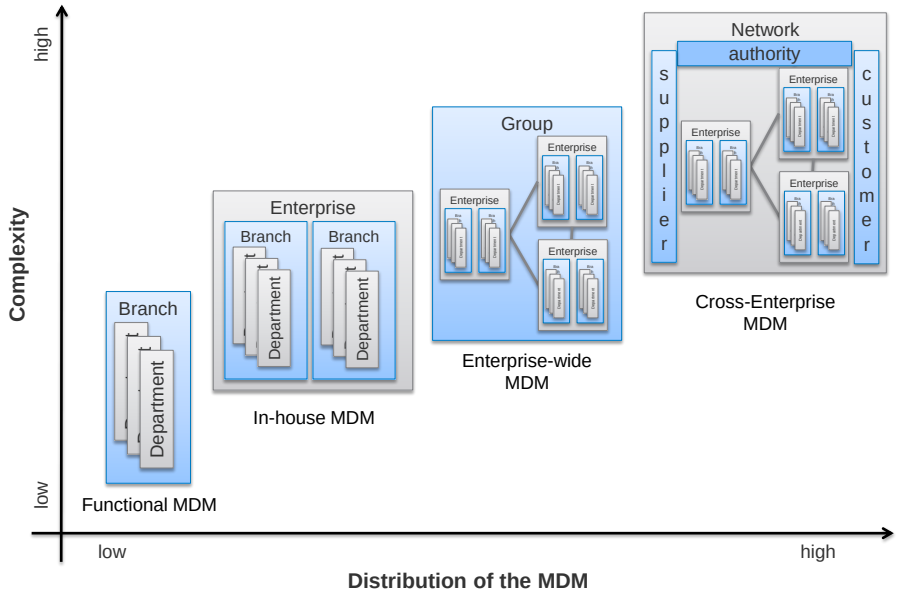


Figure 2.8.: Relationship between the complexity of an MDM initiative and its distribution scope (adapted from [SGZ12, p.74])

2.5.2.1. Controlling

In order to measure improvements compared to the situation prior to the initiative, a controlling function for MDM is required [OH09]. This primarily includes the creation and operationalization of metric systems to measure master data quality and related business improvements. As MDM is a supporting function that has no direct influence on the service provision of the organization it is crucial to link MDM to business value by measuring its impact on key business processes dealing with master data [RS08]. Having a controlling function with process oriented performance measurement already in place is a big advantage in achieving this task. Additional to the view on business process performance that supports the effectiveness of MDM, another view measuring data quality along the dimensions accuracy, completeness, consistency, relevance, timeliness, and accessibility (cf. Section 2.3)) will further back up the positive influence of MDM on overall master data quality. By combining both views it is possible to communicate the benefits of MDM in a consistent and comprehensible way in order to involve additional and retain existing business stakeholders. [SGZ12, p.163ff], [Rad09]

2.5.2.2. MDM Organization and Governance

Without a supporting cross-organizational structure and defined roles and responsibilities, MDM will fail to achieve its appointed goals and thereby improve busi-

ness capabilities. The design of an MDM organization is very specific to the individual enterprise as multiple case studies by the university of St. Gallen have shown (cf. [EHO11], [Sch09], [SHG10], [WO08a]). Generally, three different possibilities for organizing MDM are available that may be combined in practice [SGZ12, p.213ff]:

- **Formal organization:** People concerned with MDM tasks form a separate organizational unit with different possibilities regarding its characteristics (staff unit vs. cross-function, managerial responsibility, budgeting, etc.). A major advantage of this organizational form is that MDM has full-time resources available with clear responsibilities. Also it brings advantages in communicating and enforcing an MDM strategy. The downside of this organizational form is the significant initial effort required as well as its lack of close integration with other operational departments.

- **Virtual organization:** With this organizational form people remain in their original reporting line while being accessible for MDM specific roles and responsibilities. Not requiring a change to the existing organization and being flexible are major advantages of this organizational form. Challenges arise due to the additional responsibilities that may lead to conflicting interests and the threat that people act as stakeholders for their original organizational role instead of focusing on their role in the virtual team. This can negatively impact an MDM initiative.

- **External organization:** The MDM organization is implemented externally and not part of the basic organization (e.g., as a discrete enterprise in a networked organization). Again, this requires no changes to the existing organization and also bears benefits with regard to clear task responsibilities. On the other hand it requires a significant amount of co-ordination to achieve a consistent MDM strategy across all participating enterprises as well as the understanding that the external organization has the lead in managing the MDM initiative. Also regulatory issues may arise due to restrictions concerning sensitive data (e.g., customer data).

Regarding the applicability of these organizational forms for different types of organizations no agreed upon pattern exists. As already mentioned it is possible to combine these options (e.g., having a formal organization only for parts of the overall MDM) and apply them to the specific organizational needs and circumstances. The organization of MDM in practice is further elaborated in Section 2.6 by detailing two of the aforementioned case studies.

Master Data Governance with respective roles and responsibilities is the resulting governance discipline from the intersection of MDM and Data Governance (cf. Section 2.1.3) [BD11, p.404]. Its main focus is on defining role descriptions and decision authorities that are of relevance for Master Data Management to meet its

strategic goals. As master data is stored and shared across multiple lines of business and business processes it requires some differing role descriptions compared to general Data Governance, especially on the business side [DHM+08, p.484]. Specifically business people have to fulfill the following roles [DHM+08, p.484]:

- **Executive Sponsors:** Have overall responsibility for MDM. Represent top management support and are the true owners of master data at an enterprise level.
- **Business Data Stewards:** Management delegates with direct responsibility for master data (e.g., organized by master data domain). Take the lead in bringing together the key IT staff (e.g., IT Architects, Data Architects, Data Integrators, IT Management) and the key business staff (e.g., data stewards, data consumers, application owners) in order to push MDM. Focus is on metadata and governance concerns of master data objects.
- **Operational Data Stewards:** Responsible for daily oversight of the content and quality of the data. Typically organized by master data domain, subdomain, business process or location (depending on data load that individual stewards can manage or characteristics of master data domain). Focus is primarily on governing concrete instances of master data objects.
- **Business Analysts:** Possess deep domain knowledge about specific master data domains and especially about specific master data attributes (with regard to their formats and meaning across the enterprise). Represent critical resources in order to define master data and master data sources as well as to adapt new and existing business processes.

Establishing regular governance meetings consisting of these roles (and possibly further business and IT leaders) poses another challenge for the discipline of Master Data Governance [BD11, p.400]. Next to the people aspect, Master Data Governance has also a process aspect (cf. Section 2.5.2.3) that defines "how the business and IT users successfully collaborate to enhance and protect data as a strategic asset" [DHM+08, p.484]. This implies assessing the current state of the master data assets as well as continuously managing the quality of master data and accommodate for changes to the master data infrastructure and configuration [DHM+08, p.484].

Governance for master data does not follow an universal approach but has to be tailored to the specific organizational needs and contingencies [WOÖ09]. Also Master Data Governance has to be seen in the wider context of corporate and IT governance, not as an isolated discipline [Rad09].

2.5.2.3. Reference process models for MDM

In order to fully support all MDM design areas and to handle master data properly across the entire organization, procedures for the structured management of mas-

ter data (e.g., authoring, validating, enriching, publishing and consuming master data) have to be established throughout an organizations daily processes [OH09]. Subsequently two process models from recent literature to structure required tasks and activities for MDM are described.

Reichert, Otto and Österle [ROO13] propose a reference process model for Master Data Management involving a 3-level hierarchical structure: process areas group one or more main processes that themselves group further processes based on their purpose and task-oriented relationships. In total 38 processes were identified based on the analysis of 38 MDM departments by Otto and Reichert [OR10] that gave indications about activities already performed by MDM practitioners. This input was further reflected within focus group discussions among practitioners to finally design the reference process model and demonstrate its applicability within three participative case studies. From a structural point of view the reference model was inspired by the ARIS (Architecture of Integrated Information Systems) conventions for process architecture [DB07]. As depicted in Table 2.1, the model structures all processes hierarchically along the strategic, governance, and operational process areas which are described in the following listing [ROO13]:

- **Strategy:** Management processes to define the mid and long-term goals of MDM. As already mentioned in Section 2.5.1, MDM requires a vision and a strategy aligned to the overall strategy of an organization.
- **Governance:** Support processes to define standards for the operational activities related to MDM.
- **Operations:** Business processes to perform the actual core processes of MDM according to the standards defined within the governance process area.

The presented reference process model from Otto, Reichert, and Österle supports organizations in overcoming initial challenges with MDM, i.e., defining the scope of what needs to be coordinated and controlled and providing a starting point for the allocation of resources and responsibilities [ROO13].

Another reference process model is presented in [SGZ12, p.157ff]. In the context of this model, MDM is seen as a transformation program with a limited time frame. Therefor it is not directly applicable as a reference process model for an established MDM but as a guideline for the initial introduction of MDM. As depicted in Figure 2.9, the model is organized into three main process clusters, namely: management system, core processes and supporting processes. These main process clusters consist of multiple sub-processes which have been designed according to available best practice process frameworks: the management system cluster is mainly based on the *Standard for Program Management* by the Project Management Institute (PMI) [Ins08], the core sub-processes *Lifecycle Management* and *Data Quality Management* are designed according to the CobiT (Control Objectives for Information and related Technology) framework for strategic business process

Process Areas	Main Processes	Processes					
Strategy	**Strategic Functions**	Develop and adapt vision	Align with business and IT strategy	Define strategic targets	Set up responsibilities	Define roadmap	Develop communication and change
Governance	**Standards & Guidelines**	Adapt nomenclature	Adapt data life cycle	Adapt standards & guidelines	Adapt authorization concept	Adapt support processes	Adapt user trainings
	Data Quality Assurance	Identify business issues	Adapt measurement metrics	Adapt reporting structures	Define quality targets	Initiate quality improvements	
	Data Model	Identify data requirements	Model data	Analyze implications	Test & implement changes	Roll out data model changes	
	Data Architecture	Identify requirements	Model data architecture	Model workflows / Uis	Analyze implications on change	Test & implement	Roll out data architecture
Operations	**Data Life Cycle**	Manage requests	Create data	Update data	Release data	Use data	Archive / delete data
	Data Support	Provide trainings	Provide user support	Provide project support	Monitor & report data quality		

Table 2.1.: Reference process model for MDM according to [ROO13]

management [ITG09], and the supporting processes were inspired by IT service management processes according to ITIL V3 (Information Technology Infrastructure Library) [Buc07]. The following listing shortly explains the sub-processes:

- **MDM Program Management:** Includes central program management activities as for example stakeholder, benefits, change, and risk management. These activities are not further tailored for MDM but correlate with the definitions from the Standard for Program Management by the PMI.

- **Lifecycle Management:** This sub-process includes activities for managing master data objects as a continuous improvement process with the goal to leverage the productive use of master data within business processes throughout their entire life cycle. It requires the implementation of measures to support the master data life cycle consistently through processes and IT components. The sub-process is modeled as a feedback loop comprising plan, build, implement, and control activities as well as cross cutting activities like governance and change management. As already mentioned, this structure is aligned with the CobiT process for strategic business process management.

- **Data Quality Management:** As a prerequisite this sub-process requires finding answers to questions regarding the implications between business, data quality, and the required indicators and monitoring instruments. Based on

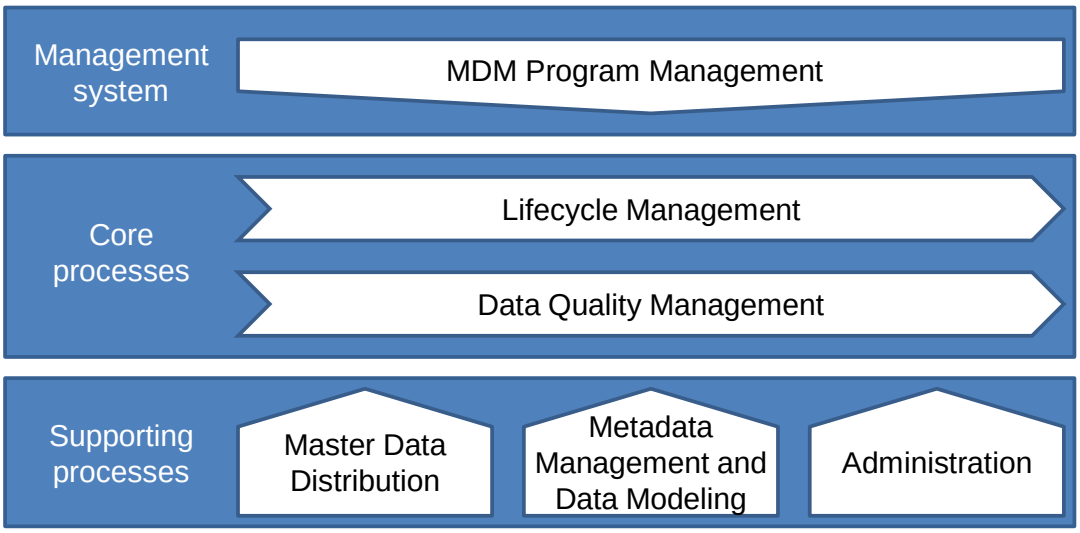


Figure 2.9.: Reference process model for MDM programs according to [SGZ12, p.157]

the outcome of these questions it has to plan, build, implement, and control all activities regarding data quality in the concerning departments. Therefor this sub-process is again modeled as a feedback loop for the continuous improvement of data quality according to CobiT. Also, this sub-process has to closely integrate with a possibly already existing DQM within the organization.

- **Master Data Distribution:** This support process aims at continuously improving the distribution, replication and harmonization of master data across information systems under the constraints of justifiable costs and quality. This requires processes for planning the integration and adaption of IT systems / IT components as well as managing their roll-out and operational supervision. It is realized as a service support process according to ITIL V3.

- **Metadata Management and Data Modeling:** As a supporting MDM process it enables the consistent management of metadata and data models along the life cycle of master data objects. Especially changes to the metamodel in the course of time (e.g., by including additional lines of business into an MDM initiative) require clear processes and guidelines to prevent confusion and misunderstandings. The sub-process therefor includes processes for managing the semantics of a unified glossary, and managing the change and enhancement of metadata models. Each process area is realized as an ITIL V3 service support process with a comprehensive continual service improvement process on top that monitors model quality and usage.

- **Administration:** Oriented towards the ITIL V3 process domains *Service Operation* and *Service Transition* this process primarily addresses support activities like request and incident management.

A comparison of the two process models is difficult because of the aforementioned factor that the model from Scheuch, Gansor, and Ziller[SGZ12] has its focus on MDM program management while the model from Reichert, Otto, and Österle[ROO13] applies to a formal MDM organization. Nevertheless, parallels between both approaches can be observed: both models distinguish between management processes, support processes, and business (core) processes. A mapping between processes is possible to a certain extent (e.g., *Data Quality Assurance* and *Data Quality Management*). In summary, looking at both approaches gives a comprehensive overview on MDM from a process perspective, more specifically what types of processes are required and how they can be structured.

2.5.3. Information systems

Information systems are the fundamental layer to support the cleansing, matching, distribution and usage of master data. Therefor, MDM requires an information systems architecture to support the aforementioned processes and functions. This implies decisions about which business applications and data sources are in scope or required additionally, which functionalities have to be provided, and how to integrate them on a logical and infrastructure level. As application landscapes have grown heterogeneously over the past, deciding on these topics is often no trivial task. Also, because most of these decisions are dependent on the outcome of decisions within the aforementioned design areas. For example, the intended usage scenario or the master data domains in scope have implications on the design of the information systems architecture. [SGZ12, p.40f], [DHM+08, p.26], [OH09]

The subsequent section presents design options concerning the system topology for MDM from literature. Afterwards, dedicated MDM applications and their functionalities provided are presented and discussed.

2.5.3.1. MDM system topologies

An ideal MDM system would manage a single copy of master data and all applications that use master data would read and write master data through services provided by this single system. Unfortunately achieving this ideal MDM system can be difficult (if not even impossible) because of confounding factors, such as [DHM+08, p.23]:

- an overly complex existing IT environment,
- master data that is not directly accessible but locked into packaged applications,

- achieving good performance, availability, and scalability in a complex and geographically distributed environment, and
- legal and compliance constraints that limit the movement of data across political or divisional borders.

To account for these circumstances, the general variety of individual situations in organizations, and the differing scope of MDM initiatives, researchers as well as practitioners have come up with different MDM system topologies.

Central system This approach consists of a dedicated MDM system that centrally consolidates master data from different sources [OO11]. Different implementation styles of this topology exist with respect to different synchronization and integration strategies: the *consolidation* implementation style represents a read-only system that transforms, cleanses, matches, and integrates master data from a variety of existing sources into a single managed MDM hub. This consolidated view of master data then serves as a trusted source to analytical downstream systems (e.g., data warehouses) that use, but don't update, the master data. Therefor, this implementation style primarily supports an analytical usage scenario. Another implementation style is the *coexistence* style. It constructs a consolidated view of master data the same way as in the consolidation style but in contrast to the consolidation style it does allow for updates on master data through the central hub that can be published to source and downstream systems. As master data may still be authored and updated by the source systems, this implementation style does not guarantee that the MDM hub contains the most up to date version of master data. Therefor, it can serve as an authoritative source of master data in a loosely distributed environment but it poses no ideal MDM system. The implementation style that is very close to an ideal MDM system is called *transactional* hub. In this implementation style the central MDM hub serves as the single version of truth for the master data it manages. All modifications to master data objects have to run through this system facilitating a central governance and requirements to control data quality. The disadvantage of such a system is the significant amount of change required to existing applications, business processes, and perhaps organizational structures which increases cost and complexity as already mentioned above. A more lightweight central approach to virtually integrating master data is called *Registry* (also *Directory* or *Repository*). It does not manage authorized versions of master data but instead holds a minimal set of data to uniquely identify master data records throughout source systems. Therefor, it serves as a read-only system that dynamically assembles the information in response to queries from other applications. As a consequence, this implementation style cannot enforce data quality requirements and assumes that source systems are able to adequately manage the quality of their own data. Figure 2.10 illustrates the central system topologies comprehensively. [DHM+08, p.26ff], [WRN07], [RWN06], [SGZ12,

Criteria	Central system				Leading System	Peer-to-peer
	Consolidation	Coexistence	Transaction	Registry		
Harmonization and consistency	Low	Medium	High	Low	Medium	High
Data storage and redundancy	Redundant data in business applications	Redundant data in business applications	Little redundancy	Redundant data in business applications	Redundant data in business applications	Redundant data in business applications
Latency	Batch to real time	Batch to event-driven	Real time	Real time	Real time	Real time
Usage scenarios	Analytical	Analytical, Operational, Collaborative	Analytical, Operational, Collaborative	Operational	Analytical, Operational, Collaborative	Analytical, Operational, Collaborative
Data quality approach	Central	Central / Federated	Central	Federated	Central	Federated
Effort required	Low	Medium	High	Medium	Medium	High
Benefits	Good data source for downstream systems, central control	Good data source for downstream systems, central control	Supports SOA integration	Complete view is assembled on request	Lightweight approach	Very flexible
Drawbacks	Read-only; not always current with source systems	Not always consistent with other systems	Cost and complexity	Complex to manage	Not always consistent with other systems	Complex to build and manage

Table 2.2.: Comparison of different MDM system topologies (based on [DHM+08, p.32], [SGZ12, p.286ff], [KW09], [BD11, p. 98ff])

p.287ff], [OO11], [KW09]

Leading system This system topology works without a dedicated MDM system that integrates data in a separate database. Instead, existing application systems (e.g., Enterprise Resource Planning (ERP) or CRM systems) are integrated to serve as a leading system for authorized versions of certain master data objects. A common solution is to choose the system with the highest expressiveness for the respective master data objects. In order to realize additional functionality (e.g., field adjustment or data cleansing) that are not part of the existing application it is possible to have an MDM system wrapping the leading system. [OO11], [KW09], [SGZ12, p.287ff]

Peer-to-peer This system topology is a relatively new approach and assumes neither a central system nor a central coordination of the data flows between integrated systems. All application systems working with master data are wrapped by peers and work in a networked structure where every system acts as a server and a client at the same time. It therefor "reflects the organizational structure of autonomous enterprises that directly and equitable share information and are responsible for the integration to their neighbors" [KW09]. Standards are used for the definition, description, and exchange of master data to provide for a semantical integration between systems, thereby avoiding a 'spaghetti integration scenario' with specialized one-to-one interfaces. The peer-to-peer style provides flexibility towards the integrated systems and allows heterogeneous behavior to a certain level while presenting themselves as a homogeneous system towards neighboring peers. [OO11], [KW09], [SGZ12, p.295ff]

Figure 2.11 illustrates these further system topologies for MDM while Table 2.2 gives a comparison of the different system topologies along a selection of criteria.

2.5.3.2. Functional capabilities for MDM

As already mentioned, MDM poses an application independent process not necessarily requiring the introduction of a newly acquired, dedicated MDM application. Nevertheless, it requires application systems to fulfill certain functionality necessary to support MDM. Otto and Hüner [OH09] present a functional reference architecture for Master Data Management that serves as a check list for functionality that is deemed necessary for doing MDM. This enables a comparison between functionality proposed by the reference architecture and functionality that is either already provided by existing business applications or provided by a possible dedicated MDM software solution available on the market. The reference architecture offers organizations guidance in the process of deciding on and evaluating an appropriate MDM information system foundation. Additionally, it supports this process by offering a basic terminology to create a common understanding for

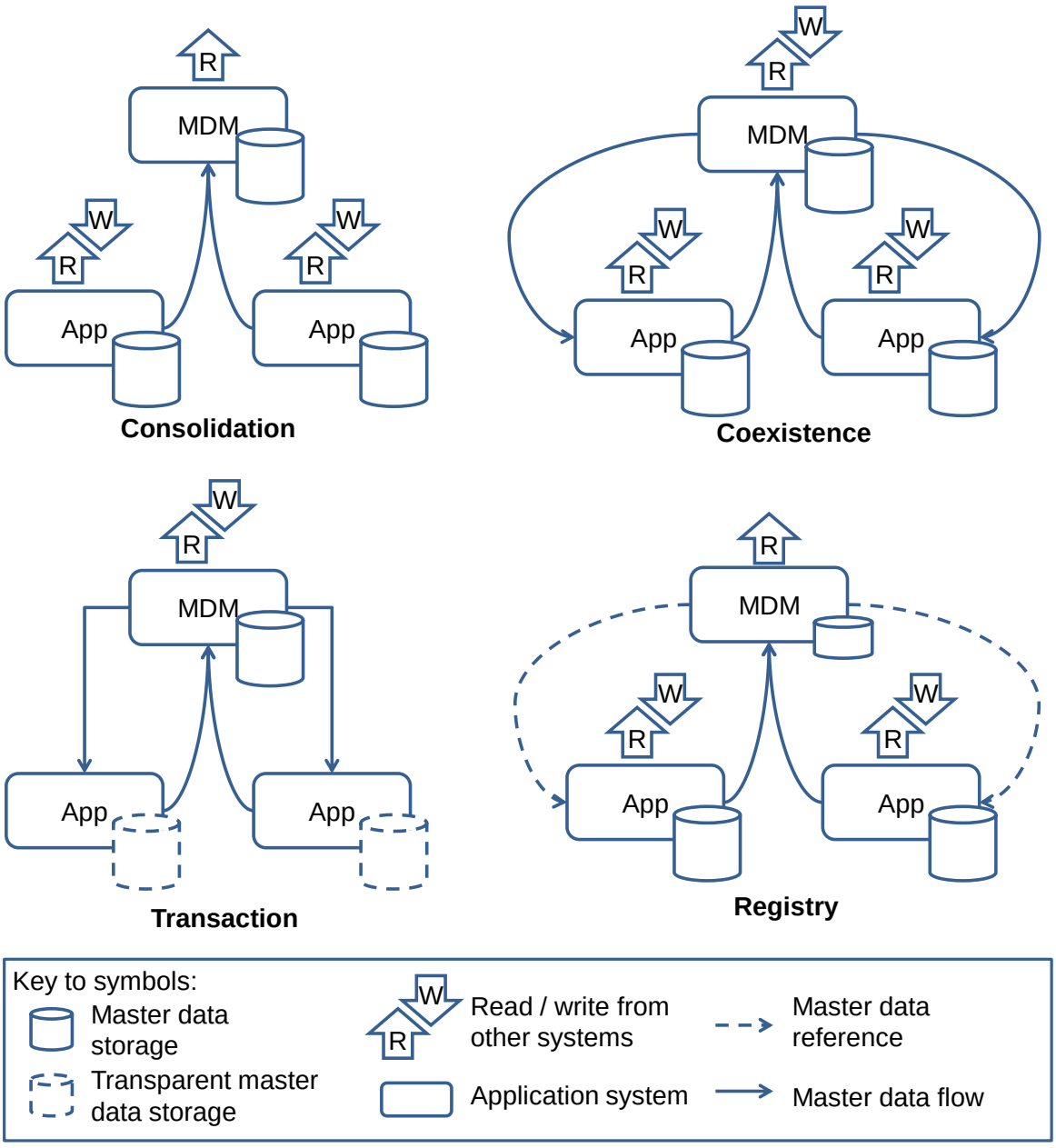


Figure 2.10.: Central MDM system topologies (adapted from [DHM+08, p.26ff])

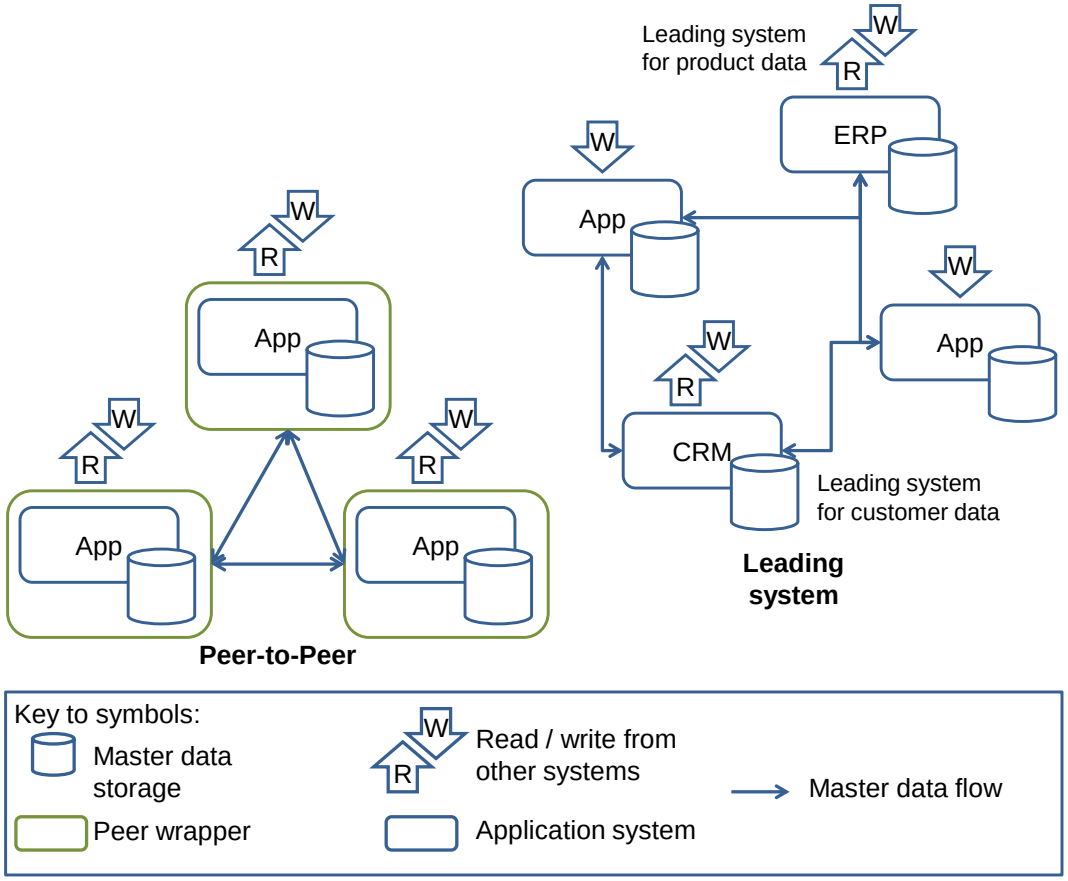


Figure 2.11.: MDM system topologies (adapted from [KW09])

communication about MDM functionality. The functional reference architecture is also adopted by Scheuch, Gansor & Ziller in [SGZ12, p.225ff].

The functional reference architecture specifies 72 discrete functions in total. These 72 functions are structured into 19 functional areas that are further abstracted by six functional categories. Table 2.3 gives an overview by illustrating the first two levels (functional categories and areas) of the reference architecture. The following listing shortly describes each functional category [OH09]:

- **Master Data Lifecycle Management:** Describes all activities data users or managers do with master data throughout their lifecycle (define, create, update, deactivate, archive).

- **Metadata Management and Master Data Modeling:** Specifies functionality to model and analyze the structure of master data (e.g., relational cardinalities between attributes) thereby creating metadata that also needs to be managed accordingly by application functionality. In general, MDM metadata

Functional categories	Functional areas			
Lifecycle Management	A1) Data Creation	A2) Data Maintenance	A3) Data Deactivation	A4) Data Archiving
Metadata Management and Master Data Modeling	B1) Data Modeling	B2) Model Analysis	B3) Metadata Management	
Master Data Quality Management	C1) Data Analysis	C2) Data Enrichment	C3) Data Cleansing	
Master Data Integration	D1) Data Import	D2) Data Transformation	D3) Data Export	
Cross Functions	E1) Automation	E2) Reports	E3) Search	E4) Workflow Management
Administration	F1) Data History Management	F2) User Management		

Table 2.3.: Functional categories and areas according to [OH09]

contains all information required for the efficient management and effective usage of master data.

- **Master Data Quality Management:** Contains all functions regarding the preventive and reactive management of master data quality.
- **Master Data Integration:** Comprises functionality to support the transfer (import and export) as well as structural transformation (e.g., consolidation of fields) of master data.
- **Cross Functions:** Comprises functionality that cannot be assigned to any of the other categories (e.g., functionality for reporting, search or workflow management)
- **Administration:** Comprises mainly functions for user administration.

An organization implementing MDM should consider this set of functionality as a baseline (not an ultimate catalog of MDM functionality) that can be on the one hand tailored to a specific usage scenario (e.g., a purely analytical MDM approach will require significantly less functionality) and on the other hand further complemented with organization-specific aspects and functionality.

Next to the functional reference architecture of Otto and Hüner [OH09], Dreibelis et al. [DHM+08] present key capabilities that support the implementation of an

MDM solution. The main structure of these capabilities is similar to the functional categories proposed by Otto and Hüner [OH09] and is further explained by the following listing [DHM+08, p.101ff]:

- **Master Data Lifecycle Management Capability:** As mentioned earlier, master data have a long lasting lifecycle and therefor require a consistent management of all concerning activities. This capability comprises all functionality regarding the lifecycle of master data and can be mapped to the functional category *Master Data Lifecycle Management* by Otto and Hüner.
- **Data Quality Management Capability:** Comprises information integrity functionality to account for high quality, standardized master data. A mapping to the functional category *Master Data Quality Management* by Otto and Hüner is possible.
- **Master Data Harmonization Capability:** Describes functionality for integrating and distributing master data across an organization and is therefor similar to the functional category *Master Data Integration* as proposed by Otto and Hüner.
- **Analysis and Insight Capabilities:** This category comprises additional functionality that cannot be directly associated to one of the other categories. For example functionality to provide insight into master data relationships or the access to unstructured information sources. Also, functionality related to a business rule engine and workflow management is subsumed under this capability category. This category represents a hybrid of *Metadata Management* and *Cross Functions* when mapped to the functional categories from Otto and Hüner.

Again, both sets of functionalities respectively capabilities are neither an exhaustive nor a minimal set of functionality that an MDM application has to fulfill but rather provide guidance throughout the analysis and design phase of an MDM initiative.

2.5.3.3. Reference component models

In literature different reference models composed of components (or service clusters) exist, providing a more detailed view on how an industry- and data domain-agnostic MDM solution looks like. Dreibelis et al. [DHM+08, p.119ff] provide coarse-grained architecture building blocks and describe responsibilities of components within these building blocks. Berson and Dubov [BD11, p. 105ff] describe a multi-layered architecture where each layer consists of key service components facilitating an MDM solution. Also Scheuch, Gansor & Ziller [SGZ12, p.267ff] provide an architecture that consists of coarse as well as fine-grained services required

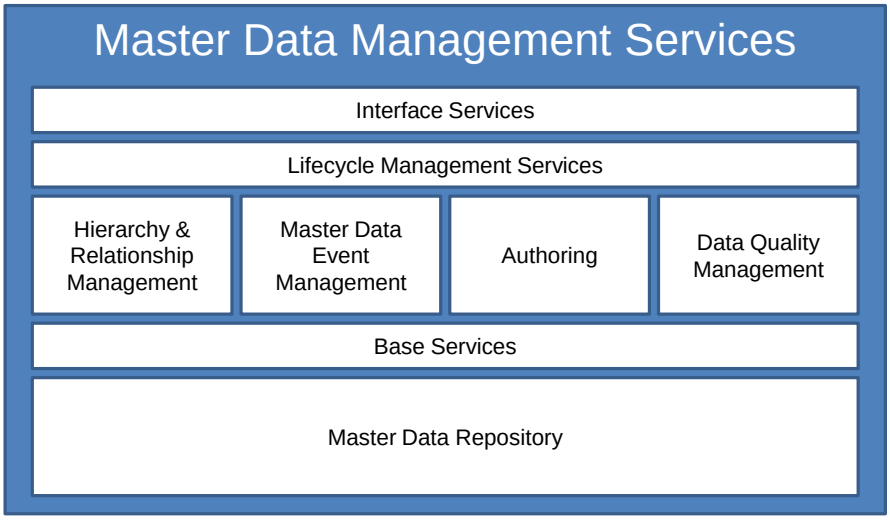


Figure 2.12.: MDM component model according to [DHM+08, p.119]

to fulfill MDM functionality. All three reference models have in common that they leverage a *Service Oriented Architecture* (SOA) approach for MDM. In short, SOA is a conceptual business architecture where reusable and loosely coupled business services encapsulate functionality or application logic that can be invoked by consumers through well defined and standardized interfaces [MB06, p.1]. By combining these standardized services to fulfill business requirements, a SOA aims at facilitating an agile and flexible application landscape [Fes10]. Furthermore, SOA and MDM are perceived to be in a symbiotic relationship, where on the one hand MDM profits from SOA design principles (i.e., service reuse, granularity, modularity, composability, monitoring and tracking) and on the other hand enables a SOA by providing consistent use of master data entities as a basis for business processes that interact with a SOA [Fes10], [DHM+08, p.64ff], [BD11, p.95f] [SGZ12, p.264f].

To illustrate an MDM reference component model in more detail, the approach from Dreibelis et al. [DHM+08, p.119ff] is described subsequently. The component model consists of eight layered architectural building blocks (coarse-grained services), each clustering more fine-grained subcomponents and / or services. Figure 2.12 illustrates the main building blocks of the component model. The following listing further explains the building blocks and selected fine-grained services [DHM+08, p.119ff]:

- **MDM Interface Services:** Provides a gateway to facilitate interaction between internal MDM services as well as external IT components or data providers by supporting a variety of integration techniques (Batch, Messaging, Publish / Subscribe, Adapters, etc.). Makes sure that regardless of the integration technique used for a request, the same business logic is applied consistently. To validate authorization to a service request, basic services for

security and privacy (as included in the building block *Base Services*) can be invoked before delegating requests.

- **MDM Lifecycle Management Services:** Provides services by master data domain to create, access, and manage master data held within the *Master Data Repository*. This includes for example simplistic services to add or update a business partner record but also more sophisticated services for enabling data stewardship to support manual reconciliation of conflicts or relationships. *Lifecycle Management Services* invoke *Data Quality Services*, *Master Data Event Management Services*, and *Hierarchy and Relationship Management Services*.

- **MDM Data Quality Management Services:** Consists of services to establish and maintain consistent and standardized data within the *Master Data Repository*. Comprises fine-grained services to validate and cleanse (e.g., enforce standardization rules), match and reconcile (e.g., deterministic matching of business partner records based on social security number), and cross reference master data (e.g., manage external reference keys to further enrich a master data record).

- **MDM Authoring Services:** Are used to support the authoring of master data as well as to protect its integrity while multiple users interact with the same master data record simultaneously. This includes services to define the schema for master data, to enable the modification of hierarchy structures and relationships, and to enable concurrency while ensuring consistency (check-in and check-out).

- **MDM Master Data Event Management Services:** Comprises services to detect events and trigger operations based on business rules or schedules. For example the archival of unnecessary master data after a legal retention period. Supports the implementation of Data Governance policies by providing notification services to notify data stewards in case verification of data changes is required.

- **MDM Hierarchy and Relationship Management Services:** Required to build and administrate master data relationships as well as to organize master data entities into groupings and hierarchies (logical parent-child relationships). Additionally comprises versioning capabilities to understand how relationships changed over time as well as capabilities to establish different views on master data.
- **MDM Base Services:** Provides basic services that can be further categorized into *Security & Privacy*, *Audit Logging*, *Workflow*, and *Search* services. *Security & Privacy* services enable user authorization and fine-grained access to data. *Audit Logging* services allow to preserve the history of transactions and events. *Workflow* services provide the ability to model and administrate workflows in order to support authoring of master data, business processes, or Data Governance. *Search* services enable the definition and execution of queries on up to date master data as well as history data.
- **MDM Master Data Repository:** The Master Data Repository comprises databases that store master data definitions, actual instances of master data, history data, and metadata.

This approach is primarily relevant for the central MDM system topologies described in Section 2.5.3.1 and requires tailoring according to the usage scenarios presented in Section 2.5.1.1. In addition to the *Master Data Management Services* described above, the approach from Dreibelis et al. assumes the presence of *Information and Integration Services* as well as *Identity Analytic Services*.

2.5.3.4. MDM products and solution offerings

Meanwhile organizations see themselves confronted with a variety of product and solution offerings by vendors claiming to meet functional MDM requirements. Gartner expects that the worldwide MDM software market will reach 3.2 billion US Dollar in revenue by 2015 dominated by the three major players IBM, SAP and Oracle [PvdM12]. Table 2.5.3.4 provides an overview of selected products offered specifically for MDM. Some of these products claim to support all possible master data domains and objects others only a selected set. Each product is also usually part of an overall integration solution requiring an integration platform and therefor not applicable as a stand-alone solution. For every product a link is given to get further details from the manufacturers themselves. In [KW09] Kokemüller and Weisbecker evaluated these products with respect to their capabilities regarding data modeling, security and data quality. Otto and Hüner [OH09] evaluated a subset of these products to whether or not they meet the requirements proposed by their functional reference architecture. But as already mentioned, buying a dedicated MDM solution is neither a prerequisite nor a success factor for an MDM initiative. Foremost it is required to define a clear MDM vision and strategy to

subsequently derive a set of required functionality and analyze the current (as-is) and planned application landscape as to whether certain functionality can be provided. Also, regarding the complexity of MDM, it cannot be assumed that a single vendor can provide an all-in-one, out-of-the-box comprehensive MDM solution that addresses all business and technical requirements [BD11, p.44].

Vendor	Product name
IBM	IBM InfoSphere Master Data Management[a]
Oracle	Oracle Master Data Management Suite[b]
SAP	SAP NetWeaver Master Data Management[c]
TIBCO	TIBCO MDM[d]
STIBO Systems	STEP Uniform MDM Platform [e]

Table 2.4.: Selection of vendors and according MDM software solutions

[a] http://goo.gl/oUm5A, accessed 26.06.2013
[b] http://goo.gl/2SPbT3, accessed 26.06.2013
[c] http://goo.gl/oIGUR5, accessed 26.06.2013
[d] http://goo.gl/0kr7SF, accessed 26.06.2013
[e] http://goo.gl/LfTERd, accessed 26.06.2013

2.6. Findings from MDM case studies

To illustrate common problems regarding the management of master data from a practical viewpoint and to describe corresponding solution approaches, two case studies conducted by the CC CDQ of the University of St. Gallen will be presented and analyzed subsequently.

2.6.1. Deutsche Telekom AG [SHG10]

Deutsche Telekom AG (DTAG) is a German service provider active in the telecommunications and information technology market with a revenue of 58 billion Euro and over 200.000 employees worldwide [AG12]. The telecommunications business focuses on stationary broadband (T-Home) and mobile services (T-Mobile) for private customers, whereas the information technology business (T-Systems) focuses on servicing commercial customers.

2.6.1.1. Need for action

The decision to merge the former separately operating business units T-Com (for fixed line services) and T-Online (for stationary broadband services) into T-Home

resulted in the need for a data quality management approach with focus on master data. Previously no systematic management of business data was practiced and data quality approaches were reactive and ad hoc. To be able to offer and bill integrated services composed of fixed line and broadband services it was necessary to consolidate the partly redundant customer and infrastructure master data of the former discrete business units T-Com and T-Online. Because of diverging data models and different priorities concerning data attributes the matching of redundant data objects was no easy task and required a lot of manual effort.

DTAG faced the following core problems with regard to master data that required need for action:

- Lack of transparency about which data objects are required enterprise-wide and in which quality.
- No common understanding about master data objects leading to ambiguous understandings and inconsistent usage.
- Lack of roles and responsibilities for maintaining master data.
- No transparency about the origin and distribution of master data objects in the current system landscape.

2.6.1.2. Solution approach

In order to tackle these problems, DTAG decided to establish discrete organizational units to coordinate and bundle measures for DQM at the new business unit T-Home centrally. The result were two departments concerning DQM: one business department to consolidate business requirements regarding master data serving as the central contact for DQM from business side and an MDM department located in the central information technology department of the business unit to support business demands regarding DQM from an information technology perspective. The MDM department works in close cooperation with the enterprise IT architecture department. With these organizational changes in place, DTAG started a unified modeling approach for business and data objects across all layers of their Enterprise Architecture (EA). This comprises at the top level a business process model including related business objects that are described by a business object glossary from a business point of view. Subsequently the Business Object Model (BOM) as a conceptual data model details the semantics and relationships of business objects used. The BOM integrates terminology from business and IT and was created during modeling workshops with representatives from both sides. As a basis and reference for creating the BOM, an industry specific Shared Information & Data Model (SID) was used.

Additionally a data map was created in close cooperation with the enterprise IT architecture department. Its intention is to identify and visualize silos of master

data as a basis for analyzing the application landscape towards data redundancy and consolidation potential.

Another aspect of the solution approach at DTAG was the definition of dedicated roles and responsibilities for Data Management. Per business object, one data responsible (usually originating from the management level) was defined who has the final decision right regarding the business object. Furthermore every business object has two data architects (one from business and one from IT) assigned to manage the evolution of the object with respect to the BOM. For managing the actual data objects within business applications, every business object has additionally two data managers (one from business and one from IT) assigned that act on behalf of the data responsible. As a supervising instance for controlling data quality, further data quality managers have been put in place.

2.6.1.3. Benefits

The main benefits of the MDM approach at DTAG in the business unit T-Home can be summarized as follows:

- A uniform conceptual master data model based on a harmonized glossary facilitates communication between business and IT.
- The central definition of business objects avoids redundant and inconsistent re-definitions within projects. This implies the reduction of additional work and costs.
- A uniform conceptual master data model serves as a basis for consolidating the application landscape and for integrating additional service providers.

These observed benefits are all qualitative and draw on the definition of consistent data models across all architectural layers. Nevertheless, according to the authors of the case study, educated guesses by experts predict possible savings of 0.8% of the overall IT budget for T-Home based on the described benefits.

2.6.2. SBB Cargo AG [Sch09]

The SBB Cargo AG is the market leading logistics provider for rail freight services in Switzerland with a revenue of one billion swiss franc and over 4000 employees. Of strategic importance for SBB Cargo is the Alps crossing freight transport connecting the North Sea with Italy since the market deregulation in 2001. SBB Cargo AG comprises three subsidiary enterprises: ChemOil Logistics, SBB Cargo Germany, and SBB Cargo Italy.

2.6.2.1. Need for action

The market deregulation in 2001 was the start of a rapid business transformation to service the aforementioned cross-border transport and required internal re-organization, adjustment of business processes and the introduction of new services. The transformation neglected the management of master data resulting in a situation where master data was only managed project specific with no superior department in the organizational structure that coordinated activities for the overall usage of consistent master data. As a result, new projects didn't make use of already available functionality and master data but implemented their own definitions of master data with incompatible data models, key attributes and identifiers. A difficult to oversee application landscape with many point-to-point interfaces and redundant silos of incompatible master data developed over time. Reporting and controlling capabilities (as cross cutting functions requiring comprehensive data) suffered in particular from this situation. Also planning activities were negatively impacted by the insufficient quality of master data.

In summary, the following problems regarding master data haven been observed:

- Lack of a master data strategy addressing questions regarding the need for master data and future developments.
- No uniform definitions and structures for the organization's master data objects.
- Lack of roles, responsibilities and coordination for maintaining master data.
- No transparency about the origin and distribution of master data objects in the application landscape.

2.6.2.2. Solution approach

The defined master data strategy of SBB Cargo states as long-term goal the establishment of an enterprise-wide integrated, service-based MDM. As a first milestone towards this goal, a uniform understanding about master data objects throughout the organization was created. A newly formed master data project team in cooperation with process owners and business stakeholders started to identify business objects along business processes to create a unified glossary as a basis for future harmonization initiatives. In addition to a unified description of the business object, the glossary comprised a mapping of the object to processes, application systems and an assigned data owner. The intended audience for the glossary are the business departments in order to establish a enterprise-wide business terminology. Within the same project team, roles and responsibilities were identified and defined comprising the central data owner for a business object as well as further roles for implementing operational Data Management.

The master data project team also had to make sure that current and future projects adhere to defined project management processes as a measure to prevent incompatible data definitions and models. Mandatory project milestones were defined to check for consistency with the defined data glossary. Project managers have to identify business objects that are in scope of their project and are obliged to define a data concept in cooperation with the respective data owners.

Until the date this case study was conducted, the MDM initiative did not have any impact on the information systems level of SBB Cargo since the definition and modeling of uniform business objects was not finished. The long-term goal is to define a leading system for each master data object and subsequently consolidate the systems architecture.

2.6.2.3. Benefits

The preliminary benefits of the MDM initiative after the first completed projects can be summarized as follows:

- Reduced amount of faulty financial reports due to increased transparency about the origin of master data and assigned data owners.
- Reduced administrative overhead for correcting data errors manually.
- Increased awareness regarding the importance of employing high quality master data.

According to the author of the case study, further business benefits are expected especially in the area of financial reporting.

2.6.3. Analyzing the case studies

Both case studies reveal the complexity of MDM initiatives in practice as well as the implications on all architectural layers of an enterprise. Table 2.5 classifies both case studies with respect to their design options in the strategic design area and states the core business requirement as a starting point for the MDM initiative. By further analyzing both case studies with respect to their similarities the following observations can be made:

- Within both cases the need for harmonizing business terminology throughout departments as a means to facilitate communication was recognized and addressed in an early phase.
- Approaching MDM from a business side by analyzing core processes serves as a basis to identify relevant master data objects and concerning IT systems.

- Conceptual (master) data modeling in cooperation with people from business and IT served as the groundwork for future harmonization approaches on an information systems level.
- Both case studies used the MDM initiative as a means to introduce roles and responsibilities for business data. This finding is also backed up by a survey from late 2011 reporting that 69% of organizations which introduced Data Governance as well as MDM felt that both initiatives are mutually supportive and that implementing Data Governance is important to deliver a successful MDM initiative [Wad12].

	Deutsche Telekom AG	**SBB Cargo**
Usage scenario	Operational	Collaborative
Domain scope	Party, Location	Party, Location
Scope of distribution	Functional	In-house
Business requirement	Merger of two business units	Cash-flow reporting

Table 2.5.: Classification of case studies regarding the strategic scope

Unfortunately, none of the cases explicitly details the process of constructing the required business rationale for its MDM approach. Both cases limit their justification of the MDM initiative to a concrete business requirement (see Table 2.5) that is negatively affected by the current situation regarding master data and give a qualitative assessment of potential benefits. In comparison, findings from other MDM initiatives indicate that a clear business case linking MDM to potential financial outcomes is required to achieve and sustain business engagement [RS08]. Accordingly, the thesis at hand subsequently describes a method to identify and document goals for MDM in order to gain the necessary support from management stakeholders.

3. Method for identifying organization-specific MDM goals

After dealing with the theory of Master Data Management and detailing its design areas to give the reader an understanding of the complexity of MDM, this chapter proposes a method backed up by a conceptual model for identifying organization-specific goals for MDM.

The method is applicable in order to get a more detailed understanding of what an organization wants to achieve with MDM, thereby laying the foundation for developing a clear MDM vision, strategy, and roadmap subsequently. It assumes that certain demands from business (e.g., developing a customer centric view on business) have been mapped to the topic Master Data Management and that sponsorship and budget for a preliminary MDM assessment is assured. The outcome of this preliminary investigation can be used to motivate business stakeholders and foster upper management support by justifying the business value of Master Data Management. The need for articulating and justifying the business value of MDM as a basis for developing a comprehensive roadmap is stated recurrent throughout MDM literature (cf. [SGZ12, p.122], [Los10, p.10], [BD11, p.288 & 296], [DHM+08, p.490], [Rad09], [SM08]). Nevertheless, practical guidance for the required tasks is scarce, unstructured and scattered throughout various book chapters and articles from analysts, i.e., Gartner with a varying level of detail and thereby practical applicability. The method and conceptual model proposed within this chapter addresses this shortcoming by combining findings from literature and expertise from the industry partner in order to create a structured, activity based process for practitioners to follow. Both artifacts have been reviewed and approved within a focus group discussion including three Data Management professionals from the industry partner.

Before introducing the method and the conceptual model, the following section describes design principles as a basis for developing the aforementioned method and conceptual model.

3.1. Design principles

In their *Design Science Research Methodology* Peffers et al. [PTRC07] point out the importance of defining objectives of a solution before starting out design and development. Also, by definition, a method should be based on guiding princi-

ples [Sou13]. Accordingly, principles have been defined to support the development of a conceptual model and method for identifying organization-specific MDM goals. These principles have been developed in cooperation with industry partner and are backed up by literature.

3.1.1. Goals as a means to support strategic initiatives

As already pointed out in Chapter 2, implementing MDM has to be seen as a strategic initiative [OH09]. Every strategic initiative requires goals for orientation and alignment to prevent the focus of an initiative from becoming too narrow and short-term [WAL08, p.199]. Goals therefor describe a future target state that is subject to achieve [Hei66, p.45] and act as a tool to motivate, control, measure and incentivize involved stakeholders [WAL08, p.200].

For these reasons, the formulation of goals is perceived as a key solution objective that serves as a groundwork for the further planning of an MDM initiative [Los10, p.37]. Goals in general ought to be SMART [Dor81]: **S**pecific, **M**easurable, **A**ttainable, **R**elevant, and **T**ime-bound. Therefor MDM goals should also adhere to these criteria whereat the time-bondage of proposed goals will not be in scope of this thesis.

3.1.2. Alignment with business and IT strategy

A proposed solution for identifying organization-specific goals has to consider that MDM may be driven by business and / or IT strategy [BD11, p.286f]. By aligning MDM goals with the business vision and resulting business and / or IT objectives, the rationale behind MDM and how it can foster organizational capabilities is likely to become more clear to stakeholders from upper management who were involved in the process of explicating the business vision and related objectives [Rad09], [DHM+08, p.490]. Without a close alignment to an organization's strategic objectives, MDM may appear as a solution looking for a problem to solve and therefor struggle to achieve the required management attention [RS08].

3.1.3. Core processes as a basis for highlighting business value

In order to demonstrate the business value of an MDM solution and thereby motivating business stakeholders it is required to identify core business processes that can be improved or enabled with managed master data [BD11, p.319], [Kar06]. Without a clear link to the improvement of core business processes, funding requests for MDM are likely to be rejected or postponed as executive management wishes to know which divisions will ultimately benefit from the MDM initiative and how [BD11, p.288]. Therefor, explicating the (positive) impact of MDM on

core business processes is a key part in creating a compelling value proposition for MDM and thereby justifying the resources and effort required (cf. Section 2.4.1).

3.1.4. Performance indicators to measure success

Next to the alignment with strategic objectives and a clear linkage to business value, a method for identifying MDM goals has to incorporate the need for measuring the achievement of the proposed value added [Los10, p.240], [Rad09]. Dedicated performance indicators (commonly referred to as KPIs) represent a quantitative approach to check the degree a particular MDM goal is currently fulfilled. A performance indicator can be defined as "an item of information collected at regular intervals to track the performance of a system" [FG90, p.1]. A direct link between goals and and KPIs measuring their achievement is perceived important, amongst others, by [FHKS08]. Accordingly, the method has to elaborate on information required to track how an MDM goal performs regarding the achievement of its objective. This implies that it has to be measured by metrics that are most suitable given the context of the goal and not exclusively by data quality related metrics [RS08]. For example, if a goal is related to the improvement of a certain business process, the appropriate performance indicator should be based on business performance metrics (e.g., process cycle time) and not on the accuracy of master data that support the process.

3.1.5. Issues in current environment as basis for need to act

Drawbacks with regard to the handling of master data in the current business process and / or application landscape are the catalysts and rationale for moving towards Master Data Management [Los10, p.31]. Therefor, the description and analysis of the current state of an organization is of importance for identifying the key business and technical drivers behind MDM [DHM+08, p.490]. In order to support MDM goals, a proposed method therefor requires to point out the need to take action based on specific issues with the current state.

3.1.6. Support through drivers

In this sense a driver represents a (abstract) supporting factor. A driver may appear as a stakeholder, a project or anything else that has positive influence on a specific subject. In Section 2.3 for example, business benefits were presented as drivers for engaging Master Data Management. Accordingly, a method for identifying MDM goals has to extract all relevant drivers for MDM within an organization and relate these drivers in the sense of supporting factors to specific goals. This way, drivers form a part of the rationale behind a goal.

3.1.7. Incorporate lessons learned

Systematically searching for earlier (Master) Data Management approaches and investigating the rationale that formed their basis is perceived a worthwhile task. Important aspects regarding MDM or Data Management in general may have already been covered by previous projects that provide valuable insights and lessons learned. Accordingly, a method for identifying organization-specific MDM goals should not neglect the importance of searching and extracting the findings and lessons learned from previous approaches.

3.2. Conceptual model

Based on the defined design principles, a conceptual model as UML (Unified Modeling Language) [OMG05] class diagram was created as a means to oversee the overall context of an MDM goal (cf. Figure 3.1). The following paragraphs explain how certain design principles are covered in this model.

Goals as a means to support strategic initiatives `MDMGoal` forms the central object within the model and thereby connects all relevant constructs that form the justification and support for an MDM initiative. An `MDMGoal` can have a generalization relation to other `MDMGoal`s depending on the desired granularity of goals.

Alignment with business and IT strategy In order to cover this principle an `MDMGoal` has to relate to at least one `StrategicObjective` which may represent either a `BusinessObjective` or an `ITObjective` depending on whether the objective originates from IT or business strategy.

Performance indicators to measure success The design principle *Performance indicators to measure success* requires MDM goals to be measurable regarding the achievement of its objective. Therefor, an `MDMGoal` relates to at least one `KPI`. A `KPI` may represent a `Business-KPI` if it originates from business and, for example, measures the runtime of a business process. Alternative, a `KPI` may represent an `IT-KPI` if it originates from a metric used within IT (e.g., a metric to measure data quality or the homogeneity of the application landscape). As indicated in the model it is also possible that a `KPI` abstracts other `KPI`s by aggregating them. Furthermore, to specifically capture the value added, a `KPI` should relate to one or more `FinancialStatement`s. For example a performance indicator measuring the number of up-sells per customer can be set in direct relation to revenue as a value of `FinancialStatement`.

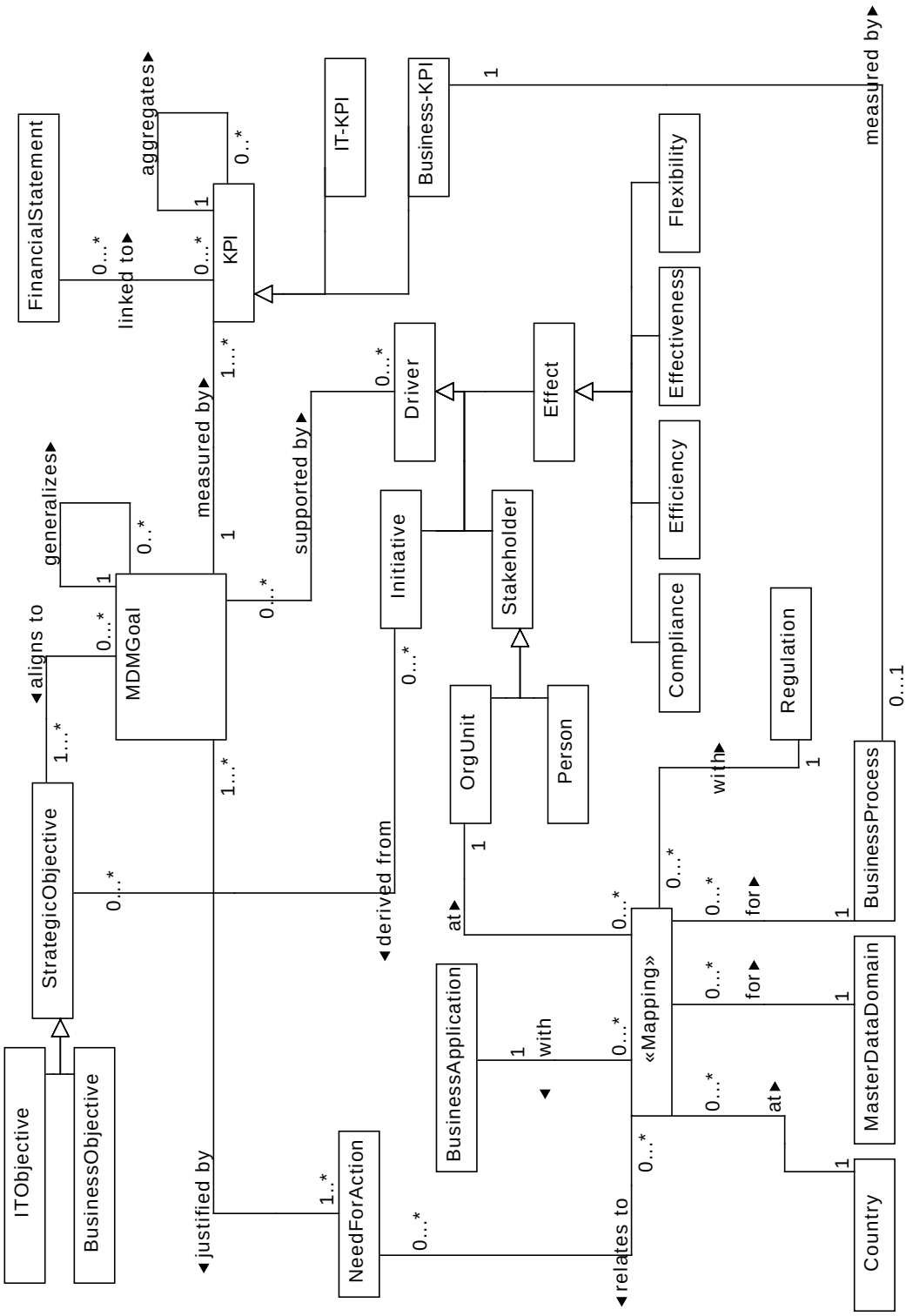


Figure 3.1.: Conceptual model as UML class diagram

Issues in current environment as basis for need to act According to this principle, drawbacks in the current situation regarding master data in the business and / or application landscape should form the rational for moving towards MDM. In order to capture the current situation, the conceptual model comprises a mapping between `BusinessApplication`, `OrgUnit`, `BusinessProcess`, `MasterDataDomain`, `Regulation`, and `Country`. Issues regarding the current situation are then expressed using the construct `NeedForAction` as an extension to the mapping. For example a `NeedForAction` may relate to a suboptimal situation where party master data for a pre-sales process is stored in different CRM applications for different countries. Ultimately an identified `NeedForAction` then serves as a justification for a specific `MDMGoal`.

Support through drivers Drivers represent supporting factors for MDM goals. Accordingly in the conceptual model an `MDMGoal` relates to one or more `Drivers`. In this context a `Driver` may represent either a `Stakeholder` (which comprises an `OrgUnit` or a specific `Person`), an `Initiative` or an `Effect`. An `Effect` is modeled as a generalization and represents the clusters of business benefits that were introduced in Section 2.3.

3.3. Process steps of method

The proposed method for identifying organization-specific MDM goals is structured into multiple process steps that have been modeled using an UML activity diagram (cf. Figure 3.2). The following paragraphs describe each process step in more detail and cover as a whole the design principles described in Section 3.1. The described output of process steps serves always as input for subsequent process steps even if this is not explicitly stated in the process descriptions.

For practicability reasons each process step is also described using a structured template (cf. Figure 3.3). The structured process step descriptions can be found in the Appendix B.

Initial setup In order to carry out the preliminary investigations and collect necessary information regarding MDM that will serve as the basis for compiling organization-specific goals, it is required to commission a project team [DHM+08, p.493]. Scheuch, Gansor and Ziller [SGZ12, p.308] recommend setting up a consultancy project for this purpose consisting of two people, one being an experienced executive consultant and the other a business analyst with MDM and EA project experience.

Investigate former (Master) Data Management approaches As requested by the design principle *Incorporate lessons learned* the commissioned team does not neces-

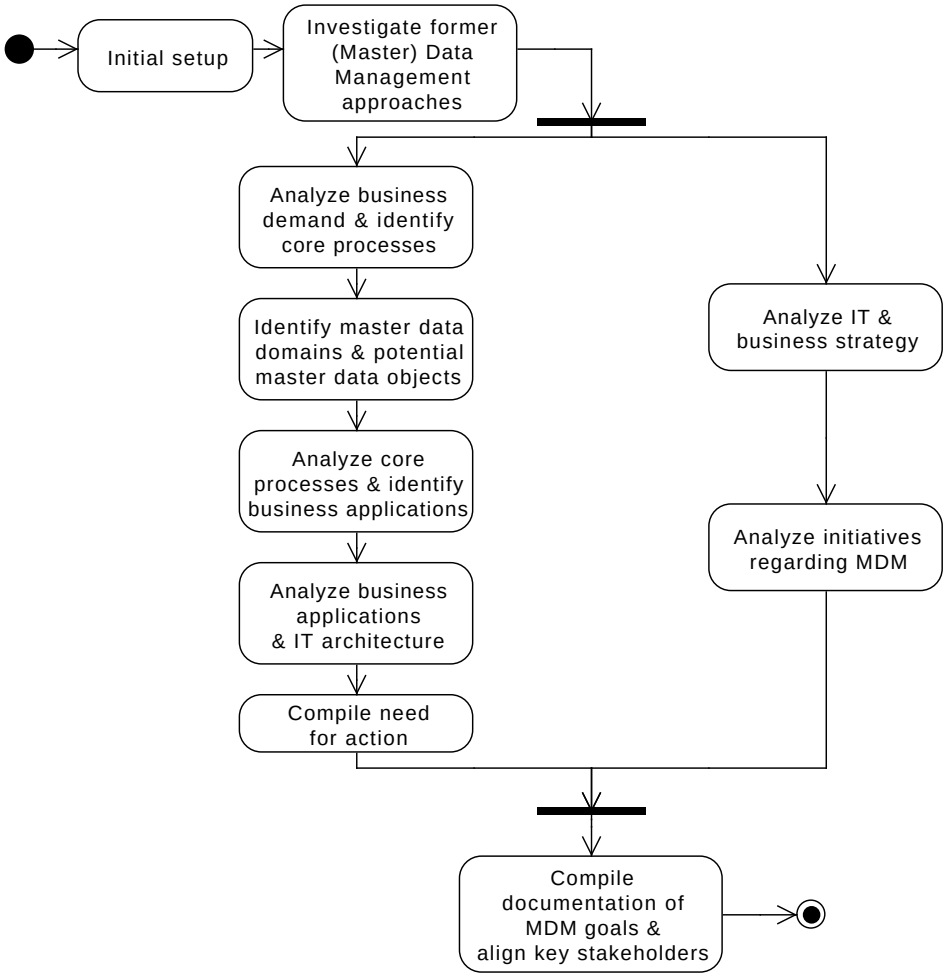


Figure 3.2.: Process steps of method modeled as UML activity diagram

sarily have to develop everything from scratch. Therefor, a comprehensive search for historic projects / initiatives addressing the topic (Master) Data Management is seen as an essential process step. Available project documentation may provide valuable input and lessons learned. For example already documented mappings between core processes, data objects and business applications save effort and time during subsequent process steps. Also the reasons behind discontinued projects or initiatives may provide valuable insights and lessons learned that prevent the project team from committing similar mistakes. Contact persons that serve as interview partners and sources of documentation suitable to investigate historic approaches are the former project or project portfolio managers.

Activity	<<Name of process step>>
Activity details	<<Detailed description of process step>>
Input	<<Required input>>
Questions to answer	<<Questions in focus of the activity>>
Output	<<Desired output of process step>>
Techniques	<<Techniques applicable to answer questions>>
Information sources	<<Possible information sources to answer questions>>

Figure 3.3.: Template for structured description of process step

Analyze business demand & identify core processes As it is of importance to demonstrate the specific value that MDM provides to each line of business (cf. [Los10, p.24]) this process step is about identifying the organizational structure of business units and how MDM can support the development of their business. This process step focuses on answering the following questions:

- Which business units are potential key stakeholders for MDM?
- How can MDM support the development of business?
- What are key performance metrics for business success?
- What are the core processes and which business objects are involved throughout?
- Which (country) specific regulations are of relevance to the business?

In order to find answers to these questions, the methods of choice are interviews and / or workshops with people who can provide a solid understanding of the business unit. The aimed for outcome of these interviews / workshops is to have a description of each business unit regarding its basic characteristics (size, locations, decision makers), core processes, key business performance metrics, relevant (high-level) business objects, relevant regulations, and its medium term vision for business development. This comprehensive view representing all business units is a basis for specifying the needs that drive the change on a high level and reveals a first indication of the impact that MDM can have on the organization [BD11, p.319], [SGZ12, p.311].

Identify master data domains & potential master data objects Based on the input from the previous process step, key data domains and objects have to be identified for scoping the further analysis of processes and business applications. The following questions should be answered:

- Which business objects are relevant across all business units and fulfill further master data criteria (e.g., have an organization-wide accepted semantic, have a long lifecycle and constitute a reference for other business objects)?
- Are certain business objects affected by planned (data) initiatives (Enterprise Information Management, Metadata Management)?

This preliminary assessment of master data objects in scope helps to understand the complexity regarding required master data integration and master data quality efforts [BD11, p.300], [SGZ12, p.308].

Analyze core processes & identify business applications Regarding the identified business objects that fulfill master data criteria, analyze the core processes of each business unit and identify business applications. The process step aims at defining and validating the business need as proposed by the design principle *Core processes as a basis for highlighting business value* (cf. Section 3.1). Furthermore it helps to get an idea of the complexity of process harmonization required among different business units [SGZ12, p.308]. Questions in focus of this process step are:

- Which process steps create, read, update or delete master data objects?
- Which business applications are involved?
- How is process performance measured (used KPIs)?

The desired outcome is a mapping between process steps and master data objects as well as a mapping between business applications, process steps and possibly countries. Identified drawbacks resulting from this mapping need to be documented as requested by the design principle *Issues in current environment as basis for need to act*. CRUD (Create, Read, Update, Delete) matrices are an appropriate instrument to illustrate which process steps create, read, update, or delete which master data objects (cf. Figure 3.4). Process support maps (cf. [LMW05]) can be used to visualize the connection between processes, business applications and countries (cf. Figure 3.5). Additionally the identification and base lining of metrics used for measuring the process performance is required as an indicator for business success of MDM [Los10, p.240], [RS08]. Accordingly this process step adheres to the design principle *Performance indicators to measure success*. The methods of choice for building up the necessary information base are interviews, workshops,

and the review of available documents. Relevant interview partners are people responsible for processes and applications (from business and IT). Further valuable information sources may comprise available process and IT architecture repositories.

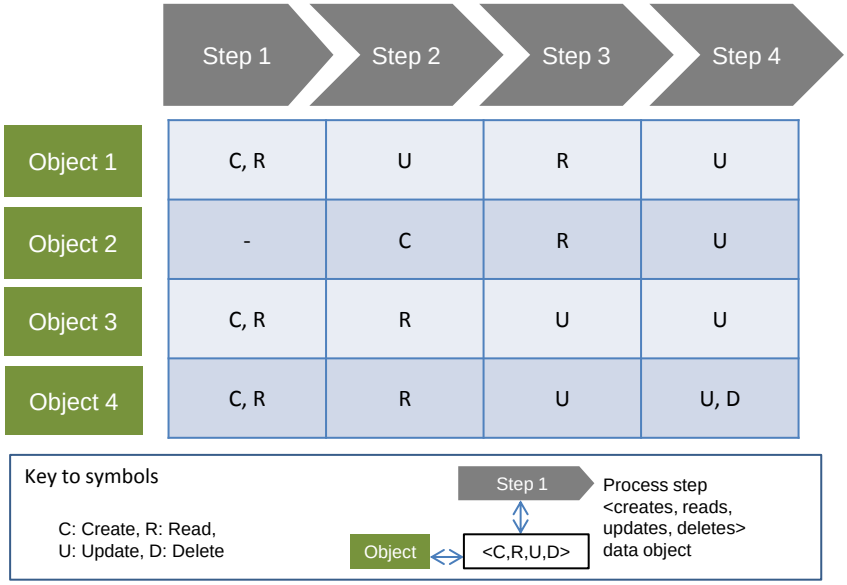


Figure 3.4.: Example of a CRUD matrix mapping process steps

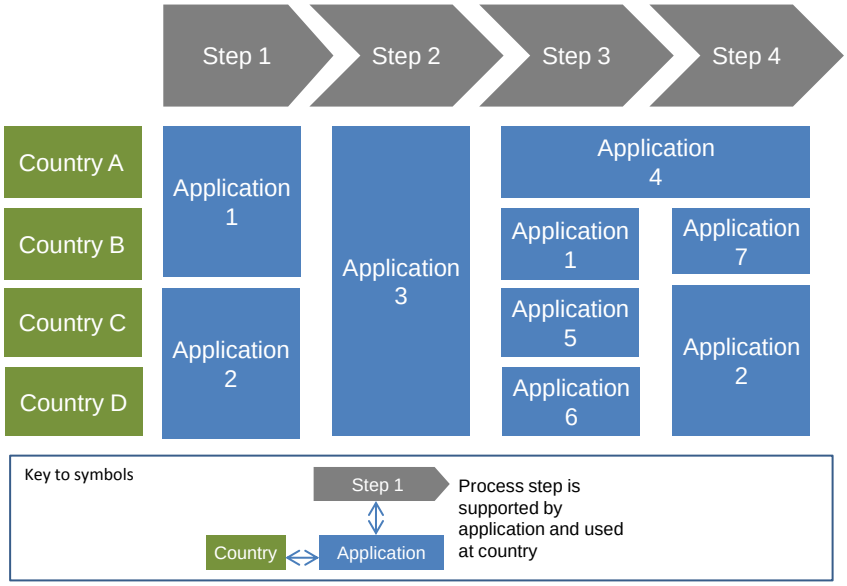


Figure 3.5.: Example of a process support map

Analyze business applications & IT architecture A further analysis of the IT architecture and embedded business applications regarding the identified master data objects is required to estimate the complexity of transforming the IT landscape and master data distribution [SGZ12, p.308]. A lot of business applications may get into the scope of a long lasting data and systems integration initiative like MDM [BD11, p.299]. In contrast to the preceding process steps where the business value of MDM was highlighted, this process step focuses more on a possible value proposition regarding the IT landscape. Therefor, the analysis has to provide answers to the following questions:

- Which business applications create, read, update or delete master data objects and are in scope of an MDM initiative?
- Which business applications hold the most accurate and up-to-date master data?
- How are business applications interconnected regarding master data distribution?
- Which master data silos exist?
- How is the IT architecture evolving?
- How is IT performance measured?

As a means to find answers to these questions, interviews and workshops with specific application owners from business, IT application managers, or data owners are appropriate.

Result artifacts from this process step should comprise visualizations clustering master data object, business units and business applications (cf. Figure 3.6), CRUD matrices mapping business applications and master data objects (cf. Figure 3.7), as well as a big picture of the IT landscape depicting silos of master data. Additionally, the flow of master data between business applications along a business process should be visualized (Figure 3.8 proposes a possible visualization). All evident drawbacks from this environment (e.g., no consistent view on master data due to poorly integrated business applications) need to be captured according to the design principle *Issues in current environment as basis for need to act*. Capturing and base lining metrics that are used to measure the performance of the IT department respectively the IT landscape facilitates to express the value of MDM to IT management stakeholders and thereby adheres to the design principle *Performance indicators to measure success*.

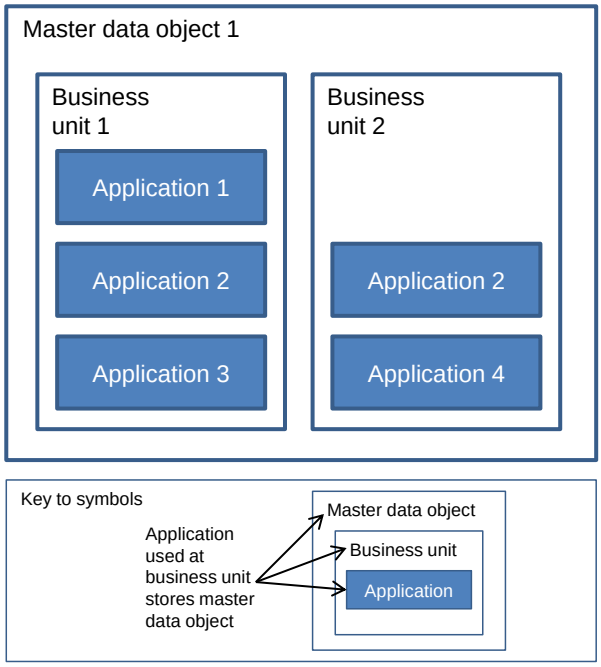


Figure 3.6.: Example of a cluster-map

	Application 1	Application 2	Application 3	Application 4
Object 1	C, R	U	R	U
Object 2	-	C	R	U
Object 3	C, R	R	U	U
Object 4	C, R	R	U	U, D

Key to symbols

C: Create, R: Read,
U: Update, D: Delete

Application

Object <C,R,U,D>

Application <creates, reads, updates, deletes> data object

Figure 3.7.: Example of a CRUD matrix mapping business applications

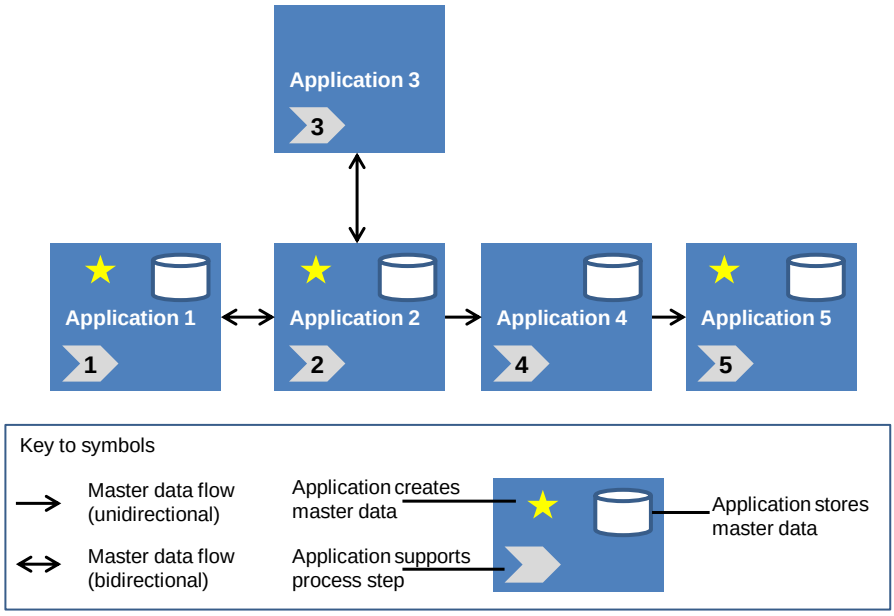


Figure 3.8.: Example for visualizing the flow of master data between business applications along a process

Compile need for action After describing the current state and documenting the drawbacks connected to master data objects, business processes, and business applications in the preceding process steps, a need for action is derived subsequently. This involves answering the following questions:

- How do the documented drawbacks impact business and IT?
- How can MDM help to tackle these drawbacks?

The aimed for target is to compile a list of improvements regarding the business and application landscape that are subject to be addressed by MDM goals in a further step. For example if the previous process steps reveal that each country within a business unit holds their own set of business partner master data, an improvement would be to dissolve these silos of master data and foster data exchange.

Analyze IT & business strategy In order to comply with the design principle *Alignment with business and IT strategy*, an analysis of the documented business and IT strategy is required. As indicated in the UML activity diagram (cf. Figure 3.2), this process step can be conducted parallel to describing the current state and compiling the need for action. This process step aims at identifying high-level business and IT objectives as well as strategic initiatives that drive the need for MDM [BD11, p.286f], [SGZ12, p.308]. The following questions are in focus:

- What are documented business priorities and objectives?
- What are documented IT objectives and how is the stand of IT within the organization?
- What strategic (IT) initiatives are documented?

Contact persons within the business and IT strategy departments are the first choice for finding answers to these questions. The desired output of this process step is a listing of strategic initiatives and high-level IT and business objectives with relevance for MDM. Section 2.3 provides general benefits of MDM that may serve as an indication for identifying objectives with MDM relevance. The identified strategic initiatives are further analyzed during the subsequent process step.

Analyze initiatives regarding MDM To identify possible further drivers and potential synergy effects for an MDM initiative, planned and running (strategic) initiatives have to be analyzed [SGZ12, p.321], [BD11, p.304]. Specifically the following questions have to be answered for each identified initiative:

- Can potential synergy effects be identified?
- What are possible dependencies on MDM?
- What are drivers behind the initiative?
- What are goals for the initiative?
- How is the success of the initiative going to be measured?

Interviews with responsible stakeholders of initiatives and the review of documents are the method of choice in order to answer these questions. Subsequently, the gathered information is transformed into a listing of initiatives including basic characteristics (short description, drivers, goals, time scope) and identified synergies with MDM. Possible related initiatives may include: data warehouse projects, CRM initiatives, transforming IT architecture (SOA initiative).

Compile documentation of MDM goals and align key stakeholders As described by the design principle *Goals as a means to support strategic initiatives*, the expected outcome of this method is a collection of organization-specific goals that provide guidance and rationale for a Master Data Management initiative. This requires to cluster and align pieces of information gathered and created during the preceding steps of the method and derive goals accordingly. In addition, key stakeholders for each goal need to be aligned. Outlining the influence and concerns from stakeholders is essential for developing goals for Master Data Management [SGZ12, p.322f]. The pool of potential stakeholders is manifold: senior

management, line-of-business leaders, application owners, information architects, Data Governance and Data Quality practitioners, system developers, operations staff, regulatory compliance and legal staff [Los10, p.37], [BD11, p.40].

The conceptual model (cf. Figure 3.1) shows how certain information artifacts interrelate and thereby serves as guidance for constructing an MDM goal. The starting point for drafting a goal should be either the output from the activity *Compile need for action* or drivers in the form of desired effects or demands from business units. Furthermore, the following questions help to compile organization-specific goals:

- Which metrics are applicable to measure the achievement of a goal?
- Can a link to business success be established trough KPIs?
- Which level of granularity is advisable to align the goal to business and IT strategy?
- Which identified initiatives are of particular relevance to a goal?
- How can a goal be named unambiguously while being easy to memorize?
- What are the stakeholders for a specific goal and what concerns them?
- How is business success defined for the stakeholders?

As no agreed upon technique for documenting MDM goals exist, a template was designed as a practical solution to present identified MDM goals (cf. Figure 3.9). The template is aligned to the conceptual model and clusters all relevant aspects for documenting a goal. Therefor, it serves as a goal definition scheme and represents a possibility to present and communicate the results of the method to a broader audience.

To illustrate the varying degree of interest for different stakeholders, an onion diagram may be created per MDM goal in addition. An example of an onion diagram is depicted in Figure 3.10.

3.4. Measuring MDM goals

As already pointed out by the design principle *Performance indicators to measure success*, performance indicators are a suitable tool to track the status of MDM goals and thereby reporting improvements. This section will further elaborate on metrics suitable for measuring MDM goals and align the proposed structure from the goal template (cf. Figure 3.9) with findings from literature.

To the authors knowledge no agreed upon set of performance indicators regarding the measurement of MDM goals exist. John Radcliffe, an analyst from Gartner,

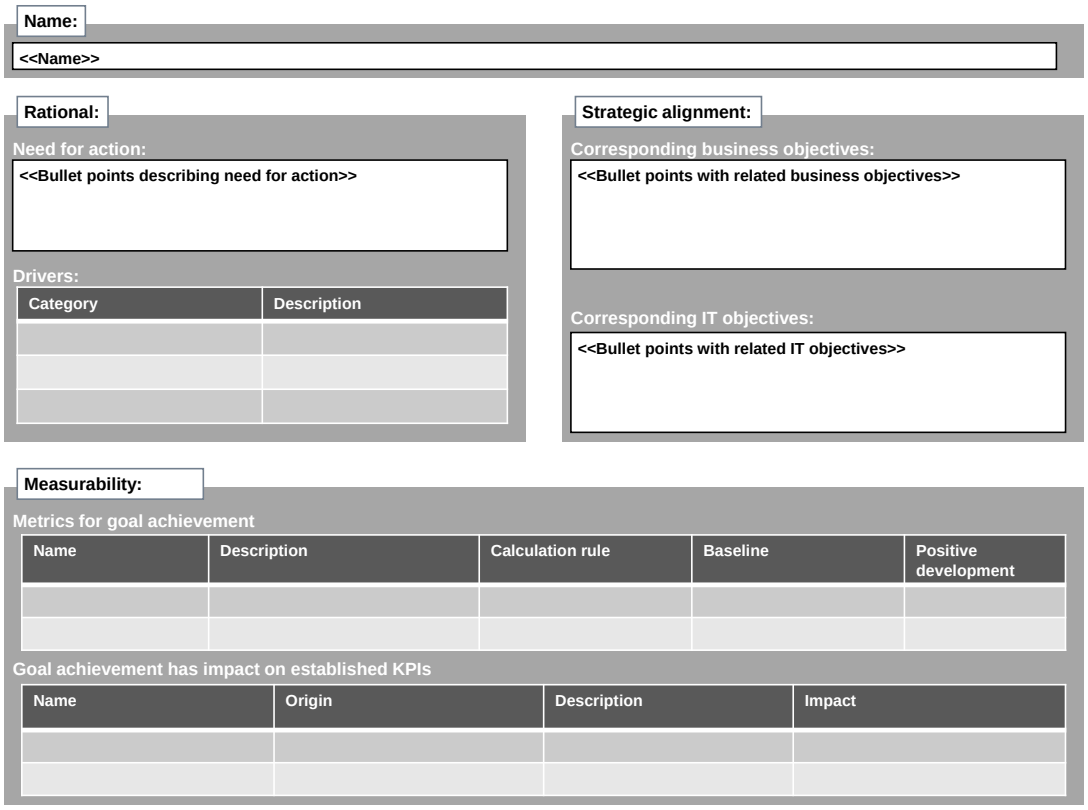


Figure 3.9.: Template for documenting MDM goals

proposes to use a mix of metrics originating from the business and IT environment on different levels of abstraction to measure an MDM initiative and ultimately link it to business value [Rad09]. Also, wherever possible, an MDM initiative should link to metrics that are already in place at an organization and perceived important by business stakeholders [RS08]. It is possible to transfer this approach to the concept of MDM goals since every MDM initiative is decomposable into specific goals [SGZ12, p.305ff]. Based on this knowledge transfer a twofold approach for measuring MDM goals is pursued: lower level performance metrics that focus on checking the degree a particular MDM goal is currently fulfilled as well as higher level metrics from business or IT that are established (e.g., used within internal dashboards) and can be positively impacted by a specific MDM goal. As MDM goals diverge with regard to their underlying drivers, so do the respective performance indicators. For example, an MDM goal that is driven by the need to improve the quality of master data supporting a specific business process may use a data quality metric (measuring quality dimensions like accuracy, completeness, timeliness, or consistency; cf. [BCFM09] or [Hü11]) as a low level performance indicator for its goal achievement and a (higher level) business metric like process runtime as a KPI that is positively impacted if the goal is to be achieved [OE10]. Otherwise

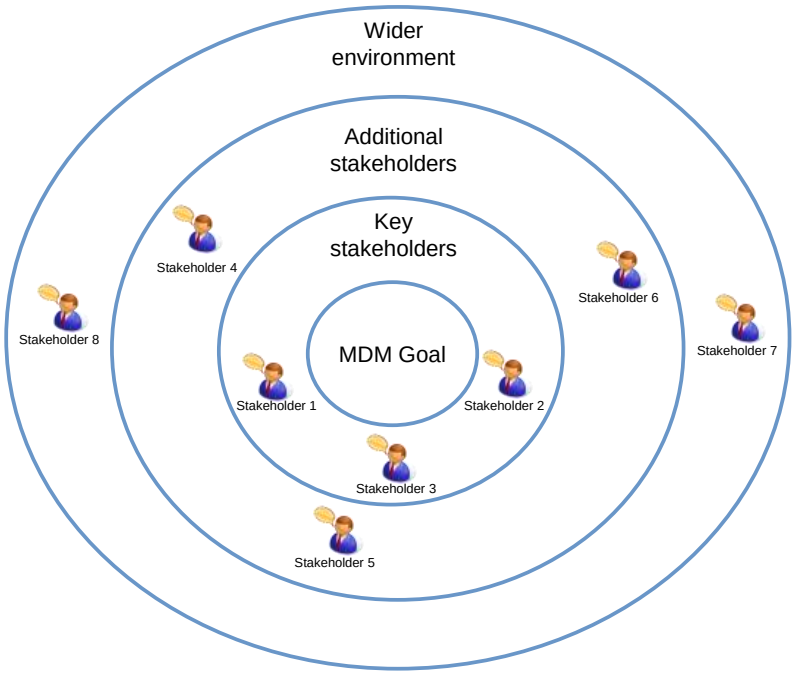


Figure 3.10.: Example of an onion diagram

if an MDM goal is driven by the need to reduce the number of data interfaces between business applications, then the total number of data interfaces may serve as a performance indicator for goal achievement and further established metrics for the management of application landscapes (cf. [MMSS12a]) can be positively impacted. One possibility to develop specific (lower level) performance metrics for tracking the degree of fulfillment of an MDM goal is the *Goal, Question, Metric* approach by Caldiera, Basili, and Rombach (cf. [CBR94]).

The structure proposed for documenting the metrics for goal achievement (as seen in Figure 3.9) is inspired by the work of Matthes, Monahov, Schneider and Schulz. In their paper *Towards a unified and configurable structure for EA management KPIs* [MMSS12b] the authors conduct an in-depth study of IT management, EA management, economics and IT controlling literature to extract, amongst other things, structure elements for EAM KPIs. Since EAM is also considered a long-term business transformation, the general structure elements for KPIs are perceived to be also applicable in the context of MDM. In order to keep the goal template simple and focused, only a small subset of KPI structure elements as proposed by [MMSS12b] has been adopted for documenting possible metrics for goal achievement. Nevertheless, if certain metrics should qualify for KPIs in the course of an MDM initiative, it is recommended to document them more extensively using more structure elements from the EAM KPI template (e.g., information model and mapping, dedicated KPI owner and consumer, etc.). The first element adopted

is a short and unique title (name) that is easy to memorize and acts as a means of communication. Next to the title, a short textual description, the employed calculation rule as well as the interpretation of the values (positive development) have been adopted as structure elements from the EAM KPI template. In line with [RS08], *baseline* is proposed as a further structure element that represents the initial value of the metric before addressing the respective MDM goal in the course of a project. For already established KPIs it is sufficient to document only the name, origin (e.g., name of the in-house dashboard or scorecard), description as well as the anticipated impact when achieving the goal it is linked to. This is based on the assumption that established KPIs are already documented comprehensively (e.g., by adopting the proposed template from Matthes, Monahov, Schneider and Schulz [MMSS12b]) at their respective source.

The proposed approach for measuring MDM goals represents a possibility to measure the achievement of defined MDM goals while at the same time providing a link to business success by including established KPIs from business and IT management.

4. Demonstration

After introducing the method for identifying organization-specific goals for MDM, this chapter demonstrates the applicability of the method at the industry partner from the financial services sector. Demonstrating the use of an artifact (method) to solve an instance of the described problem (cf. Section 1.1.1) is deemed to be an important activity in the course of Design Science Research [PTRC07].

The demonstration of the method is focused on a specific business unit which provides equipment finance and leasing solutions to organizations of all sizes. Customers range from large and medium-sized companies, international corporations, municipalities and public-sector entities to small, privately owned businesses. The organization has business locations all over the globe and is split into multiple legal entities.

4.1. Application of method and selected results

The application of the developed method followed the proposed process steps as outlined in Section 3.3. This section will provide details on selected process steps and their results.

4.1.1. Identification of MDM drivers

To gain a first impression of the needs, drivers, and current situation regarding the topic MDM at the business unit, semi-structured interviews with IT demand managers were conducted. The guideline used for these interviews can be found in the Appendix A. Additionally, further unstructured interviews with business stakeholders were carried out.

During the interviews it became clear that the business unit has the potential of becoming a key stakeholder for MDM. The core process is considered a leasing process that spans across the high level process steps pre-sales, sales, operations, and accounting. Data objects recurrent in nearly all those steps are business partner data and asset data. Both are considered master data according to the criteria listed in Section 2.1. Nevertheless, as indicated by all interviewees, the management of business partner data should be prioritized in the course of a possible MDM initiative as this would yield more benefits regarding the development of business. Accordingly, the top driver determined during the interviews was to

foster the understanding of business partners (in the sense of customers) including their structure and business relations with the organization. Also risk management and M&A capabilities are perceived to benefit from a more consistent management of business partner data. Asked about the background of this estimation, all interviewees referred to the heterogeneous growth of the organization through M&A activities in the past and the subsequent distribution of business partner master data throughout multiple (poorly integrated) front- and back-end solutions in the countries. This leads to media breaks and increased manual effort along the process chain. As a noteworthy regulation in the context of business partner master data, all interviewees mentioned that Chinese law prohibits the export of individual-related data. This regulation affects the organization as it operates a subsidiary in China and has to be incorporated when designing a potential MDM solution for business partner master data. Another aspect verified by all interview partners is the lack of a harmonized business object terminology (e.g., in the form of a glossary) throughout the organization even though it was not perceived to be a major issue for internal communication. Nevertheless, in the course of a data harmonization initiative (like MDM), this shortcoming should be addressed to prevent misunderstandings and facilitate orientation for new employees.

According to this preliminary set of MDM drivers and business insights the further application of the method focused on the management of business partner master data along the core leasing process.

4.1.2. Analyzing core process & business applications

To investigate the current situation regarding the management of business partner data along the leasing process, a workshop took place. The goal of this workshop was to map data operations (create, read, update, delete) on business partner data to the process steps and subsequently to the involved business applications. Also, the identification of KPIs for measuring business and IT performance was in scope of this workshop.

As an initial step, the core leasing process was detailed into further process steps. These process steps still remained on a level high enough to be applicable in all countries the organization operates in. Subsequently, business applications supporting each of these process steps in specific countries were identified and captured using a process support map (cf. Figure 3.5).

Subsequently, the following questions were answered for the identified business applications:

- Does the application hold business partner data in its database?
- Does the application create, read, update, or delete business partner?
- Is the business partner data in the application considered accurate and up-to-date?

The result of these questions (true or false) regarding each application was captured using a two dimensional matrix visualization. Furthermore, for all countries in scope the flow of business partner master data between applications supporting specific steps of the leasing process has been detailed using the proposed visualization as seen in Figure 3.8.

As suitable sources to extract KPIs that are of interest to management stakeholders from business and IT, a dashboard project and a project to design an IT-Scorecard were identified. Ultimately, the compilation of MDM goals should link to a positive development of these KPIs as a means to justify the business value of engaging in MDM (cf. Section 3.4).

4.1.3. Compile need for action

After documenting and visualizing the current situation regarding business partner master data in processes and business applications, resulting drawbacks from this situation were identified and documented. This was achieved by reviewing the output from previous process steps as well as interviewing further stakeholders from business and IT.

The following listing further explains the identified drawbacks and represents the concrete need for action to justify an MDM approach:

- **Business application silos:** Business partner data are managed by up to four different business applications per country. A new business partner therefor has to be created redundantly in business applications supporting the core leasing process. This leads to additional (one-to-one) interfaces, media breaks, and manual effort. Ultimately, it impacts the quality of business partner data if business applications are not kept in sync. As a result, errors in business processes emerge that induce additional manual correction effort.

- **Country silos:** Even if business applications along the leasing process are well integrated regarding business partner master data in some countries (e.g., Germany, Russia), the unique identification of a business partner on a transnational level remains a challenging task. Also, capturing the structures behind business partners from different countries (e.g., group affiliation) requires significant manual effort during reporting and is an error prone and time consuming task. Ultimately, this situation negatively impacts reporting, collaboration, marketing as well as risk management capabilities.

These findings represent a starting point for motivating further stakeholders to engage in Master Data Management as a potential solution to these drawbacks. Additionally, they serve as the basis for constructing specific MDM goals.

4.1.4. Strategic alignment

Parallel to investigating the current process and business application landscape regarding business partner master data, the generic strategies from business and IT were analyzed with the focus on aspects that support the need for MDM. This was achieved by conducting unstructured interviews with representatives from IT and business strategy departments as well as reviewing respective documents.

The following listing contains objectives of business strategy and explains how MDM supports them:

- **Higher customer satisfaction and retention:** MDM has the potential to generate a quality controlled single source-of-truth for customer master data to support sales and service processes.

- **Foster cross-unit and cross-regional collaboration:** By addressing data integration needs and developing a comprehensive view on the basic entities business is based on, MDM provides the foundation for transnational business collaboration.

- **Increase operational excellence:** By leveraging data quality efforts, MDM prevents process errors and business disturbances due to defect master data.

In addition, following objectives of the IT strategy can be considered supportive for investing in MDM:

- **Improve BI capabilities:** BI is used for management reporting, risk management, and to assure regulatory compliance. MDM supports BI capabilities (e.g., data warehousing) by providing a consistent foundation of master data and thereby facilitating ETL (Extract-Transform-Load) processes [1].

- **Leverage technology:** By harmonizing master data, MDM supports the creation of a streamlined IT landscape that facilitates the integration of new applications through standardized interfaces.

- **Workflow automation:** MDM supports the reduction of lead times and the increase of process stability by avoiding media breaks through integrated master data flows.

- **Foster employee productivity:** By providing a trusted source for master data, MDM supports employees in finding necessary and up-to-date information (e.g., about their customers) efficiently.

[1] ETL processes facilitate the original loading and the periodic refreshment of data warehouse contents (cf. [Vas09])

Our analysis showed that MDM is a supportive discipline that fits business as well as IT strategy. Subsequently, these strategic targets are subject to be aligned with MDM goals.

Concerning planned and running initiatives that bear potential synergies with MDM, a project to develop the future BI landscape was identified. As BI benefits from a consolidated set of trustworthy data sources, evaluating the development of an MDM data hub supplying downstream systems with consolidated and quality controlled master data should be incorporated into the projects agenda.

4.1.5. Documenting MDM goals

Based on the output generated by all previous process steps, specific MDM goals for the business unit have been developed. Starting point for assembling the goals was the identified need for action (cf. Section 4.1.3) which resulted from analyzing business demands, application and process landscapes with regard to master data. These needs have been aligned with identified drivers (cf. Section 4.1.1) and strategic objectives (cf. Section 4.1.4). As a means to measure goal achievement, metrics and established KPIs have been designed for (using the *Goal, Question, Metric* approach [CBR94]) respectively aligned with the goals (cf. Section 3.4). Due to the case that the definition and implementation of KPIs at the organization is still a running project, this alignment was only achieved partially. The approach for developing MDM goals is summarized illustrative in Figure 4.1. Relevant stakeholders for each goal have been named on the level of organizational units and aligned using onion diagram visualizations. Figure 4.2 shows an example of a documented MDM goal.

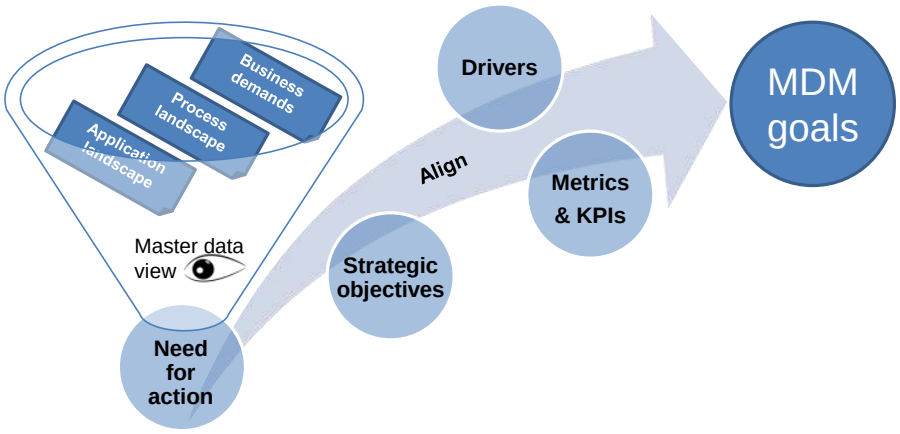


Figure 4.1.: Approach for developing MDM goals

Name:

Towards a business partner centric view

Rational:

Need for action:

- **Business partner data are managed independently in various systems**
- **No unique identifier across systems**
- **Business partner structures not consistently visible**
- **Mapping of business partners and structures from different systems for reporting is time consuming and error prone**

Drivers:

Category	Description
Compliance	Improve risk management
Effectiveness	Understand business partners
Flexibility	Pursue new business opportunities
Initiative	Target BI landscape

Strategic alignment:

Corresponding business objectives:

- **Customer satisfaction and retention**
- **Compliance, Security and Risk**
- **Management Reporting**
- **Cross-regional and cross-unit collaboration**

Corresponding IT objectives:

- **Business Intelligence, Management Reporting**
- **Business Intelligence, Risk Management**

Measurability:

Performance indicators for goal achievement:

Name	Description	Calculation rule	Baseline	Positive development
Rate of clustered BP records	Indicates how many BP records belong to a BP cluster	Number of BP records having a relationship to other BP records divided by total number of BP records	-	Increasing
Rate of uniquely identifiable BP records	Indicates how many BP records have an unique identifier compared to all BP records	Number of BP records with global identifier divided by total number of all BP records	-	increasing

Impact on established KPIs:

Name	Origin	Description	Impact
CSI scores	Leasing scorecard	Customer service index scores	Comprehensive BP information enables better customer service
Customer retention	Leasing scorecard	Average duration of business relationship with customer	Increased service capabilities foster customer relations

Figure 4.2.: Example of a documented goal

5. Evaluation

After applying the developed method at the industry partner, an evaluation took place to validate the solution design of the method and its applicability to perform the intended tasks. Since the method was only applied once, a quantitative assessment on 'how well' the method works was not possible. However, as the solution artifact concerns a novel method it is considered a significant research contribution itself and can be "evaluated even apart from the application" [MS95]. Subsequently, the chosen evaluation approach is explained in detail before ensuing results are presented.

5.1. Evaluation approach

The evaluation was accomplished by conducting an expert survey among Data Management professionals at the industry partner. Within one hour meetings, the method was presented to the experts followed by the completion of an evaluation sheet as well as an open discussion. Presentation of the method included the underlying motivation and objectives, the conceptual model, the detailed process steps of the method, the template for goal documentation, and the results (output from process steps and documented goals) generated during the application of the method.

Next to questions about the participants professional occupation and Data Management experience, the evaluation sheet contained 14 statements in four groups: *Documentation and feasibility of method* in order to validate the comprehensibility of the method, *Documentation of goals* to validate the developed goal template, *Approach for measuring MDM goals* to validate the twofold approach for measuring MDM goals (cf. Section 3.4), and *Fit for purpose* to validate the applicability of the method with regard to the defined objectives. A strict five-point Likert scale [Lik32] was used to assess the consent regarding the statements from "strongly agree that this statement is correct" to "strongly disagree that this statement is correct". During analysis, the five possible answers were given a value in the range between 2 (strongly agree) and -2 (strongly disagree) to analyze the feedback numerically. Additionally, to avoid misinterpretations, all statements were phrased in English as well as German language. The full evaluation sheet can be found in the Appendix C. Participants for the evaluation meetings have been hand-picked to assure a certain level of expertise in the area of Data Management and practical experience with strategic initiatives.

5.2. Evaluation results

In total, six Data Management professionals have completed the evaluation sheet. The participants defined their professional occupation as follows: Consultant, Senior Consultant, Service & Project Manager for CRM, IT Demand Manager, IT Solution Architect, and Enterprise IT Architect. All participants indicated to have at least five years of experience within the field of Data Management, four of them even more than ten years. The evaluation sheet was filled out completely by all participants. The ratings regarding each of the 14 statements are presented in Table 5.1 and further discussed in the following sections.

5.2.1. Documentation and feasibility of method

To validate the documentation, composition and comprehensibility of the process steps this group contained two statements. All participants (strongly) agreed that the documentation of the process steps in the form of a structured and uniform description template is adequate and understandable. The same goes for the comprehensibility of process step composition. Three participants further pointed out that based on the experience and previous knowledge of the team applying the method, more parallelization concerning the process steps would be possible. In summary the method was perceived to be well documented and suitable to guide practitioners.

5.2.2. Documentation of goals and approach for measuring goal achievement

To asses the proposed structure of the MDM goal definition template (cf. Figure 3.9), each single structure element has been evaluated separately to whether it should be part of the template. Additionally the participants were asked to assess whether the chosen approach for measuring MDM goals seems adequate.

The experts (strongly) agreed that all structure elements of the proposed template are of relevance and thereby that no element should be left out. Next to 'Name', especially the structure elements 'Strategic alignment' and 'Impact on established KPIs' have been perceived as essential for documenting an MDM goal. Two experts further suggested to add some sort of rough cost estimation and a dedicated structure element to detail the expected (organizational) impact of achieving the MDM goal. In contrast, another participant explicitly stated that explicating cost estimations based on a preliminary assessment is counter productive as it leads to very vague and possibly wrong estimations which lead to false expectations.

		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	Total
		2	**1**	**0**	**-1**	**-2**	**[12;-12]**
Documentation and feasibility of method							
The documentation of the process steps is adequate and understandable		2	4	0	0	0	**8**
The composition of the process steps is comprehensible		2	4	0	0	0	**8**
Documentation of goals							
Following structure elements should be part of an MDM goal template							
Name		5	1	0	0	0	**11**
Rational	Need for action	3	3	0	0	0	**9**
	Driver	3	3	0	0	0	**9**
Strategic alignment	IT strategy	4	2	0	0	0	**10**
	Business strategy	4	2	0	0	0	**10**
Measurability	Metrics for goal achievement	3	3	0	0	0	**9**
	Impact on established KPIs	4	2	0	0	0	**10**
Approach for measuring MDM goals							
The chosen approach seems adequate to measure MDM goals		3	1	2	0	0	**7**
Fit for purpose							
The proposed method is appropriate to identify and document goals for MDM		3	2	1	0	0	**8**
Respective goals are appropriate to foster management involvement for MDM		1	4	1	0	0	**6**
The output of the method (all artifacts) is seen as useful input for developing an MDM business case		3	2	1	0	0	**8**
The proposed method is appropriate to support the development of a vision, strategy and road map for MDM		3	3	0	0	0	**9**

Table 5.1.: Overview of ratings for each statement and numerical analysis

The twofold approach to measure MDM goals by a dedicated metric for goal achievement and the impact it has on established KPIs from business and IT (cf. Section 3.4) seemed adequate to 66% of participants.

5.2.3. Fit for purpose

To evaluate whether the proposed method is appropriate to meet its defined objectives (cf. Section 1.1) this group contained four statements according.

All but one participant (strongly) agreed that the method is applicable to identify and document MDM goals, thereby fostering management involvement for MDM and supporting the development of an MDM business case. Furthermore, all participants (strongly) agreed with the statement that the method supports the development of an MDM vision, strategy, and roadmap. The fact that the statement 'Respective goals are appropriate to foster management involvement for MDM' received the least acceptance among all statements may indicate a more political dimension of this problem as pointed out by one participant (cf. Section 5.2.4).

5.2.4. Further feedback and comments

The evaluation sheet contained some additional space for the participants to express further feedback and comments. Also the open discussion revealed some areas for improvement.

As an additional measure to foster management involvement, one participant proposed to use a story telling approach in order to create a management summary based on the identified and documented goals. This way, assumptions and arguments for an MDM initiative could be applied in a practical use case scenario to stimulate the imagination of management stakeholders. Another participant pointed out that to his experience the output of the method serves as an excellent groundwork to comprehensively illustrate organization-specific benefits of MDM. Nevertheless, due to the political dimension of this topic it will always involve a degree of uncertainty to whether a funding request for an MDM initiative will be successful or not, no matter how well benefits are elaborated. Furthermore, two participants gave the advice to explicate the necessary pre-conditions for applying the method (demands from business have been mapped to the topic MDM; sponsorship and budget for preliminary investigation is assured) more clearly as well as to point out possibilities for conducting more process steps in parallel. Also, they suggested to include a rough cost estimation for applying the method.

In summary, the evaluation results reflect the successful solution design as well as the applicability of the method to perform its intended tasks. All participants perceived the method to be well suited for conducting a preliminary assessment in order to work out the concrete organization-specific potential of MDM.

6. Conclusion

To conclude this work, this chapter recapitulates the central results (Section 6.1). Finally, Section 6.2 critically reflects the contributions of this work and provides a brief outlook on possible directions for future research.

6.1. Summary of results

Based on the motivation (cf. Section 1.1), the thesis at hand adopted the Design Science Research Methodology by Peffers et al. [PTRC07] to answer the research questions presented in Section 1.1.2. This effort resulted in the creation of a method for identifying organization-specific goals for MDM, which is considered the central contribution of this thesis. The method serves practitioners as a guideline for preliminary assessing MDM for their organization and supports further activities (developing MDM vision, strategy, roadmap) within the strategic design area. As a novel method it also advances the scientific body of knowledge regarding MDM.

After briefly introducing the terms *master data* and *Master Data Management*, Chapter 2 provided a comprehensive summary on the topic MDM in order to understand it to its fullest extent. This included a view on the benefits and risks of MDM (sections 2.3 and 2.4), information on MDM design areas and options (Section 2.5), and the presentation and analysis of two case studies from literature (Section 2.6).

Chapter 3 started out by explicating basic principles for approaching MDM (Section 3.1). Subsequently, based on these design principles, a conceptual model concerning MDM goals was presented (Section 3.2). The corresponding method to guide practitioners along the process of instantiating the conceptual model and thereby identifying organization-specific MDM goals was described throughout Section 3.3.

To demonstrate its practical use, the designed method was applied at the industry partner. Chapter 4 described the output from selected process steps and the final outcome in the form of organization-specific MDM goals.

Finally, the solution design of the method as well as its applicability to perform the intended tasks was validated using an expert survey among Data Management professionals. Chapter 5 detailed the evaluation approach and presented ensuing results.

6.2. Critical reflection and future research

The method for identifying organization-specific MDM goals presented throughout this thesis serves practitioners as a guideline for preliminary assessing MDM for their organization and further supports the definition of a dedicated MDM vision, strategy and roadmap. Due to the time-constraints of this work, the demonstration and evaluation of the method was limited to one iteration at a dedicated business unit at the industry partner. This, of course, limits the ability to make statements about the performance and general applicability of the method. Therefor, future research could approach the application of the method with a larger (organization-wide) scope and at further organizations. This would provide additional evidence of its practical use and enable an iterative improvement of the method (and the underlying design principles and conceptual model) based on the additional feedback. Also, in this way, the solution design and the applicability of the method to perform the intended tasks could be validated by a larger audience of Data Management professionals (the expert survey in this thesis comprised only six participants) and thereby increase the expressiveness of the evaluation of the method.

Taking up this work, future research may focus on the continuous evolution of the method. For example, including a possibility to prioritize identified goals regarding their strategic fit or involved stakeholders. Also incorporating a rough cost-benefit analysis into the method, as already pointed out by participants of the expert survey (cf. Section 5.2.2), may be possible. Next to further improving the method, future research could approach the development of a guideline how to translate artifacts from the strategic design area of MDM (goals, vision, strategy) into specific recommendations for the ensuing design of organizational and information system aspects.

Appendices

A. Interview guideline

Interview guideline

<<Short presentation concerning the definition of master data and MDM>>

Cluster “Master data objects and terminology”

1) What are (in your opinion) relevant master data objects for your organization?

2) Was an effort to identify master data within your organization already made?

   – If yes, is it documented and which models do you have for specifying your (master) data (e.g. information model, logical model, database model)?

3) Does a unified glossary / terminology exist within your business unit and especially across business units?

   – If yes, is it documented?
   – If yes, have you used any standards or reference models for the business terminology?

Cluster “Processes and applications“

4) Name and describe core processes, information systems and roles that interact with master data objects.

5) Do you know about any (core) processes specifically suffering from insufficient master data quality? If so please describe an example.

Cluster “Data quality and measurements”

6) Have you received any concrete complaints about (master) data quality in the past?

7) Are measures / role responsibilities / processes / guidelines for controlling and maintaining (master) data quality currently implemented or planned?

   – If yes, how is it done? Proactive (e.g. business rules) vs. reactive (e.g. cleansing activities)? KPI’s defined and reported?

Cluster “Business drivers and compliance“

8) Being presented the following drivers… (cf. Figure 2.4). Please name the top 5 for your business.

9) Are you aware of any master data objects that you share with or that you use from regulated entities? Which regulations will have an effect on Master Data Management in your opinion?

B. Method and detailed process steps

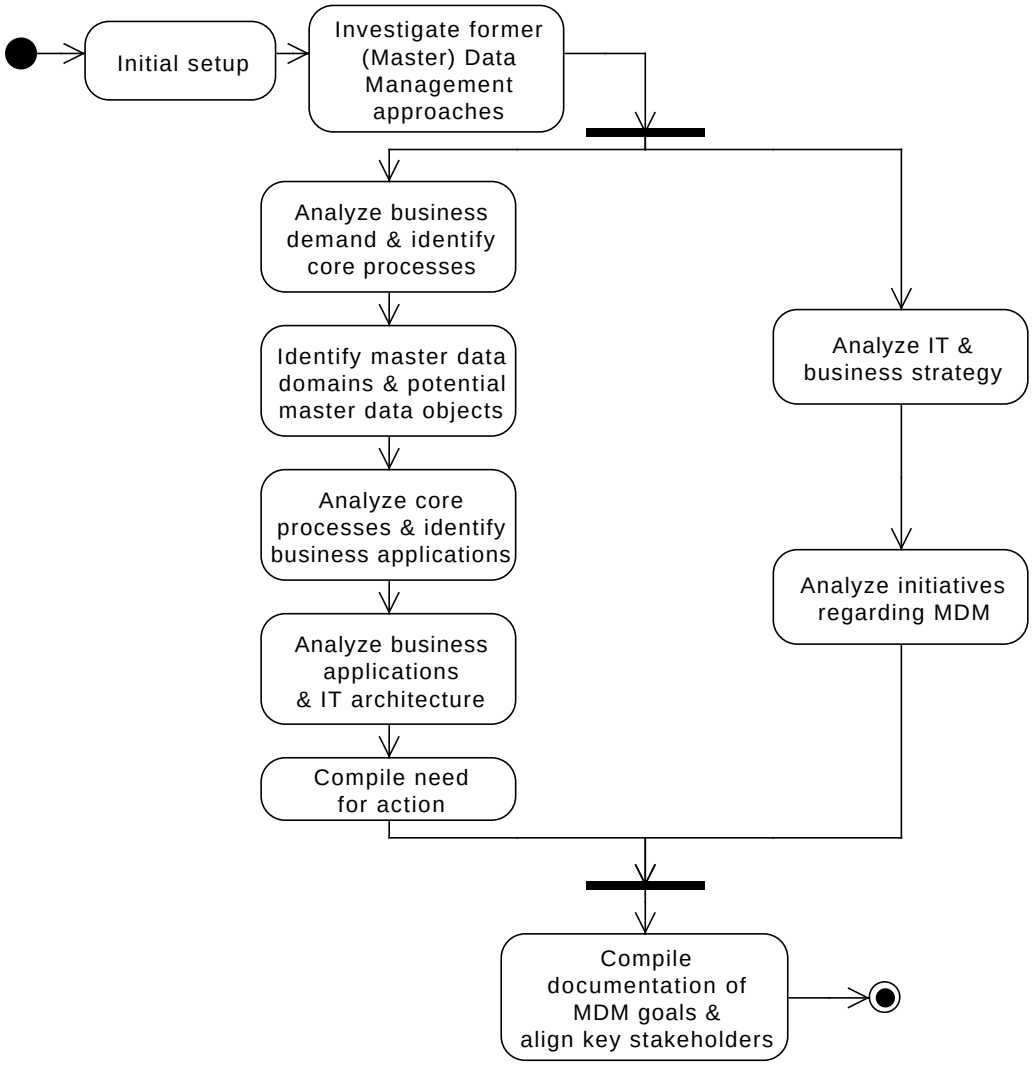


Figure B.1.: Process steps of method modeled as UML activity diagram

Activity	Initial setup
Activity details	In order to carry out the preliminary investigations for an MDM initiative, assure sponsorship and set up a team
Input	-
Questions to answer	Sponsorship for budget and resources is assured? Who is suitable to carry out the preliminary investigations? Has someone experience in EA and MDM? Which consultants may be suitable for this job?
Output	Assignment of a team with preferably two persons. One (external) experienced consultant (MDM insight does not matter) and one (internal) business analyst with MDM and EA experience.
Techniques	-
Information sources	-

Figure B.2.: Process step *Initial setup*

Activity	Investigate former (Master) Data Management approaches
Activity details	To learn from failed approaches, an investigation of former initiatives is required
Input	Project documentations
Questions to answer	Which historic projects / initiatives exist (with focus to data management) that can provide valuable input and lessons learned?
Output	Lessons learned
Techniques	Interviews, Review of documentation
Information sources	Project managers, Project portfolio managers

Figure B.3.: Process step *Investigate former (Master) Data Management approaches*

Activity	Analyze business demand & identify core processes
Activity details	This activity strives to identify the organizational structure of business units and analyze them regarding their MDM demands.
Input	Organizational charts, documents regarding business development
Questions to answer	Which business units are potential key stakeholders for MDM? How can MDM support the development of business? What are key performance metrics for business success? What are the core processes and which business objects are involved? Which (country) specific regulations are of relevance for the business?
Output	Description of each business unit including: Basic characteristics (size, locations and decision makers) Coarse-grained medium term business plan, Core business processes Metrics for business success Relevant business objects
Techniques	Interviews, workshops, review of documentation
Information sources	Documented organizational structure, Process repository

Figure B.4.: Process step *Analyze business demand & identify core processes*

Activity	Identify master data domains & potential master data objects
Activity details	Compile candidate list of master data domains and objects in scope
Input	Output from preceding activities
Questions to answer	Which business objects are relevant across all business units and fulfill further master data criteria? Are certain business objects affected by planned initiatives (Enterprise Information Management; Metadatamanagement)?
Output	Candidates for master data domains and objects
Techniques	Interviews, workshops, review of documentation
Information sources	-

Figure B.5.: Process step *Identify master data domains & potential master data objects*

Activity	Analyze core processes & identify business applications
Activity details	Based on the identified master data objects, analyze core processes working with these objects and identify involved business applications
Input	Output from preceding activities, List of master data objects, Process support maps
Questions to answer	Which process steps create, update, read or delete (CRUD) master data objects? Which business applications are involved? Process KPIs used?
Output	Mapping core process (Name, description), master data object and business application CRUD matrices with master data object and process step Mapping core process and KPI's Documented drawbacks resulting from current situation
Techniques	Interviews, workshops, review of documentation
Information sources	Process repository, IT architecture repository, People responsible for processes and applications

Figure B.6.: Process step *Identify master data domains & potential master data objects*

Activity	Analyze business applications & IT architecture
Activity details	Analyze the support of business applications for identified core processes with focus on master data objects
Input	Output from preceding activities
Questions to answer	Which business applications are in scope of an MDM initiative? Which business applications hold the most accurate and up-to-date master data? How are business applications interconnected regarding master data distribution? Which master data silos exist? How is the IT architecture evolving? How is IT performance measured?
Output	Clustering master data object, business unit and sources of master data (business application) CRUD matrices with master data object and business application Big picture of IT landscape with master data silos Master data interfaces Documented drawbacks from current landscape
Techniques	Interviews, workshops, review of documentation
Information sources	IT architecture repository, People responsible for processes and applications

Figure B.7.: Process step *Analyze core processes & identify business applications*

Activity	Compile need for action
Activity details	Based on the drawbacks of the current situation, compile the need for action and document rationale
Input	Output from preceding activities
Questions to answer	How do the documented drawbacks impact business and IT? How can MDM help to tackle the drawbacks?
Output	Listing that explains areas for improvement based on the drawbacks identified from mapping business processes, master data objects, business applications, countries, regulations, and organizational units
Techniques	Workshops
Information sources	-

Figure B.8.: Process step *Compile need for action*

Activity	Analyze IT & business strategy
Activity details	In order to link MDM goals to the IT and business objectives, an analysis of the current IT and business strategy is required
Input	Strategy documents
Questions to answer	What are documented business priorities and objectives? What are documented IT objectives and how is the stand of IT within the organization? Which strategic (IT) initiatives are documented?
Output	Listing of strategic initiatives, IT and business objectives
Techniques	Interviews, workshops, review of documentation
Information sources	Business and IT strategy departments, strategy documents

Figure B.9.: Process step *Analyze IT & business strategy*

Activity	Analyze initiatives regarding MDM
Activity details	In order to identify possible drivers and potential synergy effects for the MDM initiative, planned and running initiatives have to be analyzed
Input	Strategic initiatives, project documentation
Questions to answer	Can potential synergy effects be identified? What are possible dependencies on the MDM iniative? What are drivers behind the current initiatives? What are the goals for the initiatives? How is the success of the initiatives going to be measured?
Output	Listing of initiatives (including short description, drivers, goals and linked KPI's) and impact analysis, Visualization (e.g. graph) of initiatives surrounding MDM
Techniques	Interviews, review of documentation
Information sources	Project portfolio managers

Figure B.10.: Process step *Analyze initiatives regarding MDM*

Activity	Compile documentation of MDM goals & align key stakeholders
Activity details	Based on the output of all activities, compile a set of goals documenting the business rationale, drivers and KPI's for MDM using the goal template. In addition, key stakeholders for each goal need to be aligned.
Input	Output of all preceding activities
Questions to answer	Which metrics are applicable to measure the achievement of a goal? Can a link to established KPIs be established? Which level of granularity is advisable to align the goal to business and IT strategy? Which identified initiatives are of particular relevance to a goal? How can a goal be named unambiguously while being easy to memorize? What are the stakeholders for a specific goal and what concerns them? How is business success defined for the stakeholders?
Output	Organization-specific goals for MDM
Techniques	-
Information sources	-

Figure B.11.: Process step *Compile documentation of MDM goals & align key stakeholders*

C. Evaluation sheet

Evaluation

Background information

Professional occupation:_____

Experience with Data Management (years):_____

1) Documentation and feasibility of method

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The documentation of the process steps is adequate and understandable (Die Dokumenation der Prozessschritte ausreichend und verständlich)					
The composition of the process steps is comprehensible (Die Anordnung der Prozessschritte ist nachvollziehbar)					

2) Documentation of goals (goal template)

Following structure elements should be part of a MDM goal template (Die folgenden Strukturelemente sollten Teil einer MDM-Zielvorlage sein)

		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Name						
Rational	Need for action					
	Driver					
Strategic alignment	IT strategy					
	Business strategy					
Measurability	Metrics for goal achievement					
	Impact on estabhlished KPIs					

3) Approach for measuring MDM goals

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The chosen approach seems adequate to measure MDM goals (Der gewählte Ansatz ist geeignet um MDM Ziele messbar zu gestalten)					

4) Fit for purpose

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The proposed method is appropriate to identify and document goals for MDM (Die vorgeschlagene Methode ist geeignet um MDM Ziele zu entwickeln)					
Respective goals are appropriate to foster management involvement for MDM (Derart dokumentierte Ziele können helfen, die Einbindung des Management in MDM zu fördern)					
The output of the method (all artifacts) is seen as useful input for developing an MDM business case (Der gesamte output der Methode ist geeignet als Grundlage für die Erstellung eines MDM business case)					
The proposed method is appropriate to support the development of a vision, strategy and road map for MDM (Die Methode unterstützt bei der Formulierung einer MDM Vision, Strategie und Roadmap)					

Further feedback and comments

Nomenclature

ARIS	Architecture of Integrated Information Systems
BDSG	Bundesdatenschutzgesetz
BI	Business Intelligence
BOM	Business Object Model
CC CDQ	Competence Center Corporate Data Quality
CDI	Customer Data Integration
CobiT	Control Objectives for Information and related Technology
CRM	Customer Relationship Management
DAMA	Data Management Association
DQM	Data Quality Management
DSR	Design Science Research
DSRM	Design Science Research Methodology
DTAG	Deutsche Telekom AG
EA	Enterprise Architecture
EAM	Enterprise Architecture Management
ERP	Enterprise Resource Planning
ETL	Extract-Transform-Load
IT	Information Technology
ITIL	Information Technology Infrastructure Library
KPI	Key Performance Indicator
KYC	Know Your Customer

M&A	Mergers and Acquisitions
MDM	Master Data Management
OFAC	Office of Foreign Assets Control
PIM	Product Information Management
PMI	Project Management Institute
ROI	Return on Investment
SDN	Specially Designated Nationals
SID	Shared Information & Data Model
SOA	Service Oriented Architecture
SOX	Sarbanes-Oxley Act
UML	Unified Modeling Language

List of Figures

List of Tables

Bibliography

[AG12] Deutsche Telekom AG. Annual Report 2012. `www.telekom.com/static/-/173410/10/130228-q4-12-pdf-si` [accessed 28.06.2013], 2012.

[Ake04] Joan E. van Aken. Management research based on the paradigm of the design sciences: the quest for field-tested and grounded technological rules. *Journal of management studies*, 41(2):219–246, 2004.

[Arc84] L. Bruce Archer. Systematic method for designers. In N. Cross, editor, *Developments in Design Methodology*, pages 57–82. John Wiley, London, 1984.

[BCFM09] Carlo Batini, Cinzia Cappiello, Chiara Francalanci, and Andrea Maurino. Methodologies for data quality assessment and improvement. *ACM Comput. Surv.*, 41(3):16:1–16:52, July 2009.

[BD11] Alex Berson and Larry Dubov. *Master Data Management and Data Governance*. Mcgraw-Hill Professional, 2. edition, November 2011.

[Buc07] Ralf Buchsein. *IT-Management mit ITIL V3: Strategien, Kennzahlen, Umsetzung*. Springer, 2007.

[CBR94] Victor R. Caldiera, Gianluigi Basili, and H. Dieter Rombach. The goal question metric approach. *Encyclopedia of software engineering*, 2(1994):528–532, 1994.

[CPRS05] Robert Cole, Sandeep Purao, Matti Rossi, and Maung K. Sein. Being proactive: where action research meets design research. In *Proceedings of the Twenty-Sixth International Conference on Information Systems*, page 325–336, 2005.

[DB07] Rob David and Eric Brabänder. Business process architecture with ARIS. In *ARIS Design Platform*, pages 49–60. Springer London, January 2007.

[DHM+08] Allen Dreibelbis, Eberhard Hechler, Ivan Milman, Martin Oberhofer, Paul van Run, and Dan Wolfson. *Enterprise Master Data Management: An SOA Approach to Managing Core Information*. Ibm Press, 1. edition, June 2008.

[Dor81] George T Doran. There's a SMART way to write management's goals and objectives. *Management Review*, 70(11):35–36, 1981.

[DP98] Thomas H. Davenport and Laurence Prusak. *Working Knowledge: How Organizations Manage what They Know*. Harvard Business Press, 1998.

[EHO11] Verena Ebner, Kai Hüner, and Boris Otto. Fallstudie Bayer CropScience AG – entwurf und implementierung geschäftsorientierter datenqualitätskennzahlen. BE HSG/ CC CDQ/ 18, 2011.

[ER91] Johannes Eekels and Norbert FM Roozenburg. A methodological comparison of the structures of scientific research and engineering design: their similarities and differences. *Design Studies*, 12(4):197–203, 1991.

[Fes10] Sven Fessler. Master data management und service-orientierte architekturen – eine symbiotische beziehung. In Frank Keuper, Kiumars Hamidian, Eric Verwaayen, and Torsten Kalinowski, editors, *transformIT*, pages 277–292. Gabler, January 2010.

[FG90] Carol Taylor Fitz-Gibbon. *Performance indicators*. Multilingual Matters, 1990.

[FHKS08] Ulrich Frank, David Heise, Heiko Kattenstroth, and Hanno Schauer. Designing and utilising business indicator systems within enterprise models-outline of a method. In *MobIS*, pages 89–105, 2008.

[Gro13] Timm Grosser. Data governance – daten effizienter nutzen. BARC Research, April 2013.

[Hei66] Edmund Heinen. *Das Zielsystem der Unternehmung*. Gabler, Wiesbaden, 1966.

[HMPR04] Alan R. Hevner, Salvatore T. March, Jinsoo Park, and Sudha Ram. Design science in information systems research. *MIS Q.*, 28(1):75–105, March 2004.

[Hü11] K. Hüner. Methode zur spezifikation geschäftsorientierter datenqualitätskennzahlen. BE HSG / CC CDQ / 13, 2011.

[Ins08] Project Management Institute. *The Standard for Program Management*. Project Management Institute, 2. edition, January 2008.

[Int09] DAMA International. *The DAMA Guide to the Data Management Body of Knowledge*. Technics Publications, LLC, first edition, March 2009.

[ITG09] ITGI. CobiT 4.1. Technical report, IT Governance Institute, Rolling Meadows, USA, 2009.

[Kar06] Rob Karel. Introducing master data management. Forester Research, 2006.

[Kar11] Rob Karel. Trends 2011: It's time for the business to own master data management strategies. Forrester Research, February 2011.

[KB10] Vijay Khatri and Carol V. Brown. Designing data governance. *Commun. ACM*, 53(1):148–152, January 2010.

[KP04] Kenneth B Kahn and Product Development & Management Association. *The PDMA handbook of new product development*. Wiley, Hoboken, N.J., 2004.

[KW09] Jochen Kokemüller and Anette Weisbecker. Master data management: Products and research. In *Fourteenth International Conference on Information Quality*, page 7–8, 2009.

[Lik32] R. Likert. A technique for the measurement of attitudes. *Archives of Psychology*, 22 140:55, 1932.

[LMW05] Josef Lankes, Florian Matthes, and André Wittenburg. Softwarekartographie: systematische darstellung von anwendungslandschaften. In *Wirtschaftsinformatik 2005*, page 1443–1462. Springer, 2005.

[Los10] David Loshin. *Master Data Management*. Morgan Kaufmann, July 2010.

[MB06] Eric A. Marks and Michael Bell. *Service Oriented Architecture (SOA): A Planning and Implementation Guide for Business and Technology*. Wiley, 2006.

[MMSS12a] Florian Matthes, Ivan Monahov, Alexander Schneider, and Christopher Schulz. EAM KPI catalog v1.0. Technical report, chair for software engineering of business information systems, Technische Universität München, Munich, 2012.

[MMSS12b] Florian Matthes, Ivan Monahov, Alexander W Schneider, and Christopher Schulz. Towards a unified and configurable structure for EA management KPIs. In *Trends in Enterprise Architecture Research and Practice-Driven Research on Enterprise Transformation*, pages 284–299. Springer, 2012.

[MS95] Salvatore T. March and Gerald F. Smith. Design and natural science research on information technology. *Decision support systems*, 15(4):251–266, 1995.

[MSS13] Florian Matthes, Alexander Schneider, and Christopher Schulz. Goals in enterprise architecture management – findings from literature and future research directions. In *IEEE International Conference on Business Informatics 2013 (CBI 2013)*, 2013.

[Neg04] Solomon Negash. Business intelligence. *Communications of the Association for Information Systems*, 13(1):177–195, 2004.

[NJC90] Jay F. Nunamaker Jr and Minder Chen. Systems development in information systems research. In *System Sciences, 1990., Proceedings of the Twenty-Third Annual Hawaii International Conference on*, volume 3, page 631–640, 1990.

[OE10] Boris Otto and Verena Ebner. Measuring master data quality: Findings from an expert survey. 2010.

[OH09] Boris Otto and Kai Hüner. Functional reference architecture for corporate master data management. BE HSG / CC CDQ / 21, 2009.

[OHO12] Boris Otto, Kai M. Hüner, and Hubert Österle. Toward a functional reference model for master data quality management. *Information Systems and e-Business Management*, 10(3):395–425, September 2012.

[OMG05] Object Management Group. Unified Modeling Language 2.0. `http://www.omg.org/gettingstarted/what_is_uml.htm` [accessed 28.09.2013], 2005.

[OO11] Boris Otto and Martin Ofner. Strategic business requirements for master data management systems. *AMCIS 2011 Proceedings - All Submissions*, August 2011.

[OR10] Boris Otto and Andreas Reichert. Organizing master data management: findings from an expert survey. In *Proceedings of the 2010 ACM Symposium on Applied Computing*, page 106–110, 2010.

[Ott11] Boris Otto. A morphology of the organisation of data governance. 2011.

[OW03] Hubert Österle and Robert Winter. *Business Engineering - Auf dem Weg zum Unternehmen des Informationszeitalters*. Springer, Berlin, 2003.

[PTRC07] Ken Peffers, Tuure Tuunanen, Marcus A. Rothenberger, and Samir Chatterjee. A design science research methodology for information systems research. *Journal of management information systems*, 24(3):45–77, 2007.

[PvdM12] Christy Pettey and Rob van der Meulen. Gartner says master data management software revenue to grow 21 percent in 2012. `https://www.gartner.com/newsroom/id/1886314` [accessed 21.06.2013], January 2012.

[Rad09] John Radcliffe. The seven building blocks of MDM: a framework for success. GartnerGroup Research #G00168103, May 2009.

[Red95] Thomas C. Redman. Improve data quality for competitive advantage. *Sloan Management Review*, 36:99–99, 1995.

[Ric13] Robert Rich. Master data management or data governance? yes, please. `http://goo.gl/80BlVA` [accessed 03.07.2013], June 2013.

[ROO13] Andreas Reichert, Boris Otto, and Hubert Österle. A reference process model for master data management. In *Proceedings of the 11th International Conference on Wirtschaftsinformatik (WI2013)*, volume 1, pages 817–845, Leipzig, February 2013.

[RS08] John Radcliffe and Michael Smith. Creating a business case for master data managment. GartnerGroup Research #G00160270, August 2008.

[RWN06] John Radcliffe, Andrew White, and David Newman. How to choose the right architectural style for master data management. GartnerGroup Research #G00142610, September 2006.

[Sch09] Alexander Schmidt. Fallstudie SBB cargo – einführung eines unternehmensweiten stammdatenmanagements, 2009.

[SGZ12] Rolf Scheuch, Tom Gansor, and Colette Ziller. *Master Data Management: Strategie, Organisation, Architektur*. dpunkt.verlag, 1. edition, June 2012.

[SHG10] Alexander Schmidt, Kai Hüner, and Axel Grewe. Fallstudie Deutsche Telekom AG – einheitliche datenarchitektur als grundlage für unternehmensweites datenqualitätsmanagement, 2010.

[SM08] Heather A. Smith and James McKeen. Developments in practice XXX: master data management: Salvation or snake oil? *Communications of the Association for Information Systems*, 23(1), July 2008.

[Sou13] SourceMedia. Glossary. `http://www.information-management.com/glossary/m.html` [accessed 24.06.2013], 2013.

[TVY90] Hideaki Takeda, Paul Veerkamp, and Hiroyuki Yoshikawa. Modeling design process. *AI magazine*, 11(4):37, 1990.

[Vas09] Panos Vassiliadis. A survey of Extract–transform–Load technology. *International Journal of Data Warehousing & Mining*, 5(3):1–27, 2009.

[Wad12] David Waddington. Data governance and MDM more successful together. `http://www.information-management.com/newsletters/data_governance_MDM_maturity_ROI-10022164-1.html` [accessed 30.06.2013], March 2012.

[WAL08] Martin K Welge and Andreas Al-Laham. *Strategisches Management: Grundlagen - Prozess - Implementierung*. Gabler, Wiesbaden, 2008.

[Whi10] Andrew White. The five vectors of complexity that define your MDM strategy. GartnerGroup Research #G00175538, June 2010.

[WO08a] Kristin Weber and Martin Ofner. Case study Ciba – organizing master data management, 2008.

[WO08b] Andrew White and Bill O'Kane. Mastering master data managment. GartnerGroup Research #G00157050, May 2008.

[WOÖ09] Kristin Weber, Boris Otto, and Hubert Österle. One size does not fit All—A contingency approach to data governance. *J. Data and Information Quality*, 1(1):4:1–4:27, June 2009.

[WRN07] Andrew White, John Radcliffe, and David Newman. The important characteristics of the MDM implementation style. GartnerGroup Research #G00146840, May 2007.

[WWES92] Joseph G. Walls, George R. Widmeyer, and Omar A. El Sawy. Building an information system design theory for vigilant EIS. *Information systems research*, 3(1):36–59, 1992.