MASTER DATA MANAGEMENT

An Analysis of the Master Data Management Implementation Process

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Abstract

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This thesis aims to examine Master Data Management (MDM) and its implementation process, to identify challenges, opportunities and ongoing discussions. The purpose of this research is to point out and formulate key success factors, and to create an MDM implementation process framework. The framework provides suggestions, regarding preparations, actions and measures for an MDM implementation. The framework further serves as a guideline for decision making and supports the identification of needs.

With thorough literature research, topic related, theoretical information was gathered and analysed. The findings enabled the holistic understanding of MDM and its aspects. Firstly, the definition and impact of data was formulated, considering communication and business processes. Secondly, the taxonomy of data was studied, and Master Data distinguished from other data forms, based on its attributes. Finally, the research proceeded by analysing MDM, its implementation in enterprises and related challenges. These steps enabled the elaboration of an MDM implementation framework.

The research demonstrated that data quality and MDM have the potential to influence an enterprise and its processes positively. The successful MDM implementation is dependent on a combination of people, process, and tool factors. The main challenge of MDM is the need for an individual implementation strategy solution for every enterprise. MDM implementation is a collaborative, long-term project, which affects the entire enterprise. It is recommended to align the MDM implementation project with business goals, to ensure that measures meet expectations and improve the quality of Master Data to the advantage of the enterprise.

Keywords Master Data Management, Master Data, Data Quality, Data Management, Data Governance

Pages 43 pages and appendices 4 pages

Glossary

ADAPSO	Association of Data Processing Service Organization
BI	Business Intelligence
C-level executives	Chief level executives
CIO	Chief Information Officer
CTO	Chief Technology Officer
DIKW	Data Information Knowledge Wisdom
DW	Data Warehouse
HR	Human Resources
ITAA	Information Technology Association of America
MDM	Master Data Management

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1 Introduction

Customer service represents the linking point between business and customer. To reach out and conduct business, a customer can choose between various communication channels, like walking up to the counter, make a phone call, write an Email, send a letter, or make a request via the enterprise's website. For every new customer, a profile is going to be generated, which will be the origin for interactions and transactions. However, the focus lies on making revenue and not on generating customer profiles. Therefore, this task is rushed, so the customer does not lose interest. This can lead to faulty and incomplete profiles.

The next time a specific profile is searched, there might be no match, because of those errors. No match conveys that there is no existing profile and an additional one is generated, which leads to duplicates. Even when an error or duplicate is discovered, the lack of time or sense of duty, prevents the correction of the faulty data. Core business data like customer details, is used repeatedly in several systems all over an enterprise. Seldomly these departments have the same process definitions, which leads to additional deviations in identical data objects in different systems. (Haneem et al., 2019, p. 25)

The organisational structure of strictly separated systems and work departments, better known as silo structure, leads to insufficient quality of internal communication. These structural barriers prevent the exchange of new information and therefore impact the quality of external communication. (Casciaro et al., 2019; Gleeson, 2013). This situation favours the possibility, that a customer experiences poor customer service, which results in customers turning away. Faulty data causes unstructured processes, loss of trust, loss of revenue and bad decision making, due to insufficiently managed data resources which are used in reports. (Vilminko-Heikkinen & Pekkola, 2019, p. 77)

This example demonstrates the importance of data quality and its impact on an enterprise. Data is generated, collected and stored but not maintained and managed to the needed extend. The need to solve this situation, led to the idea of identifying, unifying and managing business core data in one location, to simplify maintenance and distribution. In business this task is known as Master Data Management (MDM). The number of involved stakeholders and the cross divisional impact makes MDM implementation even more challenging. With

this thesis work, the author aims to analyse the status of MDM in enterprises. The gathered knowledge will be used to formulate an implementation framework, which can be considered and adapted according to the respective business needs. To achieve the above-mentioned goals, the following questions were formulated:

1) What is considered data in an enterprise?

2) What is the benefit of MDM?

3) What issues occur in the MDM implementation process?

2 Methodology

The structure of this thesis is divided into four sections. Firstly, the term data, its impact on communication and business and its taxonomy will be examined. Secondly, the definition of MDM and its composition will be analysed. Thirdly, based on the research findings an MDM implementation framework is formulated and finally, a conclusion is made. The detailed description of the methods used in the corresponding sections, is described in the succeeding paragraphs.

2.1 Research

The research for this thesis consists of the collection and classification of suitable literature and the analysis of topic relevant work. The search and classification of literature has been conducted according to the methods described in "*Wissenschaftliches Arbeiten*" (Balzert, et al., 2017). These methods cover the aspects of scientific writing, research and the correct citing of sources. The book enabled the author to develop critical thinking, find a suitable research strategy and identify trustworthy sources.

To obtain a better understanding of the current situation and ongoing discussions on the topic, the author performed an online keyword search. The following databases, platforms and libraries were searched and consulted in the process: jstor.org, journals.sagepub.com, link.springer.com, sciencedirect.com, scholar.google.com and swisscovery.bfh.ch. Search terms like "Master Data Management", "Data Management", "Data Quality" and "Data Governance" have been used to find papers and case studies on the corresponding topics.

2.2 Scope

The author classifies the topic of MDM under the main topic of data management. The topic of data management can be viewed from various perspectives, such as legal, business, philosophical, ethical or technical. The scope of this work touches the business and philosophical aspects of MDM and its subdomains, because the thesis questions consider the value of MDM to a business and its implementation process and is not dedicated to a specific field of industry.

2.3 Benefits and Relevance of the Research

MDM represents an aspect of the digital transformation movement in business and industry. The vision of MDM is to manage core business data, standardise, unify and redistribute it to systems and users. Further MDM should break down silos by reducing interfaces, enhancing interconnectivity and data quality within an enterprise. This process has the potential to increase efficiency of business processes and improve the quality of decision making.

The market for MDM solutions is growing and developing for several years. In the 2018 released Gartner Hype Cycle for data management related technologies, MDM passed the peak of inflated expectations and is now undergoing modifications to reach a plateau of productivity. Flaws and difficulties have been identified and vendors are developing their products to meet business needs. Gartner estimates MDM to reach the productivity plateau in the next 2 to 7 years. (Gartner.com, 2018a; Gartner.com, 2018b) Besides obtaining the right software solution, the implementation of holistic MDM holds many difficulties, which need to be distinguished, analysed and managed.

2.4 Results

Based on the findings the author developed an MDM implementation framework which suggests a variety of actions and measures, to address challenges, faced in the implementation process. Additionally, a conclusion regarding the findings was formulated and can be found at the end of this thesis. The findings covered questions regarding ongoing issues and needs, related to the MDM implementation process.

3 The Development of MDM

The goal of this chapter is to identify the origin and meaning of data and to analyse and summarise the findings. It is aimed to provide a better understanding of data and data management, as well as to demonstrate the connection between data, knowledge and process implementation.

3.1 Data Definition

According to the Cambridge Dictionary, data can be described as: “Information, especially facts or numbers, collected to be examined and considered and used to help with making decisions” (Cambridge University Press, n.d.). This qualifies data to be an observable property or asset, to support daily decision making within an enterprise, as well as the forming of business objectives and process definitions. (Cleven & Wortmann, 2010, p. 1; Frické, 2018, p. 1) Modern tools and systems are designed to record every action and monitor behaviour and therefore generate data at an increasing rate. All this additional data bears new potential and challenges. (Luís et al., 2021, p. 1-2)

3.2 Data Processing Development

Herman Holerit, the founder of the company later known as IBM, developed the punch card system for data storage. His punched card tabulator was used for the 1890 census in the US. (Blodgett & Schultz, 1969, pp. 222-225) In this process, Holerit faced the problem of frequently changing data. Holerit approached the issue by defining categories and classifying data as static and changing data. This classification of data, can be considered the cornerstone of the field of data processing and MDM. (Foote, 2019)

With the rise of electronical data processing, procedures and the understanding of data management started to change in enterprises (Mann & Williams, 1960). This led to the foundation of the Data Processing Service Organization (ADAPSO), in 1961. Today the association is still active and known as the Information Technology Association of America (ITAA) (Effy, 1993, p. 715). This movement shifted the focus towards knowledge management through data management, quality assurance and staff training. Data management received a unified

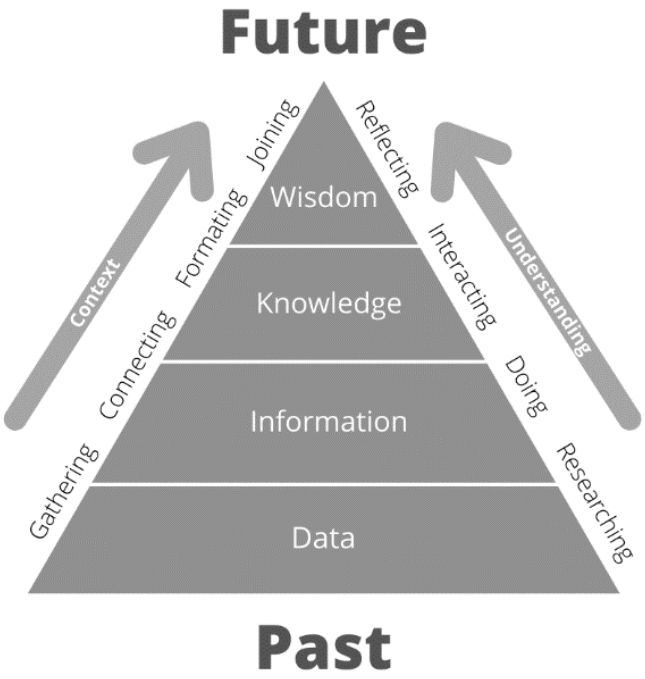
platform. The various data related topics in IT like MDM, data governance, knowledge management, Big Data and machine learning fluctuate and rely on strategic data management. (Marmonti, 2019, p. 66)

In the context of communication and business, data needs to be processed to become readable information and knowledge. The Data-Information-Knowledge-Wisdom model (DIKW model), a model with four stacked layers, describes the simplified process of data transformation into a revenue generating asset (Sharma, 2016). Regarding business and process management, the DIKW model supports the understanding and the identification of necessary steps regarding communication and knowledge management (Frické, 2018, p. 1). The model was further developed, to describe the different development stages and thinking steps, as well as the purpose of processing data. This process considers both, machines as well as the human mind. (Ackoff, 1989)

3.3 DIKW Model

The DIKW model is visualised in the following Figure 1 and does not represent a complete and self-contained process.

Figure 1: DIKW model (Frické, 2018; Kirsch et al., 2015)



The model supports the understanding of the necessary steps within the process and the extent, to which digital data and the wisdom of the human mind are dependent. (Snowden, 2007; Snowden, 2010)

3.3.1 Data

In the described DIKW model, data builds the base of the pyramid. Data is the collection of unsorted, uncategorised forms of actions. This data itself has no value. (Figueroa, 2019; Frické, 2018, p. 1) Today's industry understands that collecting and evaluating data, provides more and better insights, in order to develop and improve technologies and processes. (Lasi et al., 2014, pp. 239-240)

3.3.2 Information

Information manifests when one formulates a question and processes data in a way, that it delivers an answer to this question. This implies that Information can be defined as processed data, or data with a meaning. With this process, the data gets reduced and condensates to a more specific form. This demonstrates, the development of the DIKW-pyramid scheme formation. (Frické, 2018, pp.1-2)

3.3.3 Knowledge

Knowledge is generated when Information is transferred and used in a task and turned into experience. This situation arises, when applying new information while conducting a specific task, which then becomes a skill. Information acts as a catalysator in the process of gaining knowledge. (Frické, 2018, pp. 2-3)

3.3.4 Wisdom

The top part of the DIKW model is discussed seldomly among experts. Reflecting on events, experiences and knowledge, can lead to new insights, when combining the resulting conclusions and can be considered as wisdom. Further experiencing the same task several times,

leads to a broad spectrum of awareness and develops standards and moralities over time (Frické, 2018, p. 2).

3.4 Knowledge Types

After discussing the development from data to knowledge and wisdom in the previous section, the different forms of knowledge will be distinguished and clarified in this section. The two top parts of the pyramid do not solely origin from information and data. Context, experience and situation settings influence an individual strongly on how data and information is perceived. There are numerous ways and preferences, as to how an individual gains knowledge. These factors are considered in change control and education of staff, when aiming to successfully direct an organisations development into a specific direction. In literature knowledge is divided into explicit and tacit knowledge. (Garfield, 2018; Schoenherr et al., 2014, p. 123)

3.4.1 Explicit Knowledge

Explicit knowledge can be formulated in words and documented by writing it down. This form of knowledge can be shared and taught to other individuals. Within an enterprise, explicit knowledge can be found in white papers, policies or research reports. (Tobias, Schoenherr et al., 2014, p.123)

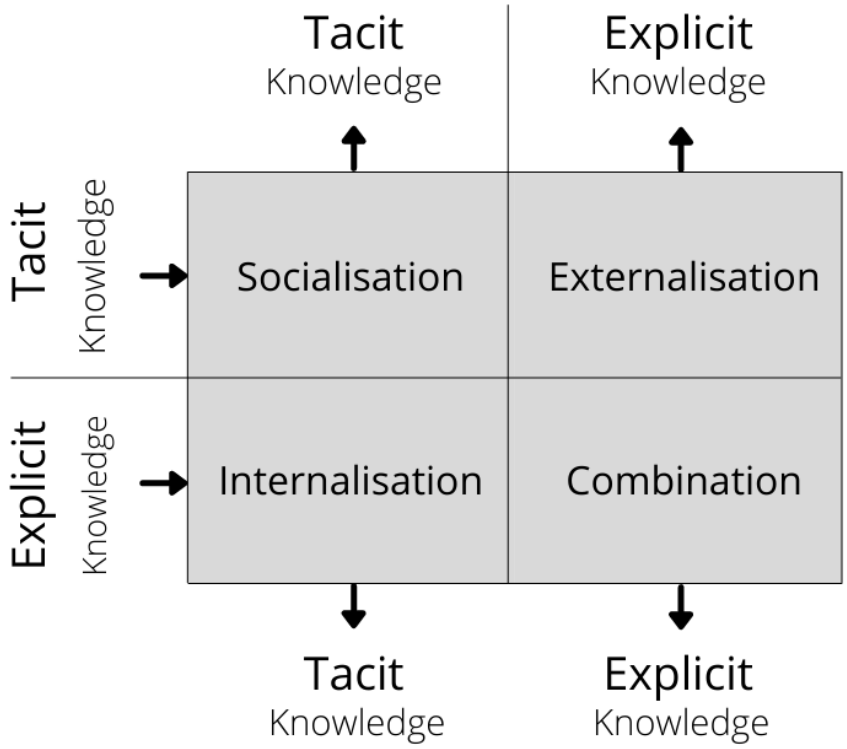
3.4.2 Tacit Knowledge

Tacit knowledge, also referred to as implicit knowledge, is the experience we gain from using explicit knowledge in a task. Knowledge of this form is difficult to conceptualise and is part of an individual's experience. Tacit Knowledge develops over time from experience and interactions. This kind of knowledge can't be deliberately taught or documented and is difficult to transmit. (Tobias, Schoenherr, et al., 2014, p.123)

3.4.3 Knowledge Transmission

To manage and use these types of knowledge, they must be understood and considered when implementing processes. Figure 2 demonstrates how explicit and tacit forms of knowledge are connected, transmitted and how one knowledge type can be converted into the other. Socialisation, for example by joining a lunch break and discussing a specific topic, can lead to new tacit knowledge, by making observations during the event. Further, the externalisation of tacit knowledge, through demonstrating task, leads to the gain of new explicit knowledge. Combining new explicit knowledge, with existing one, enhances the quality of said knowledge and can lead to a better solution to a process. Finally, internalisation is understood as converting explicit knowledge, into tacit knowledge.

Figure 2: SECI model (Vaiappuri et al., 2016, p. 457)



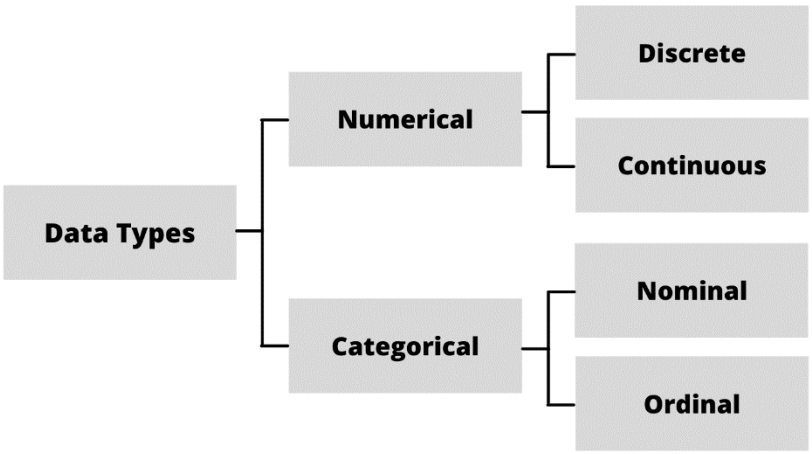
All four processes can occur on an individual level, within a work group or even a whole organisation. From engaging in all four possible forms of knowledge exchange, one can gain new knowledge as well as improve the quality of the already existing one. (Vaiappuri et al., 2016, pp. 457-459)

3.5 Data Analysis

Statistics describes the mathematical interpretation of data. A specific statistical method can only be conducted with a certain data type and not all data can be visualised the same way. To gain a better understanding of statistical data manipulation, one must be familiar with the different requirements towards data. In statistics, variables are divided into specific data types, based on their attributes.

As shown in Figure 3, data is classified in either numerical or categorical data and then further divided into four scales of measurement. Numerical data are numbers, where a difference is measurable, such as the number of orders or production time. Categorical data can be divided by attributes, such as colour or rating. Numerical data is further divided into discrete and continuous data.

Figure 3: Data Types, adapted from (Donges, 2018)



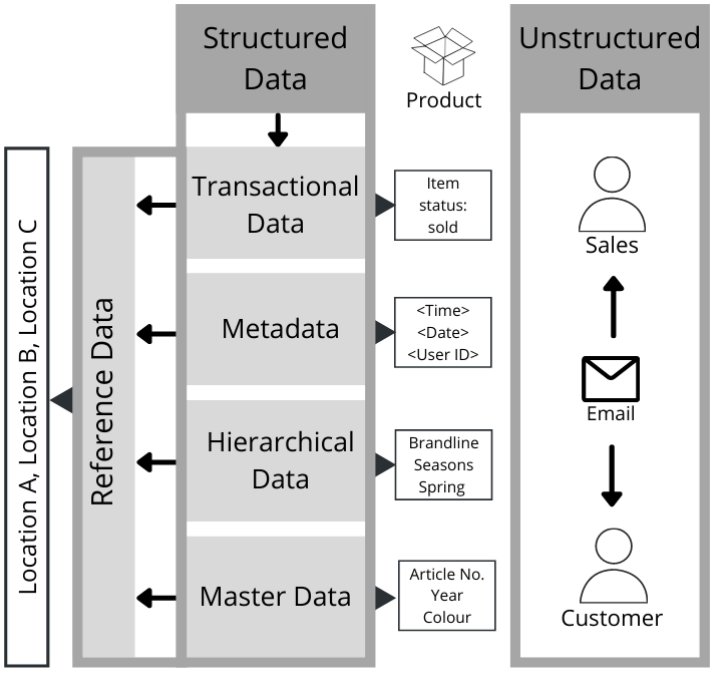
Discrete data can only be resembled by whole values, for example the quantity of an ordered item. Continuous data is any measured value within an interval scale. For example, the time it takes to deliver an order. Categorical data is further divided into nominal and ordinal data. Nominal data has no quantitative value and is categorised by terms, like the different colours of a product. Ordinal data can be sorted in a hierarchical order, like the survey ranking of a service. The respective category type of data defines which statistical calculations can be conducted on the data. To answer a specific question, the right data type must be collected and processed. (Anderson et al., 2011, pp. 5-7; Donges, 2018)

3.6 Data Taxonomy

To regulate and manage data, its taxonomy and categorical features need to be known. This knowledge enables the identification of needed measures, to enable the storage, handling and processing of data. To obtain a better understanding of Master Data and being able to distinguish it from other data, the author examined the six typical categories of data, handled in enterprises, and describes them in more detail in the next sections.

In this context, data can generally be divided into structured and unstructured data. Structured data can be further divided into transactional data, metadata, hierarchical data, reference data and finally, Master Data. A model of the data taxonomy is presented in Figure 4. (Das & Mishra, 2011, p. 130; Kirk Haselden, 2021; Schemm, 2008, p. 19)

Figure 4: Data Taxonomy (Schemm, 2008, p. 20)



3.6.1 Unstructured Data

Under the definition of unstructured data goes clear text, such as e-mail bodies, documents, text on an intranet portal, audio or video footage. This form of data is easily interpreted and handled by humans, but not by machines. (Haselden & Wolter, 2021)

3.6.2 Transactional Data

Transactional data describes information related to ongoing business transactions like orders, sales or invoices, with historical relevance. Transactional data is inherently variable, and experiences change due to status and volume alterations with every business activity. Transactional data is often considered by other systems for analysis. (Cleven & Wortmann, 2010, p. 2; Kirk Haselden, 2021; Mohrmann, 2019)

3.6.3 Metadata

Metadata is structural data which holds information about other data and is often described as data about data. Metadata is descriptive for entities such as databases, products or documents and describes details such as when, where and by whom an action was taken. Metadata is the documentation of behavioural conditions of objects, such as customers, products or tools. (Haselden & Wolter, 2021)

3.6.4 Hierarchical Data

Hierarchical data describes relationships between data. An example for hierarchical data is the structure of product lines or organisations. Hierarchical data supports the traceability and discovery of interlinks between Master Data. For example, when a customer buys a product at a specific location. (Haselden & Wolter, 2021)

3.6.5 Reference Data

Reference data resembles the designated description or abbreviation for data objects, valid within a limited range, such as an enterprise. An example for reference data is the defined term for a location or currency. Reference data ensures the consistency of attribute values for transactional data or Master Data. Reference data shares attributes with Master Data such as high stability in data volume and change. What distinguishes it from Master Data is the higher granularity and the absent limitation to core business entities. (Cleven & Wortmann, 2010, p. 2)

3.6.6 Master Data

Master Data is the core data of an enterprise which describes objects, such as places, parties or things. In the following Table 1, the most common attributes of Master Data are described in detail.

Table 1: Master Data Attributes (Cleven & Wortmann, 2010, p. 2; Kirk Haselden, 2021; Schemm, 2008, p. 19)

Attributes	Description
Constant data volume	Master Data is a constant set of data objects. It consists of entities, with little fluctuation in number, such as parties, locations and items.
Static	The change frequency of Master Data attributes is very low during its lifecycle and business transactions.
Independent	Master Data can exist independent from other data.

The entities are the centre point, around which an enterprise conducts business and which are edited in several organisations and systems. (Kirk Haselden, 2021; David Loshin, 2011, p. 329) The attributes of these entities change seldomly and therefore, they are also referred to as static data. Master Data is essential for an enterprise, because all business actions resolve and orientate themself around Master Data (Mohrmann, 2019). All data produced in an enterprise, stands in relation to Master Data.

The relationship between master and transactional data can be compared to the relationship between nouns and verbs in language. The combination of the two, can be described as behavioural data. (Foote, 2019; Haselden & Wolter, 2021) The entities, described in Table 2, resemble the most common entities, considered in MDM.

Table 2: Master Data Entities (Das & Mishra, 2011, p. 131; Foote, 2019; Kirk Haselden, 2021)

Entities	Examples
Parties	Contact details or bank details of business partners such as customers, organisations, vendors, suppliers.
Locations	Detailed locations, for example office sites, production facilities, or a specific shelf at a store.
Items	Details about an enterprises asset like sales, planning or finance for objects such as accounts, policies, products, services or warranties.

Especially locations, are often combined with other entities to answer Business Intelligence (BI) related questions. BI examines and combines data, regarding behaviours or coherences of a specific combination of entities, like items and locations to make strategic business decisions. (tableau.com, n.d.) The granularity of top Master Data is often increased to analyse and process specific business processes, because requirements and lifecycles can vary greatly. For example, customers and products can be divided into subdomains and be segmented to enable up-selling and cross-selling of products and targeted marketing. (Cleven & Wortmann, 2010, p. 2; Kirk Haselden, 2021)

However, the decision of which entities need to be managed as Master Data, is different for every enterprise and depends on the main business. There are several factors, which can help decision making, such as value for the business, data lifecycles, cardinality, or reusability. An enterprise can consider the individual attributes and the behaviour of data, within the context of business processes and needs. This viewpoint will enable decision making on prioritising specific Master Data over other data. (Haselden & Wolter, 2021)

4 Master Data Management

In this section, the definition of MDM, its purpose, impact and challenges will be analysed and described. Additionally, the author will have a closer look into the implementation process of MDM, its aspects and challenges.

4.1 Benefits of MDM

The purpose of MDM is to define and gather an enterprises Master Data, to enhance visibility on the use of core business data. The managed gathering and storing of said data, enables simplified control over data quality. This action further facilitates the distribution and use of a single, true version of the currently used Master Data and provides a unified view of the enterprises data assets. MDM promises to optimise and simplify processes and reduces errors, due to data quality. The quality of communication, reporting and decision making will be increased because MDM ensures that everybody is referring to the same trustworthy data. (Haneem et al., 2019, p. 26; Vilminko-Heikkinen & Pekkola, 2019, p. 77; David Loshin, 2011, p. 328-329)

4.2 MDM Implementation

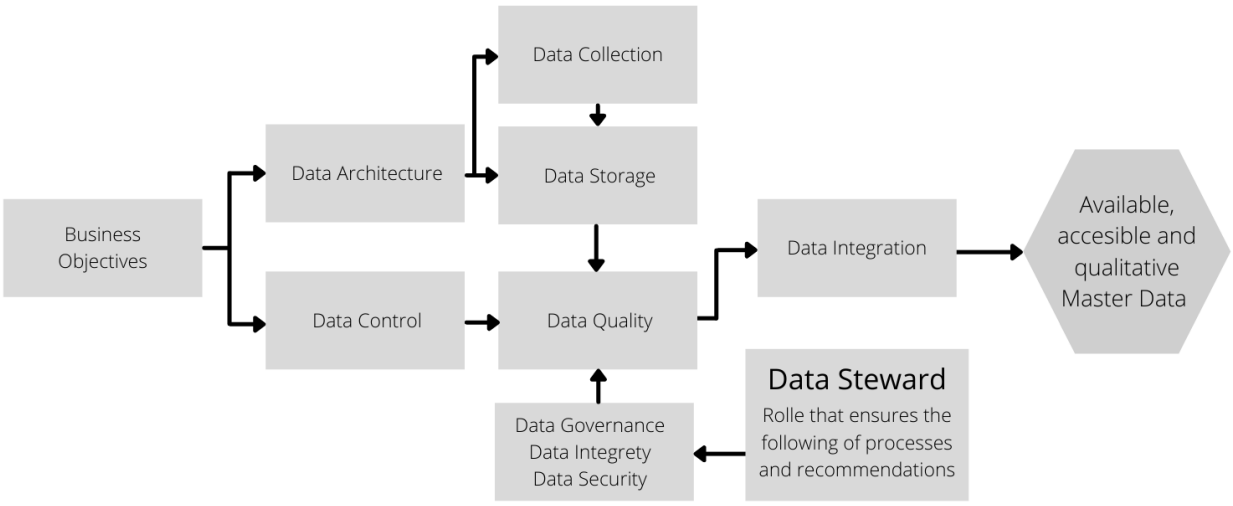
MDM implementation projects, which have been documented, were initiated in the years 2004 to 2009 and the conduction of the complete integration lasted on average 10 years (Fernando & Haddela, 2017, p. 144; Haneem et al., 2019, p. 26). The successful realisation of MDM requires the configuration of several aspects. Those aspects include system architecture, data storage, roles and responsibilities and governance, including processes, validation and optimisation (Cleven & Wortmann, 2010, p. 3). Current business objectives, systems and processes need to be analysed, to gain a clear view of the initial situation and condition of the individual aspects. Based on the outcome, the MDM implementation strategy can be aligned with business goals and the scope for the implementation process can be defined.

Data quality matters can be divided into data storage, data control and data governance. For data collection it must be decided, what the enterprises Master Data is and how this data will be gathered. Laws and regulations regarding the storage of personal data vary greatly,

depending on the geographical location and must be addressed by an enterprises legal team (Niebel, 2021; Vilminko-Heikkinen & Pekkola, 2019, p. 79). Data control screens data and decides upon, which data will be further processed and stored. Upcoming questions addressing data storage, like storage location or life cycle need to be defined, so individuals can find needed data again.

Data governance defines the availability, usability, and consistency of stored data and therefore, who will have what level of access. The assessment of the adherence to defined standards and regulations needs to be conducted and evaluated by a role, which is often referred to as Data Steward. When this state of data quality and continuous data management is reached, staff should undergo training on how to handle data properly and consistently. For Master Data to be implemented into daily business processes, affected personnel needs to be aware of MDM and their role regarding the implementation and management process. After this step, the Master Data should be accessible and available throughout the entire enterprise. An overview of the involved MDM implementation aspects and their connections is displayed in Figure 5.

Figure 5: MDM aspects (Haselden & Wolter, 2021; Kekwaletswe & Lesole, 2016)



4.3 MDM Implementation Factors

MDM implementation aspects can be generally divided into technical approaches and organisational approaches. (Kekwaletswe & Lesole, 2016; Otto & Reichert, 2010) Within those

approaches, four main factors, namely technical support, management support, data governance and finally, roles and responsibility, were most noticeable discussed in MDM related literature. The four factors of MDM implementation will be regarded in more detail in the following sections. (Fernando & Haddela, 2017, pp. 142-144; Mohrmann, 2019)

4.3.1 Technical Support

Technical support influences the successful software integration and implementation of new elements to a large extend. The process and outcome of MDM implementation depends on already existing systems and data architecture. The compatibility of MDM software solutions and existing systems needs to be evaluated and compared, to decide upon, whether the existing systems undergo alteration or the targeted MDM software, to reach interoperability.

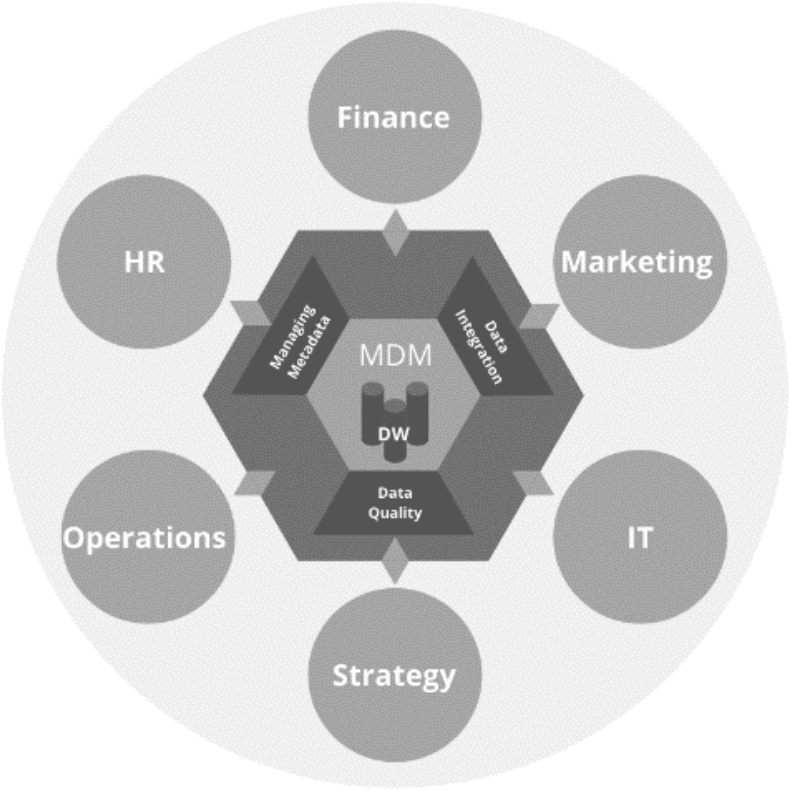
Therefore, good communication and inclusion of IT and other departments is needed, for the enterprise to benefit from available, technical expertise and detect preferences, which are more likely to be accepted. The current situation of already available infrastructure must be evaluated, to identify possible solution options, the enterprise can choose from.

Technical support enables unequivocally requirements definition towards a MDM software solution (Gualo et al., 2020, pp. 1023-1026). IT can evaluate and provide a holistic view of available MDM software solutions and supports decision making with recommendations (Fernando & Haddela, 2017, p. 142-144; Gualo et al., 2020, p. 2010; Kokemüller & Anette, 2009). Mechanisms for Master Data, being separated from other data and being able to be managed independently needs to be implemented.

A Data Warehouse (DW) consists of the full history of changes done to data entities. The origin of DW entity lists, are transactional or operational system sources and new data is generated when an event or transaction, such as a customer purchase happens, or a product inventory changes. MDM on the other hand ensures the single, unified view on business key data assets. (Harris, 2017) One of the challenges, regarding MDM implementation, is to keep the right balance of efficiency, effectivity and acceptance, when modifying systems and tools. Employees must be included and educated, to enable acceptance of change and willingness to adhere to defined standards. The involvement of all support groups, such as HR,

IT, business administration and procurement, as well as considering consulting from vendors, is important. (Vilminko-Heikkinen & Pekkola, 2019, p. 78-79) An MDM system model with all involved parties and technical components is displayed in Figure 6.

Figure 6: MDM system (Haneem et al., 2019, p. 27)



4.3.2 Management Support

Chief-level (C-level) executives hold senior positions and oversee a whole department, such as IT or marketing and influence companywide decisions. The Chief Information Officer (CIO) or the Chief Technology Officer (CTO), is responsible for the operational and strategic lead of the IT department. (Gouveia & Varajão, 2019, p. 220; workable.com, n.d.) One of the major factors for the successful implementation of MDM, is the support from management. If the executives at C-level management understand the impact and value of MDM, it is more likely that such a project receives the needed resources and is driven forward. (Haneem et al., 2019, p. 31; Schemm, 2008, p. 81)

Management must define goals and make strategical decisions. The main strategical questions are whether MDM implementation should be conducted in a local, central of hybrid approach. The decision on how to proceed could have an influence on the organisational structure, its roles and the assigned responsibilities. (Fernando & Haddela, 2017, p. 144) The transition to a holistic, sustainable MDM process requires continuous alterations and adaptions, regarding practices of people, processes and technology. In order to achieve these goals successfully, good change control in the form of communication and recurring assessments, needs to be conducted. (Schemm, 2008, p. 13; Vilminko-Heikkinen & Pekkola, 2017, 76-77)

Technologies and processes need to be changed in a way, that they support the initial goal by making processes easier, while personnel have enough time to adapt to the changed processes and can use the technology to support their work. The implementation extent of technologies and processes and the willingness of staff to follow changes, has a direct impact on data and its quality. (Mohrmann, 2019) At the very beginning of an MDM implementation project, an evaluation of the current overall situation is needed. The findings can be brought into context with the set goals by comparing them to a Maturity Model for the enterprises MDM. Such a model demonstrates the needs of the individual factors, in order to reach full maturity status. (Gualo et al., 2020, pp. 1021-1022; Spruit & Pietzka, 2015)

4.3.3 Data Governance

In the context of MDM, data governance describes all actions which ensure Master Data quality. Master Data must be managed according to the defined standards, which includes data security and integrity processes. (Langer, 2018; Vilminko-Heikkinen & Pekkola, 2019, p. 77) Successful data governance results in Master Data quality, which is complete, reliable and timely. Data security as a part of data governance, defines the process of data storage, entry points and accessibility, to ensure privacy and retention of Master Data. (Haneem et al., 2019, p. 31)

Integrated data enables an enterprise to use it for decision making and building a successful future for the organisation (Marmonti, 2019, p. 64). A challenge faced when implementing data governance for MDM, is to join, manage and control all data sources, which are spread

over several business units (Haneem et al., 2017, p. 4). Data governance naturally has an impact on the enterprise's strategy and influences business processes because rules and requirement limit the flexibility and speed of a process.

Because no standards or specific frameworks for MDM implementation exist, it is recommended to consider accepted frameworks such as COBIT or ISO 8000 for data quality of Master Data (Gualo et al., 2020, pp. 1020-1021; Spruit & Pietzka, 2015, p. 1069). The COBIT framework concerns IT governance in general and provides guidelines and recommendations on how to approach such a project (ISACA, 2012). The ISO 8000 standard covers the topic of data quality and Master Data and defines requirements to meet desired goals (Iso.org, 2011).

4.3.4 Roles and Responsibilities

An additional major aspect of MDM is the operational implementation of roles and responsibilities, as well as the ownership of data (Vilminko-Heikkinen & Pekkola, 2019, p. 76). One of the main challenges regarding the implementation of MDM, is the clear assignment of roles and responsibilities (Vilminko-Heikkinen & Pekkola, 2019, p. 77). Existing role descriptions need to be overlooked and adapted if necessary. Finding a concept owner for MDM and its implementation on C-level management can lead to discussions, because IT is only one of many aspects of an MDM implementation and a CIO might not be the right fit for this task. (Gouveia & Varajão, 2019, p. 222-223)

Due to this situation, it is challenging to find an obvious candidate, who could be assigned to this role. Assigning the role of the Data Steward, also uncovers some difficulties, since the responsibilities, as well as the tasks are difficult to formulate. The ongoing, individual MDM implementation process of a respective enterprise must be observed and documented over the course of several years, to be able to name the task and responsibilities, a Data Steward is going to hold. Since numerous parties are involved, nobody is willing to take the risk of being hold accountable for the data alone. This situation makes assigning the Data Steward to a specific department challenging. (Schemm, 2008, p. 85; Vilminko-Heikkinen & Pekkola, 2017, p. 81)

The role of the Data Steward however is a key role, regarding MDM, because of the responsibility for data quality and the accompanying processes, which are crucial for the continuous execution of MDM. Issues with data quality are directly linked to processes, data creation and data management and therefore need to be closely monitored. (Vilminko-Heikkinen & Pekkola, 2019, pp. 84-85) Roles which hold responsibilities, regarding data stewardship are necessary because their accountability for the Master Data quality, will ensure the commitment of an enterprise to the MDM implementation. (Vilminko-Heikkinen & Pekkola, 2019, p. 79-80)

Additionally, clearly defined roles and responsibilities, distributed among IT and business departments, ensure successful MDM implementation (Cleven & Wortmann, 2010, p. 4). The following Table 3, suggests but does not limit, roles which are considered necessary to implement MDM.

Table 3: MDM Role Description (Kirk Haselden, 2021; Marmonti, 2019, p. 65)

Role	Responsibility	Involvement
Data Steward	Responsible for the collection, control, governance, maintenance and processing of data within an MDM solution.	Full time
Administration	IT department employees who are responsible for the set up and configuration of the MDM solution.	Full time/ occasional support
Data Governance Taskforce	Driving the definition, requirements and solutions for MDM	Regular meetings for interaction and exchange
Business Analyst	Planning the system functionality and requirements. Participation in workshops, planning and execution of reviews and testing procedures.	On demand support

Data Architect	Expert for enterprise concepts, logic, and physical data models, in conformance to an enterprise's standards and conventions. This expertise is needed for leadership and guidance, regarding enterprise data strategies. Consultant for organisational governance practices, and standards.	On demand support
End User	Individuals who generate, use and work with Master Data and are affected by the business processes.	Part time

5 MDM Implementation Framework

In this chapter, the findings of the research section will be utilised to create an MDM implementation framework. The purpose of this framework is to provide an overview over the necessary actions needed, over the course of an MDM implementation. The structure of this chapter is divided into two parts. Firstly, a framework justification and scope description part and secondly, a framework presentation part.

5.1 Framework Justification

The research results demonstrated that MDM is often not conducted and utilised to its full potential. Regarding the MDM implementation process, risks seem to be too high and the needed efforts too laborious compared to the possible benefit. Since data is generated and stored digitally, MDM is still considered a task which needs to be managed by the IT department. There are many software solutions on the marked, but they only resemble a small part of the whole MDM spectrum.

Staff needs to be trained and ideally undergoes an ideology shift, regarding data. Enterprise members need to feel responsible and accountable for the data they produce and handle. This synergy is necessary, because inconsistent data leads to the lack of trust towards systems and processes, and influences, how well guidelines are conducted. The people and process aspect of MDM is not managed as easily as the software and tools implementation aspect. It requires endurance, time and transparency.

MDM affects a big portion of an enterprise because it influences and limits processes, changes roles and responsibilities and alters organisational structures. This change is cumbersome and issues difficult to predict. This situation comprises many difficulties, which cannot be predicted, which is why, long-term goals and timelines are difficult to plan. Therefore, the author aims to create a holistic implementation framework approach, which considers and supports all involved parties. The idea of adhering to the MDM framework is to achieve a sustainable and continuous, positive change, regarding MDM.

5.2 Framework Development

The created framework considers the aspects of an MDM implementation process, which the author found relevant for such a project to be successful. The framework represents a guideline, consisting of four steps which pave the way towards a desired state of continuous MDM. Opinions were built by literature study and by concerning oneself with the findings, conclusions and issues. MDM implementation is a recurring task, which is why the framework is designed in a lifecycle model. To measure progress and promote work towards defined goals, a framework checklist was set up to support a potential project team. The check list ensures that important questions are addressed, and current situations analysed.

5.3 Framework Goal

The purpose of the framework is to act as a guideline for all involved parties and to address the most common issues, distinguished in the research section. It supports the initialisation of an MDM implementation project and facilitates the orientation within an ongoing transformation process, since the many involved parties make the transformation a complex matter. The framework therefore should enable a view on the bigger picture. This view ensures that all needed steps along the process are properly conducted and supported. The combination of following the four steps towards the recurring life cycle model and considering the check list have the purpose of benefiting the accomplishment of aimed goals related to MDM implementation.

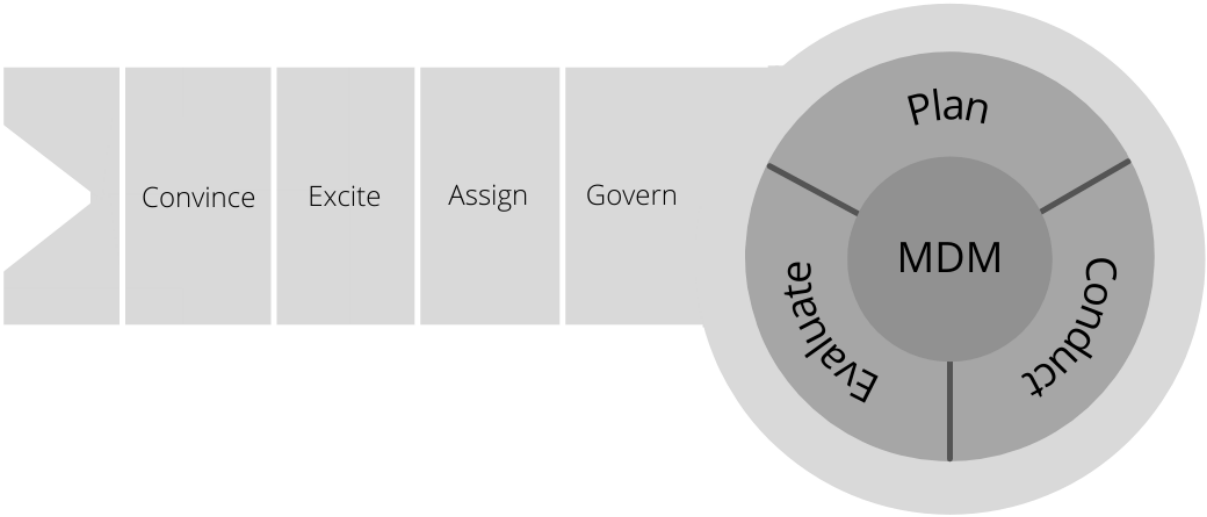
5.4 Framework Scope

The possible challenges in an MDM implementation process can deviate in each business sector, due to goals, conditions and involved parties. The vast number of possible issues does not make it possible to formulate a framework solution, which covers and considers all existing factors. A framework of such extend would not be useful and clear anymore. Therefore, the framework is limited to the findings made in the research section and formulates generally applicable recommendations based on this knowledge.

5.5 Framework Description

The following Figure 7 demonstrates the steps of the MDM implementation framework. It starts with the four working blocks convince, excite, assign and govern, to afterwards transition into an MDM process life cycle of plan, conduct and evaluate actions, regarding an MDM implementation.

Figure 7: MDM Implementation Framework



A major success factor of such a project is the support and acceptance of stakeholders. To obtain this, management support must be ensured and involved parties must experience educational enlightenment, to be convinced and to understand MDM and its purpose. Affected individuals of structural and process changes must be prepared and involved. Roles and responsibilities must be defined and assigned at the right time and at the right place, to ensure the successful promotion of the project. Processes must be defined and governed to ensure the desired execution and quality of all involved aspects.

Changes and implementations must be actively conducted, monitored and evaluated. All these steps within the framework will be processed repeatedly, since they are most likely required again at several points of the project or because of changing goals, demands and strategies which can occur during a long-term project. The overall goal of the MDM framework is, that there is a general understanding and acceptance of the implementation and the consequences of MDM. The implementation should be planned and conducted in small incremental steps, since there is a need for evaluation and possible reorientation after every

step. After MDM has been implemented, it is a recuring process of planning, conducting and evaluating, to make conclusions upon which the planning for the next steps starts all over, to support maintenance and management. In the following paragraphs, the individual steps of the MDM implementation framework will be explained and discussed in detail. The framework supporting checklist is presented in the annex 'Annex 2: MDM Implementation Framework Checklist'.

5.5.1 Convince

Convince management at C-level, especially the CIO or if available, another chief executive with suitable abilities, requires convincing and plausible arguments, which must be carefully prepared, to obtain business sponsorship. To initiate, an MDM implementation project, it needs to start with data collection and the evaluation of the current situation. The challenge is to demonstrate that the effort of implementing MDM improves the performance compared to a state of working with inconsistent data.

Current work processes and data management need to be analysed and compared, to a maturity model, to receive a maturity level score of the initial MDM status. Factors like the proportion of faulty data, time spent on handling errors and looking for information must be measured and summarised. Such findings also demonstrate the impact on the quality of business reports, which are considered and therefore influence decision making. These facts can convince management to support MDM and see the potential of a holistic MDM process.

On one hand, this analysis demonstrates inefficiencies of current processes and on the other hand the potential advantages, regarding the future of business in general. A preceding analysis report ensures realistic expectations from management towards MDM. When management support is ensured, objectives and strategies must be defined and formulated and brought into alignment with the current business goals.

5.5.2 Excite

To gain support from personnel and obtain the willingness of individuals to undergo change and training, it must be assured that all affected parties are involved and informed. The positive impact and benefits of MDM on daily work, needs to be pointed out to employees. Individuals need to learn and understand what MDM is, how it works and how it is going to be achieved, without being overwhelmed. Enterprise members need to undergo training and sensitisation regarding data and the importance of integrity. An environment for open discussions and an information platform for further questions and regular updates on the project enhances trust towards management and the project and lowers the fear for negative effects.

5.5.3 Assign

During the MDM implementation project, it must be analysed, what human resources are already available and whether new roles and additional staff is needed. Existing roles and responsibilities need to be analysed and if necessary redefined. If specific tasks cannot be compensated by existing resources, staff needs to be trained accordingly or new roles need to be implemented and external experts consulted. Next to other roles, the role of the Data Steward resembles a key role, because it supports and consults the affected parties and controls governance processes, to ensure data quality. Especially such a position is important and needs to be realised during the MDM implementation process.

5.5.4 Govern

The enterprises own data and MDM processes need to be governed, to ensure the desired quality. Frameworks and standards like COBIT and ISO 8000 should be considered to manage the MDM governance aspect and the implementation process of new rules and processes. The generally known and accepted frameworks could facilitate the definition and conduction of tasks like Master Data distinguishing, collection and the implementation of control processes.

Further, enterprise-wide valid rules, regarding data handling and storage must be defined, to maintain control over all generated data. This considers questions like the location and timespan of data storage. Additionally, task like the definition of the access level of individuals and which measures are taken to secure the data, need to be conducted. Standards for the desired data quality need to be defined and measures taken to ensure the conduction Business processes need to be evaluated and adjusted to meet the aimed, standard definitions and quality. These measures must be managed and controlled across all departments. A governance body ensures the conduct and quality of defined standards and processes.

5.5.5 Plan, Conduct and Evaluate

After the initial enterprise situation is set to the required state, the execution phase of MDM implementation actions can start. With the iterative plan, conduct and evaluate circle of the framework, MDM gets gradually integrated into an enterprises system and ensures acceptance and consolidation. Every single MDM related action, as well as the whole project, will be accompanied by this control cycle. Planning the tasks ensures that affected parties are informed and that sufficient resources are available. The planning further enables a targeted and efficient conduction.

Following the conduction, the evaluation analyses the process and concludes whether future actions can be processed the same way or whether alterations are necessary. These experiences and results influence the planning of the next action cycle. This procedure ensures, that the status and possible challenges of every action is monitored and documented. Delays will be immediately detected and processed, which ensures that necessary measures are taken, to enable the continuous development of the MDM implementation.

After the initiation of the MDM implementation process, regularly recurring overall assessments need to be conducted, analysed and conclusions made, to understand the current state and needs of MDM within the enterprise. Regular confrontation with the topic, will remind individuals of the importance of MDM and demonstrates changes and possible new needs. This ensures the continuous development of MDM and ultimately the successful implementation of the MDM practice into an enterprise.

6 Conclusion

Data, represented by digitally documented facts and actions, is converted into information, used for daily business processes and knowledge development, must be considered an asset. Therefore, core business data, needed daily by departments, must be distinguished from other data and be defined as Master Data. The quality of Master Data influences business processes, customer service and ultimately business revenue. Master Data is further considered in reports which influence decision making and business strategies.

MDM is the management, maintenance and distribution of core business data and associated processes. Additionally, it addresses issues, generally experienced with data quality and availability. Qualitative good Master Data enables better supply chain management, efficient processes, and innovations in combination with BI and machine learning. New trends and preferences are detected more easily, which allows targeted marketing, cross and up-selling.

The MDM implementation process is complex and consists of factors, such as people, processes and tools, which all need to be regarded depending on the respective enterprise's situation. These aspects can be divided into technical support, management support, data governance and finally, roles and responsibility, which all contain different challenges. The four aspects have a major impact on MDM implementation development and need to be considered extensively. Foremost, the acceptance and support of C-level management and the development of an implementation strategy is required. The maturity level and goals of an enterprise are different in every case and existing IT and management expertise must be identified and used. Depending on the business field, of an enterprise, the use of frameworks and standards is recommended to conduct data governance. Finally, roles and responsibilities need to be clearly defined and assigned.

Technical and organisational structures need to be gradually changed according to the goals and strategies to enable best suitable MDM for an enterprise. Recuring, small changes ensure control, detection of challenges and an overall view at any time. Every strategy solution has its own benefits, regarding costs, performance and quality. The MDM factors, which require the most maintenance, must be individually detected, analysed and prioritised in the resulting strategy plan, to reach the initial goal of holistic MDM.

7 Outlook

The research work and its findings assured the author that MDM has a positive impact on business and is a competitive factor. Hopefully, more discussions and insights around MDM implementation appear in the future and contribute to the development of the MDM practice. This would lead to new studies and insights, regarding the handling of MDM and would deliver clear results. Such a movement would lower the number of risk factors and eradicate uncertainties about the outcome of an MDM implementation project.

Data management and quality will have a stronger impact on business decisions, due to technology trends like Industry 4.0, BI and machine learning. More and more business tasks will be automated, which requires a high standard of data quality, to being actionable. The business, IT and other departments will have to work closer together and enhance agility. MDM will lead to new roles and organisational structures because managing data is no longer a side task and moves more towards the centre of attention. Businesses will adapt to changing business models, revolving around data, which resembles a rather new and underestimated asset which is able to make a difference. Conducting MDM enables enterprises to use tools and technologies to their full potential, because people and processes get regulated accordingly. This situation allows all involved factors to work in harmony.

The author is aware that the implementation of quality measures and structural changes often face resistance because they seem to be contra productive towards the immediate performance of an enterprise and its processes. The needed level of quality, regarding a work process needs to be defined, considering performance, needs and available resources. Perfection is not necessarily the right approach and upon the findings, needed and useful measures should be decided and implemented. The long-term goal of such conflicts of interest, should be a balanced solution, where the effort does not outweigh the output.

8 Reflection

The in depth work and research on the general topic of MDM in this bachelor thesis, has given the author the opportunity to capture several viewpoints and reflect on, regarding the topic of MDM implementation. Findings and assertions regarding important factors and needed changes, enabled the formulation of concluding thoughts. Understanding the many forms of data, lead to the realisation and awareness of how frequently and carelessly data is generated, without a plan or purpose. Answering the three questions demonstrated, that data bears great potential, if handled and processed correctly.

Data management and MDM is a relevant topic, affecting individuals and enterprises. The author was able to describe and define Master Data and distinguish it from other data, commonly used in enterprises. A thorough literature study enabled the author to identify and understand the many challenges and concerns, enterprises face when implementing MDM. After gaining a deeper understanding towards the topic and its challenges, the author distinguished several main topics, which were relevant and worth discussing in the thesis work.

Additionally, it was crucial for the work, that the relation between subchapter an the overall topic was visible, to demonstrate the connection towards the thesis questions and to ensure a consistent central theme of the thesis. For the future it is the goal to obtain practical knowledge and experience regarding MDM in the work environment. This enables the comparison of theory and practice and leads to new conclusions and shifts toward a more holistic expertise on MDM and its implementation. During the research, the author came across many unknown terms which needed to be understood and processed. In the end the connections between the single terms became clear and led to a more specific idea of how the future of industry and economy could look like.

Finally, the thesis work improved the authors ability of tracking down needed information and managing documents and data in a way that it is retrievable when needed at a later point again. Faced difficulties during this process increased the awareness of the importance, potential and the many facets, of data management and MDM, in personal and professional situations.

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Annex 1: Material Management Plan

Research work:

Topic related literature like books, papers and articles, will be searched and gathered from online platforms. All collected and used material and the thesis work will be stored on the C-Drive of the authors work device. A backup will be stored on an external hard drive storage device

The citation of the gathered literature will be managed with the help of the Mendeley desktop application and the corresponding add-in in Microsoft Word.

After publication, all data corresponding to the bachelor thesis work, will be stored on the authors external hard drive storage device and will be retired one year after the publication of the thesis.

If the research material, resulting from the thesis is to be given to HAMK for further use for teaching or research, a written agreement must be made.

Annex 2: MDM Implementation Framework Checklist

MDM implementation Framework Checklist		
Steps	**Description**	**Check**
Convince		
Business sponsorship	Ensure business support at C-level to enable the MDM implementation project	
Objectives and strategy	Define objectives and strategies, so they do not interfere with other business goals.	
Maturity Model	The initial situation of an enterprise is identified and decisions regarding the next needed steps made	
Excite		
Train and educate	Ensure sufficient training and information regarding change and MDM	
Open interaction	Discuss concerns and answer questions	
Establish trust	Inclusion enables support and trust which supports the success of the project	

Assign		
Role analysis	Identify which roles cover which tasks and duties. Are they conducted sufficiently?	
Implement new roles	If tasks are nor covered, implement roles for this purpose	
Assign tasks and responsibilities	Define and assign tasks and responsibilities to assure the uninterrupted progress of the project	
Govern		
Frameworks and Standards	Consider frameworks, standards like COBIT or ISO 8000 and their implementation.	
Data Collection	Define how data is collected	
Data Storage	Define data storage conditions, regarding location, security measures and life cycle	
Data Quality	Define data quality standards and implement measures to meet these standards	
Processes and Definitions	Improve and implement processes to enhance efficiency and quality	
Governance of conduct and quality	Monitor and evaluate the adherence and impact of business processes	

Plan, Conduct and Evaluate		
Plan	Affected individuals are informed and prepared. Action details are discussed and agreed on. Needed resources are available	
Conduct	Conduct actions according to the plan. Document and report actions.	
Evaluate	Evaluate the planning and conduction phase and conclude, whether alterations for the next action cycle are necessary.	
Recurring assessments	Asses the state of the MDM implementation process and whether Issues occurred, which require a realignment of the strategy and goals.	