Tampere University

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# DEVELOPING A PRODUCT MASTER DATA MANAGEMENT PROCESS

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# ABSTRACT

Kreta Korja: Developing a Product Master Data Management Process
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Master data has caused issues in organizations for decades. The data related issues have been addressed through the acquisition of new enterprise information systems but because data has not been paid enough attention to, the issues have still continued. MDM was created to solve these problems and it has been a researched topic for the past ten years now. However, issues with master data persist. Reasons for this include data being managed in silos and the ever-growing amount of data that organizations have to handle in their day-to-day operations.

Master data is the most business-critical data an organization has, and it consists of customer, product and vendor data, for example. Due to the business-critical nature of master data, its management should be paid special attention in organizations. The business-side of an organization should be managing master data, because it is a business asset consisting of business-related data and therefore should be managed such as any other business asset.

In the case organization of this study, the main issues related to master data are that the MDM processes and the data owners have not yet been defined due to the fast pace the company has grown. As found in the literature, an MDM initiative should always be started from one master data type. In this case, product master data, more specifically product item master data, was chosen because the case organization is a manufacturing company. Defining the MDM process model and ownership, creating an implementation plan for the process and committing employees to the new process were chosen as the main objectives for this study.

This study was conducted as a case study in the previously mentioned case organization. All data was gathered through qualitative research methods: participant observation, semi-structured interviews and a focus group workshop. Through the observation the researcher was able to become part of the case organization and understand the situation better. Based on the interviews an idea of the main challenges related to MDM could be formed. In addition, the main needs and development ideas of the employees were discussed.

Through this study two MDM processes could be created for the case organization*: the MDM process for a new product* and *the MDM process for a product change*. The created models were further developed in the focus group workshop and as a result the finalized process models could be defined. In addition, a tentative model for the data and process ownership for the case organization was formed.

This research yielded two main findings: the created models are not the ultimate solution to the challenges in the case organization and the overall issues in product management might cause many of the issues related to product master data. Still, this study is a good start for the case organization to developing their MDM further and it has helped the employees to finding a new mindset and to see the big picture of the organization better.

Keywords: item data, item data management, master data, master data management, MDM process, process development, process model, product master data, product MDM

# TIIVISTELMÄ

Kreta Korja: Tuote masterdatan hallinnan prosessin kehittäminen
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Masterdata on aiheuttanut haasteita organisaatioissa jo vuosikymmenten ajan. Näitä datan liittyviä ongelmia on aiemmin pyritty ratkaisemaan hankkimalla uusia tietojärjestelmiä, mutta näissä dataa ei olla huomioitu tarpeeksi, joten ongelmat ovat jatkuneet. Masterdatan hallinta (MDM) kehitettiin ratkaisemaan näitä ongelmia datalähtöisemmin ja sitä on tutkittu jo viimeisen kymmenen vuoden ajan. Masterdatan kanssa esiintyy kuitenkin edelleen ongelmia. Nämä puolestaan johtuvat siitä, että dataa on aiemmin hallittu siiloissa ja lisäksi hallittavan ja tarpeellisen datan määrä organisaatioissa kasvaa jatkuvasti.

Masterdata on liiketoiminnallisesti kaikista kriittisintä dataa, jota organisaatioilla on. Masterdata on muun muassa asiakas-, tuote- sekä toimittajadata. Liiketoiminnallisen merkittävyyden takia masterdataan ja sen hallintaan pitäisi kiinnittää erityistä huomioita. Masterdata on yrityksen liiketoiminnallista varallisuutta, sillä se sisältää liiketoiminnallista dataa. Tästä johtuen liiketoimintayksiköiden tulisi myös hallita dataa, kuten mitä tahansa liiketoiminnallista omaisuutta.

Tämän tutkimuksen kohteena olleella organisaatiolla suurimmat ongelmat masterdataan liittyen ovat olleet, että MDM-prosessia tai datan omistajuutta ei olla määritelty vielä nopean kasvun seurauksena. Kuten kirjallisuudesta on havaittu, MDM-hanke tulisi aina aloittaa yhdestä masterdatatyypistä. Tätä tutkimusta varten valittiin tuote masterdata, tarkemmin tuotenimikkeistön masterdata, koska kohdeorganisaatio on valmistavan teollisuuden yritys. MDM prosessimallin ja omistajuuden määritys, implementointisuunnitelman tekeminen ja yrityksen työntekijöiden sitouttaminen uuteen prosessiin asetettiin tämän tutkimuksen tärkeimmiksi tavoitteiksi.

Tutkimus toteutettiin tapaustutkimuksena kohdeorganisaatiossa. Datan keruumenetelminä käytettiin seuraavia laadullisia menetelmia: osallistuva havainnointi, puolistrukturoidut haastattelut, sekä kohderyhmä workshop. Havainnoinnin myötä tutkija pääsi osaksi organisaatiota ja sen toimintaa ja täten pystyi ymmärtämään tutkittavaa kohdetta paremmin. Haastatteluiden pohjalta saatiin luotua käsitys organisaation isoimmista ongelmista masterdatan hallintaan liittyen. Samalla keskusteltiin myös työntekijöiden tarpeista ja kehitysideoista.

Tämän tutkimuksen avulla saatiin kohdeyritykselle luotua kaksi MDM prosessia: *uuden tuotteen MDM prosessi* sekä *tuotemuutoksen MDM prosessi*. Luotuja malleja kehitettiin edelleen workshopissa, minkä perusteella saatiin luotua lopulliset prosessimallit, jotka ovat kuvattuna tutkimuksen liitteissä. Prosessimallien lisäksi workshopissa käydyn keskustelun pohjalta saatiin luotua ehdotus datan ja prosessin omistajuudelle.

Tutkimusprosessin aikana tehtiin kaksi päälöydöstä: luodut MDM mallit eivät ole ratkaisu kaikkiin haasteisiin kohdeorganisaatiossa ja useat tutkimuksessa löydetyt tuote masterdatan ongelmat saattavat johtua tuotehallinnan kokonaisvaltaisista puutteista. Näistä huolimatta tämä tutkimus on ollut hyvä alku kohdeorganisaation masterdatan kehitykselle ja se on auttanut työntekijöitä uusien ajattelutapojen löytämisessä sekä yrityksen kokonaiskuvan hahmottamisessa.

Avainsanat: masterdata, masterdatan hallinta, MDM prosessi, prosessin kehittäminen, prosessimalli, nimikkeistön hallinta, tuote masterdata, tuote masterdatan hallinta, tuote nimikkeistö

# PREFACE

This Master of Science Thesis was written as the final degree work of the Information and Knowledge Management studies at Tampere University of Technology. This thesis was written as a commission to a Finnish, rapidly growing manufacturing company, Framery Oy located in Tampere.

The process of conducting this study and writing this thesis lasted longer than I expected and was much more challenging than I had thought. Now I know why there are so many almost completed degrees in the fields of Science and Technology. However, now I can finally say that I made it.

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# LIST OF AND ABBREVIATIONS

| | |
|---|---|
| **BOM** | *Bill of materials* describes the item structure of a product, for instance. |
| **CEO** | *Chief Executive Officer* |
| **CIO** | *Chief Information Officer* |
| **DFX** | *Design for X* describes how the needs of the supply chain and other functions are considered already during the product design phase. |
| **DW** | *Data warehouse* |
| **ECO** | *Engineering change order* is a built-in functionality of the PDM Professional system where a short questionnaire is sent to all needed parties related to a change. |
| **ERP** | *Enterprise Resource Planning system* |
| **IM** | *Information Management* |
| **IS** | *Information systems* |
| **IT** | *Information Technology* can also mean the team working with information technology. |
| **MDM** | *Master data management* |
| **MVOT** | *Multiple versions of the truth* |
| **PDM** | *Product data management* |
| **R&D** | *Research and Development* |
| **SCD** | *Supply chain development* |
| **SSOT** | *Single source of truth* |
| **TUT** | *Tampere University of Technology* |
| **WMS** | *Warehouse Management System* |

# 1. INTRODUCTION

Master data and master data management have caused several issues and challenges for organizations already for many years. Organizations have tried to solve these issues with new enterprise information system acquisitions, but these have not sufficiently considered data. (Moss 2007) Therefore, MDM was created to solve organizational issues with master data, bring down data silos and improve effectiveness of data related processes (Silvola et al. 2011).

In this study, the focus will be on solving master data management related issues in a case organization by developing the MDM process through an empirical study. This introductory chapter will focus on the background and significance of this study (1.1), present the research problem (1.2) and questions (1.3) and then finally describe the structure of this study (1.4).

## 1.1 Background

MDM has been a hyped subject in research and organizations for about ten years now (Moss 2007). However, the problems did not start then but have been increasing as the amount of data in organizations has increased (Haug & Arlbjørn 2011). The need for MDM has emerged because earlier data used to be managed in silos in many organizations, but the need for sharing data and information across organizations has raised the need to dismantle these silos by exposing, unifying and sharing data (Silvola et al. 2011).

Master data is the most business critical data in an organization including subjects such as customer, product and vendor data (Vilminko-Heikkinen & Pekkola 2017). Therefore, MDM is a quite complex entity and the problems related to it can be both technical and organizational (Cleven & Wortmann 2010). However, due to master data being a business asset, it should be managed accordingly, as any other business asset, by the business side of an organization. For this, specific processes are needed. (Moss 2007) If master data is not managed properly and related issues emerge, it will most likely result in monetary loss for an organization (Snow 2008).

Due to the many issues and risks related to master data and the MDM processes not being defined, the case organization gave this assignment to develop a master data management process for them. The issues in the case organization are mostly organizational so the focus of this study will be more on the organizational, business and process side of MDM.

According to Joshi (2007), MDM is especially important for organizations that have to answer to the needs of a rapidly changing business environment. This is also the situation

for the case organization, because they work in a rapidly growing market, making this issue a very important one for them.

Because master data consists of different kinds of data sets and types, it makes sense to start the MDM development from just one of these parts. Once the MDM benefits from this first data type are visible, it is much easier to get the MDM initiatives started on other master data types as well. Choosing the starting point depends on the business of the organization in case. (Snow 2008) The case organization of this study is a manufacturing company, so the logical starting point is the product master data.

The topic was a very interesting one for the researcher because of her data management related studies. The researcher wanted to deepen her knowledge on the subject while doing the study and working at the same time as part of the case organization.

## 1.2 Research problem

In today's organizations there are great amounts of data usually spread out widely across the organization. Due to this, master data management needs to be started from smaller entities, pilot projects. (Fisher 2007) This study will work as a pilot MDM project for the case organization.

The case organization is a relatively young and rapidly growing Finnish manufacturing company. Because of the fast pace the company has evolved in during a short time, there has not been time nor need to define all organizational processes until now. Because the processes have not yet been defined, there are conflicting ideas and customs on operating daily work, which have started to cause some problems, especially concerning data.

Now some new information systems storing, using and providing master data will be implemented into the case organization. Therefore, this is the right time to implement MDM and MDM processes into the daily operations of the case organization simultaneously with the new system implementations.

In the case organization, the most important data for the business is the product master data because it is a manufacturing company. According to Silvola et al. (2011), product master data is the most challenging type of master data due to its variety and therefore it causes the majority of problems related to master data. Due to the importance of product data, this study will only focus on product master data, and more specifically, on product item data, and the process around it in the empirical part of this study that will be done in the case organization.

Another decision that was made regarding the scope of this study is the life cycle of master data. In this study the process models for product MDM will describe the flow of master data only until the product is taken into production and the end of life of the item data will not be taken into consideration.

Currently the main issue with master data in the case organization is that there are no clear processes defined and no data owners have been stated. As Davis (2009) pointed out, you cannot have a good process without a good process model. Therefore, the main goal of this study is to define and develop the optimal MDM process for product master data for the case organization through an empirical study.

The model created will also have to be compared to literature to find and include the best practices for MDM. In addition, an implementation plan for this new process will be created. The final goal of this study is to commit the employees of the case organization to the new MDM process already during the research process.

## 1.3 Research questions

The research questions are created based on the given assignment from the case organization and the main goals set for this study. The main goals were to develop an MDM process model, create an implementation plan for MDM and to commit the employees of the case organization to the new process. The created research questions as follows:

- How can challenges with master data be met in an organization?
    - How can the processes and roles be defined for master data?
    - What kinds of models exist for master data management?
- How can a master data management process be developed for an organization?
    - How can employees be committed to a new master data management process?
    - How should the process be implemented?
    - How does an MDM process affect other processes in an organization?

The two main questions are based on the goal of developing an MDM process model for the case organization and the other goals are set into the sub questions. The first main question describes how the developed model should answer to real needs and issues in the case organizations and the two sub questions are defining this more from the literature perspective.

The second main question is about the actual process development and will be answered through the empirical study. The implementation and employee commitment, that were also goals for this study, are set into the sub questions. In addition, a sub question was added to describe the relationship between the MDM process and other processes in the case organization.

The aim of this study is to meet the set goals and to answer to the research questions listed above. The answers to these questions are discussed in detail in the conclusions in chapter 8.1.

## 1.4 Structure

This research is divided into eight main chapters. After this introductory chapter, the theory of the research topic, master data and master data management are discussed in chapter 2. This is done to create a base and a clearer background for this research.

The third chapter discusses the methodological choices made during the research process and presents the chosen research methods. The actual research process is also described in this chapter.

Chapter four begins the empirical part of this research. In this chapter the main findings from the interviews and observation are discussed. After this, in chapter five, the first versions of the MDM models are described. In addition, the models will be validated in the focus group workshop and further development ideas are gathered.

In the final empirical chapter, chapter six, the final developed MDM models are described and evaluated. Also, an implementation plan will be created for MDM. Finally, the last two chapters summarize the research by discussing and concluding the subject.

# 2. THEORETICAL BACKGROUND

According to research (Moss 2007) master data and master data management have been relatively under researched subjects until the beginning of the 21st century. The need for this kind of management has risen due to the vastly growing amount of data that organizations have to manage during their day-to-day operations (Haug & Arlbjørn 2011). Also, data is considered to be an organizational asset in today's information age (Moss 2007). Master data management makes it possible to manage business-significant data in a more controlled and structured way (Vilminko-Heikkinen & Pekkola 2017).

This chapter focuses on the different parts of master data and takes a look at the research done about it. The background on the past research and the need for master data management is discussed in 2.1. Then the focus will be on the basics of master data (2.2) and the different parts of master data management (2.3). Finally, some master data management models from literature are described in chapter 2.4.

## 2.1 Background for the research

In the past, data gathering, analyzing and maintenance have typically been done independently in separate business units (Smith & McKeen 2008). This has caused data to be stored in many different databases and information systems (IS) and therefore the data in organizations has become siloed (Vilminko-Heikkinen & Pekkola 2013). Due to silos, it is possible for the data to have many variations in definitions or format for instance (Smith & McKeen 2008). The problem is, however, that the need to share and use data has grown in the past years and therefore the silos need to be broken down (Vilminko-Heikkinen & Pekkola 2017).

The technological development in information management has made it possible for companies to control and take advantage of the data in the form of information sharing and collaboration (Loshin 2009, p. 1). Through this need for information and data sharing, the silos are driven together so that the data can be shared throughout the organization in a unified format (Silvola et al. 2011).

Earlier, these issues have been addressed through ERP and data warehouse (DW) implementations. The problem with these approaches has, however, been that the importance of data has not been recognized. (Moss 2007) Master data management was developed as a solution to data related issues (Silvola et al. 2011). The idea of master data management is to diminish data silos to ensure better data management and to manage all data from one place (Vilminko-Heikkinen & Pekkola 2017).

In 2007, Moss described master data management to be a new and hyped subject for research where the approach was not just technical (Moss 2007). Since then, the subject

has been researched quite a lot from different perspectives. Still, there are some parts that need more research such as master data management architecture (Otto 2012) and empirical studies on the master data management process.

The importance of master data management for an organization cannot be stressed enough. This is because, once master data management has been implemented accurately, it can provide substantial value to an organization (Ambler 2007) for example through improvements in business process effectiveness and efficiency.

## 2.2 Master data

In literature there are several different – and conflicting – definitions for master data because it is usually very case and context specific (Otto 2012). However, the most common definitions describe an organization's master data as data about the characteristics of the key entities and objects of the business (Moss 2007; Loshin 2009, p. 6; Otto 2012; Vilminko-Heikkinen & Pekkola 2013). This means that master data describes the most important data of a company such as the data logged in the transactional, reporting or analytical systems (Loshin 2009, p. 6). According to Snow (2008), master data includes aspects such as business objects, classifications, definitions and terminology, which together form business information.

An organization's master data is usually used and stored in several different systems (Joshi 2007; Otto & Reichert 2010), used in multiple business processes (Loshin 2009, p. 8; Otto & Reichert 2010; Silvola et al. 2011) and sometimes even in different format (Joshi 2007). Because of this it is very important for companies to make sure that master data is always unambiguous across the whole organization, uniquely identified, and it is used in a correct manner (Otto 2012). Moreover, the quality of master data has a significant role to a company's success and thus needs to be monitored and managed (Joshi 2007).

Due to the various definitions of master data, its contents also alternate in literature. According to Cleven & Wortmann (2010) and Vilminko-Heikkinen & Pekkola (2017), the main types of master data are customer, product and supplier data. Otto (2012), however, adds material data to this list. In addition, there are some other types of master data mentioned in literature (e.g. Moss 2007; Otto 2012; Vilminko-Heikkinen & Pekkola 2013) such as employee, vendor, location, and contract data.

Because all different types of master data have their unique elements (Snow 2008), it makes sense to categorize them into groups together with similar kinds of data. Joshi (2007) divided master data into four groups: people, places, things and concepts. On the other hand, Silvola et al. (2011) approached this slightly differently. They included *places* and *things* in their list but left out concepts and changed the name of people into parties to be more generic.

Despite the differences between different kinds of master data, they all can be defined as master data in the same way. For example, reusability, stability and complexity are features of all kinds of master data (Vilminko-Heikkinen & Pekkola 2013). Additionally, there are some other characteristics that can distinguish master data from other kinds of data. Otto & Reichert (2010) mention four characteristics typical for master data: time reference, modification frequency, volume stability and existential independence. The latter three were also mentioned by Cleven & Wortmann (2010).

The time reference in master data means that the data item stays the same throughout its life cycle, meaning that for example the data ID does not change (Otto & Reichert 2010). The modification frequency refers to master data not being changed considerably during its life cycle, at least compared to other types of data. Moreover, the volume of master data should stay roughly the same, not like transactional data, for example, which grows constantly. Compared to transactional data, master data has also existential independence, which means that it can exist without any other data, not like transactional data which always need master data to define it. (Cleven & Wortmann 2010; Otto & Reichert 2010)

It is not enough to just differentiate master data from other types of data, but there is a need to understand the data on a wider scale to be able to manage it in a useful and proper way. Nowadays many companies that are not managing master data still have no exact knowledge of their most business-critical data, such as their customers, products or employees (Fisher 2007). Concepts that need to be understood also by the business side about master data are, for example, how it is defined, the way it flows through systems, and the impact changes have on the data but also the impacts of changes in the data on the whole organization (Joshi 2007). These factors increase in importance once the amount of master data in an organization grows and simultaneously increases the complexity (Haug & Arlbjørn 2011).

When it comes to master data, data quality is very important because it is the most business significant data a company has. Therefore, errors and inconsistencies in the data may lead to monetary loss for the organization. Issues with quality and uncertainty have emerged for example from using and storing data in different systems. The biggest problem is, however, when there is no knowledge about the quality of data in an organization. (Snow 2008)

Master data is often also known as the single version of truth and this is discussed in greater detail in the next chapter 2.2.1. After this in 2.2.2 the main challenges related to master data are presented. One of the greatest challenges associated with master data is quality and therefore this is described more deeply in chapter 2.2.3. Finally, due to the focus of this study a closer look is taken on product master data in chapter 2.2.4.

### 2.2.1 Single version of truth

In order for a company to be a really successful, agile and customer centric business, it should be aware of its master data (Silvola et al. 2011). Because master data should always be unique and autonomous (Moss 2007) it is also known as “the single version of truth” (Silvola et al. 2011).

In literature the term “one master data” is also used. Nevertheless, this term means the same as the single version of truth (Silvola et al. 2011). According to Silvola et al. (2011), the single version of truth describes how master data from different systems in its raw form is unified into the same format and then shared. For the unification of complex data artificial intelligence could also be used (DalleMule & Davenport 2017). The situation where master data has only a single version of the truth can be described as the ideal state of master data (Smith & McKeen 2008).

According to DalleMule & Davenport (2017), master data and master data management are based on a data defense strategy which is based on rules and structures. This means that a single source of truth (SSOT) is needed. This also has also the same meaning as the single version of the truth because it describes identifying, standardizing and governing data sources to guarantee reliable data and a single version of the truth. (DalleMule & Davenport 2017) An SSOT can for example be a unified database.

To achieve the single version of truth for master data, data, processes and information systems require governance. For data this means cleansing and rationalization before models and attributes can be defined. On the other hand, processes have to define ownership over data and also describe how the data is cleansed, secured and shared. Finally, the role of the information systems is to provide the applications where the data can be shared and integrated. (Silvola et al. 2011)

For an organization to function properly, in addition to the SSOT and the single version of truth, multiple versions of the truth (MVOT) are still required. This is because SSOT is used on the data level and is a requirement for master data, but MVOT is required on the management level where the data needs to be modified for certain business requirements. (DalleMule & Davenport 2017) This can be done through data analytics or reporting, for instance., Governance still needs to be considered in both situations.

According to DalleMule & Davenport (2017), the defensive data strategy used for master data is suited for the daily governance and maintenance of data but also the offensive data strategy, focusing more on the business side, is also required. With both of these the standardization and flexibility of data can be achieved. However, the offensive data strategy can be used only after the defense is in shape. (DalleMule & Davenport 2017)

### 2.2.2 Master data challenges

Because mater data is so complex, there are many challenges related to master data. Some of the challenges are not master data specific and therefore it might not make sense to try to separate the management of master data from all other data management (Silvola et al. 2011). However, in order for master data management to work, these issues need to be fixed in the data and the processes around it. In order to be able to do this, the root causes and the main challenges need to be identified. (Smith & McKeen 2008) One needs to understand that the greatest challenges related to master data are actually not technical, but mostly governance related (Radcliffe 2007), making the management even more important.

Challenges with master data have already existed for decades (Smith & McKeen 2008). However, in today's world most challenges with data have arisen from the growing amount of data (Cleven & Wortmann 2010). This has caused problems because there is too much data to be managed (Silvola et al. 2011). According to Fisher (2007), the main root causes for challenges in master data are poor data quality and the process of creating the data.

Most challenges related to master data are caused by the data itself. Poor data quality (Smith & McKeen 2008; Silvola et al. 2011), duplicates, missing attributes (Cleven & Wortmann 2010), data ownership and life cycle management (Smith & McKeen 2008) are just a few to be mentioned. In addition, the definition of master data and the master data models (Silvola et al. 2011) can be hard to agree upon in an organization (Smith & McKeen 2008).

The data related challenges listed above, such as unclear definitions and duplicates, can cause inconsistencies in the data, making it hard to use or to move (Snow 2008). Incorrect or poor-quality data can also cause loss for business (Silvola et al. 2011). Some challenges related to the processes around master data are that the processes are not defined, or they might be too vague, but also issues with ownership and inadequate data management are related to this. (Silvola et al. 2011)

Data ownership was listed as one of the common challenges related to master data (Smith & McKeen 2008). The main issue with data ownership is that it is defined badly or not at all (Vilminko-Heikkinen & Pekkola 2017). When the ownership is unclear, the responsibilities related to data are not known either and this can cause many issues is data management, for example (Silvola et al. 2011). Smith & McKeen (2008) mention that one typical issue related to ownership, when it comes to master data, is that nobody wants to take ownership but at the same time they do not want to give it to anybody else, meaning that the data is left without an owner and management. The undefined ownership is mostly an issue because many quality related issues have been caused by this (Silvola et al. 2011).

Another source for issues is the business side and management of an organization. The business side should always be involved in master data management, and not just the IT

department, because it is the most business-critical data a company has. To ensure enough resources, the top management also needs to be well aware of master data and its importance for the organization. (Vilminko-Heikkinen & Pekkola 2017) In order for master data to serve all stakeholders in an organization, the needs of all main stakeholders should be considered in the master data management (Vilminko-Heikkinen & Pekkola 2013).

The parts of master data, managed by the IT team are the different information systems that produce, store or use master data. The main challenge with these systems is that they handle data in a different way but still they should be integrated. (Silvola et al. 2011) Another issue is that the same data might be stored in multiple systems (Cleven & Wortmann 2010). In the past mistakes have been made by trying to solve master data related issues by just acquiring new enterprise information systems such as ERP or CRM systems (Smith & McKeen 2008). These are, however, not the solution to master data related issues because the issues are mostly not technical (Radcliffe 2007).

Improving data quality and managing master data more effectively are better solutions to the issues with master data (Silvola et al. 2011). As mentioned above, data quality is a big issue related to master data and it is related to so many different parts. According to Haug & Arlbjørn (2011), most companies have issues with data quality.

### 2.2.3 Master data quality

Data quality is quite a complex and large theme. Data quality is always dependent on the case and context at hand (Pipino et al. 2002; Haug & Arlbjørn 2011) and therefore it cannot be assessed on its own. The people using the data, data consumers, are the ones who define the quality of data by its fitness for use. (Strong et al. 1997) There are some criteria defined in literature (e.g. Strong et al. 1997; Pipino et al. 2002) by which data quality can be assessed and measured.

Strong et al. (1997) have also divided these dimensions into four categories: intrinsic, accessibility, contextual and representation data quality. In table 1 the dimensions listed by Strong et al. (1997) and Pipino et al. (2002) are divided into these four categories.

***Table 1.*** *Data quality dimensions*

| **Data quality categories** | **Data quality dimensions by *Strong et al. (1997)*** | **Data quality dimensions by *Pipino et al. (2002)*** |
|---|---|---|
| Intrinsic data quality | Accuracy<br>Believability<br>Objectivity<br>Reputation | Believability<br>Objectivity<br>Reputation |
| Accessibility data quality | Accessibility<br>Access security | Accessibility<br>Security |
| Contextual data quality | Amount of data<br>Completeness<br>Relevancy<br>Timeliness<br>Value-added | Appropriate amount of data<br>Completeness<br>Ease of manipulation<br>Relevancy<br>Timeliness<br>Value-added |
| Representation data quality | Concise representation<br>Consistent representation<br>Ease of understanding<br>Interpretability | Concise representation<br>Consistent representation<br>Free-of-error<br>Interpretability<br>Understandability |

As can be seen in table 1 above, the two articles (Strong et al. 1997; Pipino et al. 2002) have defined the data quality dimensions quite similarly. There are only a few clear differences visible; accuracy was missing from the list of Strong et al. (1997) and ease of manipulation and free-of-error were not listed by Pipino et al. (2002).

These dimensions of data quality can also be applied to master data and its quality. The quality of master data plays a very significant role for an organization because master data is used in several different systems and data formats in organizations (Vilminko-Heikkinen & Pekkola 2013). Due to the usage of the same data in different systems the issues with quality will spread in an organization very fast if not taken care of (Joshi 2007).

Moreover, according to Haug & Arlbjørn (2011), the quality of master data is very important, but it is still often not achieved. As mentioned in the previous chapter, master data quality is one of the biggest challenges related to master data. In order to find solutions to the challenges, the reasons behind the quality issues need to be addressed (Haug & Arlbjørn 2011). Finally, if the solutions to the challenges can be found, quality might be achieved (Silvola et al. 2011).

As discussed in the previous chapter, quality problems often are caused by issues with data ownership (Silvola et al. 2011). The lack of delegation and unclear responsibilities are related to the issues with ownership and therefore also cause problems with master data quality (Haug & Arlbjørn 2011). According to Fisher (2007), poor data quality is

usually not caused by technology but more often by elements such as internal disagreements or incorrect definitions. Haug & Arlbjørn (2011) have listed many organizational quality barriers in their research. In this list, there are topics such as data owners not defined, ineffective processes, lack of training, organizational structure and data quality control (Haug & Arlbjørn 2011).

The issues behind the poor quality of master data can cause many concerns and have significant effects for an organization if not taken care of (Haug & Arlbjørn 2011). If the quality cannot be trusted, neither can the data itself which means that the data might not be used as it should (Smith & McKeen 2008). Some consequences that poor data quality can cause are the increase of operational costs and other negative economic and social impacts, such as the decrease in customer satisfaction (Haug & Arlbjørn 2011).

In addition to the previously mentioned negative effects of poor data quality, master data quality is very important due to the special nature of master data. In case of master data, the issues with quality will spread easily because the data can be stored in one place and then the same data can be used in multiple systems (Smith & McKeen 2008). Because master data is the most critical data for an organization and at the same time the foundation for decision-making, the data quality needs to be in good shape so that good quality decisions can be ensured as well (Haug & Arlbjørn 2011).

If the issues with master data are solved quickly, there might only be some additional costs and some major effects could be avoided (Haug & Arlbjørn 2011). Additionally, Silvola et al. (2011 have created some solutions to tackling issues with master data quality. First of all, cooperation between business units makes it possible to understand the big picture better and a quality measuring system should be put in place. To improve data quality the most relevant business data should be identified, the current state of data should be mapped, and a data model should be created to support the goals. Also, a continuous data quality program should be started, and process should be created for data life cycle management. Finally, the data model should be unified, and the flow of data should be modelled. (Silvola et al. 2011)

### 2.2.4 Product master data

Product master data is one of the main master data types mentioned in chapter 2.2. According to Otto & Reichert (2010), customer master data is the number one focus for most organizations, but product master data is a close second. This study will focus on product master data, more specifically item master data, in the empirical part and therefore a closer look is taken on the specific characteristics of product master data.

Product master data is very diverse and significant, and therefore the most challenging type of master data (Silvola et al. 2011). Many issues, for example with incorrect deliveries, can be traced back to the problems with product master data (Snow 2008). Because the issues with product master data have such great effects, the challenges are urgent for

an organization (Silvola et al. 2011). Due to the many issues, many leaders do not really trust in the quality of product data (Snow 2008).

There are some typical aspects for product master data. Similarly to many types of master data, product master data is always stored in multiple different systems (Snow 2008). There are also several characteristics that apply specifically to item data. For instance, item data should be unique and autonomous (Moss 2007).

According to Moss (2007), there should be a formalized and systematic practice for naming items. Without this, the data cannot be trusted completely since it might be misunderstood and therefore misused. There is a growing risk for poor data quality, if the naming process is not standardized due to possible duplicates and homonyms. Moss (2007) also describes a naming method where the item name consists of three parts: the prime, qualifier and class words. (Moss 2007)

The life cycle of product master data can be defined quite precisely through the life cycle of a physical product. The phases consist of design, material acquisition, manufacture, distribution, sale, use, service and termination (Silvola et al. 2011). During the life cycle of product master data, the data and its definitions should be reviewed by the business side regularly to ensure that the data stays relevant and correct so that it can be used and understood by the business people (Moss 2007).

## 2.3 Master data management

Master data management (MDM) is an organizational function (Otto 2012) that aims to improve the value of important data, such as customer and product data, in an organization (Vilminko-Heikkinen & Pekkola 2017) This can be done by ensuring the uniqueness, consistency, reliability and traceability of the data (Moss 2007). Silvola et al. (2011) describe MDM as solving issues and improving master data by focusing on data quality, business processes and the integration of information systems.

MDM is a part of information management (IM) in an organization. The role of IM is to manage all information a business produces, and it describes the objectives that the management level has set for information. Although IM includes some frames for MDM as well, it is not the role of IM to manage master data. (Smith & McKeen 2008) The role of MDM is to describe, own and manage core business data entities defined as master data. The establishment of MDM requires business engineering and organizational changes as well. (Otto & Reichert 2010)

In 2007, Moss discussed the hype of MDM, meaning that the subject is still today relatively current in research. Before the rise of MDM, there had been attempts to solve the issues with data management through enterprise system implementations, such as ERP and CRM systems, where data was not paid enough attention to. (Moss 2007) Still today, there are many different systems that can be used for master data management. Some examples of software providers for MDM are IBM, SAP and Tobco. Despite there being

different systems for the management of master data, in the end, MDM in an independent business operation (Otto 2012), and technology alone cannot solve the issues with master data (Fisher 2007).

MDM is considered to be a support unit of the whole organization (Otto & Reichert 2010). According to Otto (2012), MDM can be summarized as three components: it is an organizational function, MDM performance should be measured with data quality, and there is not just one solution for storing and distributing master data. Data quality can be achieved through the use of business applications, different information management methods and data management tools (Vilminko-Heikkinen & Pekkola 2017). As a whole, the role of MDM is to define the data in context and the rules for it (Snow 2008).

Although there are many different definitions of MDM, the issue behind it is clear, as Smith & McKeen (2008) pointed out: "the data in most organizations is a mess". The mess has caused many severe issues with data quality, which MDM aims to solve (Snow 2008; Cleven & Wortmann 2010; Vilminko-Heikkinen & Pekkola 2013). Therefore, MDM should always include data quality management (Joshi 2007). According to Joshi (2007), MDM is even more important for organizations that have to answer to the rapidly changing needs in their business environment.

Maintaining data and data sets in different information systems is very costly (Vilminko-Heikkinen & Pekkola 2013). Therefore, the main goal of MDM is to dismount data silos so that data can be managed from one place (Vilminko-Heikkinen & Pekkola 2017). This will then enable the creation of a single and unified view of an organization and its data, making the concept of MDM even more important (Fisher 2007). Similarly to any other data, master data is an asset to an organization. Thus, master data should be standardized, inventoried and reused, as any other business asset. (Moss 2007)

Some other goals for MDM are the definition of data ownership (Otto 2012) and responsibilities, and ensuring good quality data. The defined responsibilities will ensure standardized ways of working and analyzing data in the organization. (Snow 2008) Similarly, Moss (2007) describes MDM as the custom of defining, standardizing and maintaining master data. Through these actions, the inconsistencies in data can be reduced and overall quality improved (Ambler 2007).

MDM is a continuous development process (Radcliffe 2007) that should be customized for each organization because there is no "one-size-fits-all" solution for MDM (Cleven & Wortmann 2010). However, before MDM can be implemented, an enterprise information policy has to be developed, business ownership needs to be defined, data governance must be planned, and the role of IT described (Smith & McKeen 2008). During the development of MDM, master data sources and consumers need to be defined and a plan should be created for maintaining the master data architecture (Otto 2012). Finally, when implementing the MDM into organization policies, procedures, methods and infrastructure should be in place (Moss 2007; Silvola et al. 2011) and the people taking care of data administration should be responsible for the implementation (Moss 2007).

For most companies, especially larger ones, the problems with MDM arise from organizational issues and not from issues related to IT systems (Vilminko-Heikkinen & Pekkola 2017). Therefore, technology alone cannot solve the problems with data (Moss 2007). Nevertheless, when establishing an MDM process both the needs of IT and the business side need to be considered and taken into count (Vilminko-Heikkinen & Pekkola 2013). Because of this the team creating and maintaining MDM in an organization should have members from all business functions and the IT team (Joshi 2007; Snow 2008). The role of the business people should be to manage the master data and the IT team should be in a more supportive role (Snow 2008).

For an MDM initiative to be successful, management support and activities are required due to the mostly non-technical issues related to master data (Smith & McKeen 2008). During the implementation of MDM, the new processes need to be put into practice so that MDM will become part of the daily operations in the organization (Vilminko-Heikkinen & Pekkola 2013). As a whole, MDM can be successful once the balance between technology and governance is found (Radcliffe 2007). According to Smith & McKeen (2008), the success of MDM can be guaranteed if enough weight is put on the initiative.

In this main chapter the different aspects related to master data management will be discussed in greater detail. Master data governance is discussed first in chapter 2.3.1. After this, the ownership and stewardship of master data are explained (2.3.2) and finally the benefits of MDM are viewed more closely in chapter 2.3.3.

### 2.3.1 Master data governance

One solution to the problems occurring with master data and master data management is data governance (Joshi 2007). According to Radcliffe (2007), data governance is a master data management concept and necessary for a successful MDM initiative because most issues with master data are caused by organizational factors. Governance is important because it is a good tool for defining roles, responsibilities, rules and processes for managing data as a recourse. In addition, it is an enabler for decision-making, issue resolving, change implementation and communication. (McGilvray 2006) According to Moss (2007), governance has authority over data assets, is the process by which an organization manages its data and defines the way quality responsibilities for data are shared. Additionally, data governance is one of the enablers for the single version of the truth for master data as described in chapter 2.2.1.

One purpose of data governance is to ensure the involvement of business people in data management because data is a business asset and should therefore be managed by business people (Moss 2007). This means that the people affected by decisions should always be involved in making them (McGilvray 2006). However, there is a need to make sure that the viewpoint of decisions related to master data management are not too narrow and focused only on one business unit, but they should be done from an enterprise perspective to ensure that the data can be used in all business units (Moss 2007).

Data governance can be seen as a tool for seeing the bigger picture better. This is very important in master data management, because the initiatives will most likely fail if both the business side and IT are not involved (Smith & McKeen 2008). According to Fisher (2007), in order to get a full view of data, you need to work together with IT, data stewards and data owners because they have the whole view of the data and the issues related to it. Data owners and stewards will be discussed in more detail in chapter 2.3.2. Once the data is understood broadly, a holistic solution for governance and MDM can be created (Smith & McKeen 2008).

Although master data governance requires participation of both business people and IT, they need to have clear roles related to the governance. The business side consists of data owners and stewards and the IT team should take a more administrative and analytical role. As data administrators, the IT team will manage data principles such as data definition, naming and metadata standards. Overall, the classification of roles will help in managing data. (Moss 2007).

Joshi (2007) has outlined some steps in their research for establishing data governance in an organization. Firstly, the master data flow needs to be defined. This means that the master data sources and consumers need to be identified. These can be both people and information systems. The definition of how master data is shared during the MDM process is also included in the data flow. The second step is to collect all the business metadata related to the defined master data. After this, the master data model should be defined. This means that a map of the target situation is created, which the data owners should approve. (Joshi 2007)

Once the data model has been created, the functional and operational characteristics needed for the MDM tool should be defined. This will help in selecting the right tools for the organization in case. During the implementation process the technical and business-related metadata needs to be collected and maintained. After the governance system has been established, the master data should be published. Finally, a maintenance and change management process should be defined and implemented because MDM will face many changes due to the constantly changing business needs. (Joshi 2007)

According to Otto (2012), for master data governance and MDM to be successful, a tight relationship between the master data architecture and governance is needed. In addition, some process changes are always required in an organization when it comes to MDM and data governance implementation (Fisher 2007). Some contradictions may arise from these changes between people and data because changes are made in integrations and information systems, for instance. Nevertheless, all needs for developing master data governance don’t always come internally from an organization, but the need may also rise from regulatory requirements (McGilvray 2006) such as the General Data Protection Regulation (GDPR) that came into effect in the spring of 2018 for EU countries (Krasteva 2018).

### 2.3.2 Data owners & stewards

As mentioned in chapter 2.2.2 data ownership is one of the most common challenges related to master data (Smith & McKeen 2008). For MDM and data governance to function properly, data related ownership and roles need to be defined because otherwise issues will arise for example with data quality (Vilminko-Heikkinen & Pekkola 2017). The main roles from the business side of an organization related to data handling are data owners and data stewards (Moss 2007).

Data owners in an organization might also be owners of business processes, but the owners might also be the primary consumers of the data. What is clear, however, is that the ownership of data should belong to one person in a function. The tasks of a data owner consist of, for example, determining data domains, accessibility of data and specifying data quality requirements. (Moss 2007)

Data stewards on the other hand have shared responsibility over data so that the accountability of the quality of data is with the person using the data at the time (McGilvray 2006). Similarly to owners, data stewards should also come from the business side of an organization (Moss 2007). Data stewards are responsible for data management and therefore also the accuracy, timeliness and lifecycle of data (Smith & McKeen 2008). The tasks of data stewards consist of analyzing, validating and correcting data, defining the data and ensuring data integrity (Moss 2007).

According to McGilvray (2006), data stewardship is better than data ownership because the owners only manage and maintain data for their own purposes although it affects others as well, whereas data stewards always have to consider the big picture. Therefore, ownership is better suited for processes than data management because one person is responsible for everything. Data stewards are responsible for managing data even for others, and anyone who touches the data during a process is actually a data steward. (McGilvray 2006)

### 2.3.3 Benefits of MDM

There are many benefits in establishing MDM in an organization. Although most of these benefits have been recognized, the work is still incomplete. (Silvola et al. 2011) One matter that hinders the development of MDM is that it is quite hard to get the MDM initiative approved by the top management and started because the result may appear to be beneficial only after some years after the implementation (Smith & McKeen 2008).

Improving the quality of master data is one of the biggest benefits related to MDM (Vilminko-Heikkinen & Pekkola 2013). By achieving a single version of the truth, better data quality can be guaranteed, and the correctness of data will not have to be compromised (Smith & McKeen 2008). According to Fisher (2007), MDM will ensure better knowledge of the key aspects for an organization, such as knowing your customers, vendors and products better and never having to second guess the data. These will be

achieved through the harmonization and migration of master data (Vilminko-Heikkinen & Pekkola 2013).

MDM will also bring cost savings for the organization although they might be hard to detect because they are so widely spread out. Most savings come from making processes more effective by limiting unnecessary steps and through improving the operational actions for example by making data more accessible. By eliminating the costs of bad quality data such as making bad decisions, savings can also be made even though they are not direct. (Smith & McKeen 2008)

All in all, through MDM business and technical capabilities of an organization will improve. The business capabilities will get better because the processes will be more consistent ensuring better customer service, for example. In addition, the improved management of data will make the organization more flexible and capable for change. Better technical capabilities will on the other hand make the reuse of data possible and make the data more accessible and easier to use. (Smith & McKeen 2008)

## 2.4 MDM models

In the literature, there are no ready-made models describing the process or the process model for MDM but there are some other models related to different parts of master data or MDM. In this chapter these models are found and discussed.

### FOUR STRATEGIES FOR MDM

Cleven & Wortmann (2010) created four different strategies for MDM. These were divided into two drivers and two orientations: data versus process drive and solution versus problem orientation. Thus, the four strategies can be set into a two-by-two matrix as in figure 1.

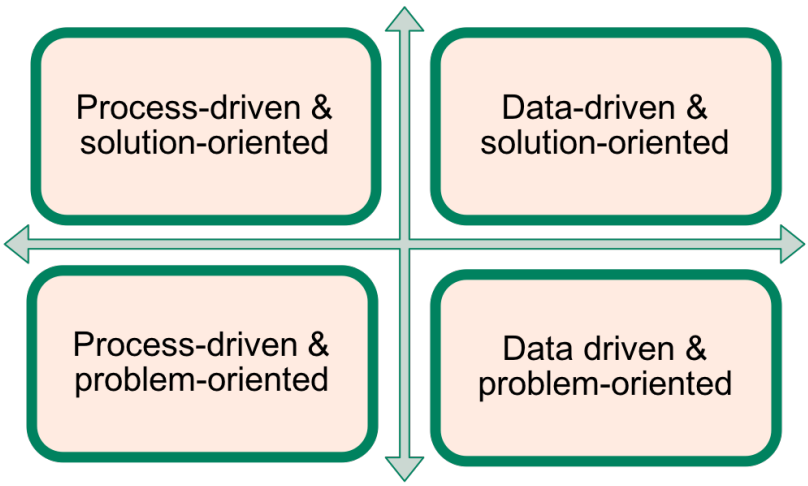


***Figure 1.*** *The four MDM strategies (Cleven & Wortmann 2010)*

Starting from the top right corner of figure 1 there is the data-driven and solution-oriented strategy for MDM. This strategy is a systematic approach for finding issues in business processes. The idea is to analyze the existing master data and compare it to the goal situation. To do the comparison, business rules should be set. For product these can be uniqueness, descriptions and categories, for example. In case of products this means that uniqueness, descriptions and categories are defined for all products. This strategy can be used to find root causes for issues and also to start an MDM change process. However, some might say that the business perspective is not considered sufficiently with this strategy. (Cleven & Wortmann 2010)

When going down in figure 1 the next MDM strategy is the data-driven and problem-oriented strategy. This strategy is good for getting an overview of what is going on and it can also be used in multiple processes. With this strategy, data related issues, such as problems with schema or instances, can be found easily. Additionally, for this strategy it is important to profile different types of data. This strategy is not as time consuming as the first one, but it is also not as systematic as the more solution-oriented strategy described above. (Cleven & Wortmann 2010)

The third MDM strategy, process-driven and problem-oriented, is placed on the lower left-hand corner in figure 1. Compared to the previous two this strategy takes the business perspective also into consideration and therefore this should be used when trying to figure out the impact of bad quality master data on the business. When using this strategy, the issues are searched in processes. This is done by finding the processes that need improvement the most and that are causing data quality issues, for instance. This strategy is not very time consuming and therefore low on costs. However, all issues might not arise from processes and therefore this approach might not be enough. (Cleven & Wortmann 2010)

The final MDM strategy presented by Cleven & Wortmann (2010) is process-driven and solution-oriented. This strategy can be used for business impact analysis and in the beginning of an MDM change process. In this strategy the processes are compared to the target situation in a systematic way. Nevertheless, this strategy is quite time-consuming and requires high effort because it is done systematically. (Cleven & Wortmann 2010)

One point that was made clear by Cleven & Wortmann (2010) was that these four strategies described above can also be used together simultaneously or sequentially. By using these strategies MDM and data quality can be improved (Cleven & Wortmann 2010).

**SEVEN BUILDING BLOCKS FOR MDM**

The seven building blocks for MDM were introduced by Radcliffe (2007). The blocks can help in seeing the big picture, in creating an MDM strategy, in MDM implementation and in measuring effectiveness (Radcliffe 2007). The blocks and how they are structured can be seen in figure 2.


***Figure 2.*** *Seven building blocks for MDM (modified from Radcliffe 2007)*

The first building block for MDM on top of figure 2 is the MDM vision. For MDM to solve real problems, the MDM vision has to be consistent with the vision of the organization. The vision will create harmony between technology, people and processes, which can enable achieving great goals, such as market leadership. (Radcliffe 2007)

After the MDM vision has been created, the next building block, MDM strategy, can be created. The strategy will bring the vision to a more concrete level by explaining how it can be achieved and how master data assets can be managed. This can be done by creating a road-map with the help of master data governance. In addition, MDM architecture and needs evaluation are part of creating the MDM strategy. (Radcliffe 2007) While creating the MDM strategy, the four strategies from Cleven & Wortmann (2010) could also be considered.

The next level is divided into two blocks, MDM governance and MDM organization. Without governance MDM initiatives are likely to fail, which makes the importance of this block quite clear. Ownership, processes, standards and metrics will be defined through governance, which again makes it possible to achieve the set goals. The MDM organization on the other hand describes how different roles are divided in the organization and how, for example, communication, training and change management are handled. This is important because the MDM roles are different depending on the task and organization in case. (Radcliffe 2007)

The fourth level describes the MDM processes. During the MDM initiative processes for authoring, validating, enriching, publishing and consuming the master data should be established. In addition, a process for maintaining data quality is needed. While these new processes will be created in a controlled way, the old processes, which might have been formed spontaneously, will have to move aside. An important factor with processes is

that a process always needs an owner, and these should be determined while defining the processes. (Radcliffe 2007)

The next building block for MDM describes technology infrastructure. This is needed due to the complex nature of MDM, which means that it requires information systems and other tools to help with the management. Finally, the seventh block is about MDM metrics. This is necessary because if a situation is not measured the real improvements that can be achieved through MDM cannot really be seen. (Radcliffe 2007)

### STEPS FOR ESTABLISHING MDM

The third model discussed was created by Vilminko-Heikkinen & Pekkola (2013). Their model describes the needed steps for developing MDM for an organization. This model is presented below in figure 3.

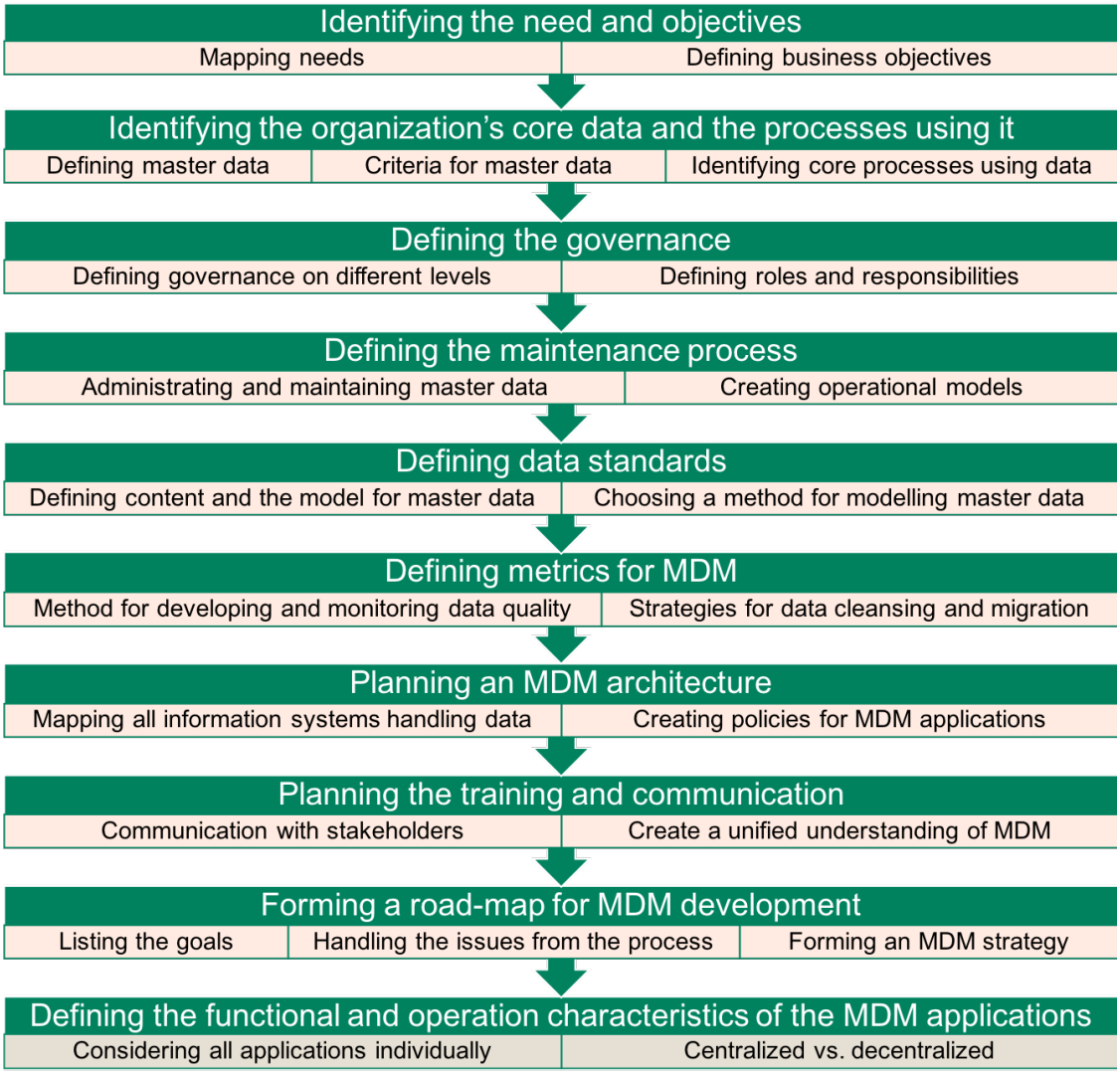


***Figure 3.*** *The steps for establishing MDM (Vilminko-Heikkinen & Pekkola 2013)*

According to Vilminko-Heikkinen & Pekkola (2013), the first two steps should always be done simultaneously because the needs and objectives might still be unclear if the core data has not been identified. The business objectives in the first step might be factors such as effective work or improving reporting. (Vilminko-Heikkinen & Pekkola 2013)

In the second step the criteria for master data will help in finding all master data sets in the organization. In addition to identifying the processes using master data, the information systems using the data need to be identified. In the third step: defining the governance, the governance should be defined on the organizational, support function and data set levels. (Vilminko-Heikkinen & Pekkola 2013) Master data governance as a whole was already described in greater detail in chapter 2.3.1.

The data administration and maintenance described in the fourth step define the responsibilities, methods, and tools for collecting data, defining guidelines, reviewing data and creating instructions. Once the maintenance has been set up, the data standard should be defined. This means that the content and models for master data should be defined at attribute level and suitable methods for modelling master data should be chosen. The purpose of MDM metrics is to develop and monitor data quality. This includes for example setting practices for monitoring and measuring master data. (Vilminko-Heikkinen & Pekkola 2013)

The seventh step, planning an MDM architecture, starts the technical part of the steps. The architecture contains information about applications and information systems, data flows, administration practices, data security and information about new acquisitions. The policies created at this point deal with MDM application integrations. (Vilminko-Heikkinen & Pekkola 2013)

Stakeholder communication is the key of the eighth step. In order to unify the understanding of master data throughout an organization, emphasizing data quality and to support future development of MDM, communication with all key stakeholders is required. As the next step, a road-map for MDM development is formed. In the roadmap the goals and issues to be solved are listed. The road-map can also work as the MDM strategy. (Vilminko-Heikkinen & Pekkola 2013)

Finally, the functional and operational characteristics of the MDM applications should be defined. At this point each system should be considered separately with each type of master data. (Vilminko-Heikkinen & Pekkola 2013) Despite this model describing the steps for establishing MDM in an organization quite thoroughly, this model will not be used as it is in this study. This is because of the inductive approach of this study where the MDM model is created through empirical findings of qualitative methods. These and other methodological decision will be discussed in greater detail in the next chapter.

# 3. RESEARCH METHODOLOGY

The theoretical part of this study was presented from a general perspective. However, the emphasis of this study is, in line with the interpretivism philosophy, on the empirical part, where the study examines a case example of MDM and, more specifically, product MDM and item data in an organization. The case organization is introduced in chapter 3.1 after which a deeper look is taken on how this study has been conducted and the different methodological choices in this case are discussed.

Data can be divided into quantitative and qualitative data. The main difference between these two is that quantitative data handles numeric data and qualitative non-numeric data. (Saunders et al. 2009, p. 151) Data gathering methods have to be chosen based on the desired data types. The methodological choices that led into choosing qualitative data gathering methods are presented in chapter 3.2. The actual data gathering methods and the choices done related to them are discussed in chapter 3.3. Finally, in chapter 3.4 the research process is described.

## 3.1 Introduction to the case organization

Framery Oy is a Finnish office furniture manufacturing company, operating in Tampere. The main purpose of the company is to create happiness at workplaces with its pioneer soundproofing solutions for open-plan offices and multipurpose spaces (Framery 2018). The company was established in 2010 by two industrial engineering students (Ekholm 2014). The idea for the company arose from the need to concentrate at work while the noisy boss was talking on the phone. When the two young men complained to the boss, the boss told them to build him a phone booth. So, that's what they did. (Keränen 2017 & Framery 2018)

After some financial problems in the beginning the company started to establish the market for soundproof office spaces by focusing on their best product, today's Framery O (Keränen 2017). Soon after that, big companies such as Microsoft and Twitter got interested and that is how the growth really started (Framery 2018).

Framery has been growing very fast in the past few years and their revenue has over doubled itself every year since 2014, growing from 1,3 million (2014) to 39,5 million (2017) (Finder 2018). Thus, the growth has really been extremely significant, which can also be seen from the number of new employees hired in the past years. For example, in 2017 over 100 new hires were made (Keto-Tokoi 2017). In addition, while writing this thesis from May until January quite a few new employees were hired, growing the total amount of employees at Framery from 184 to 234.

In the beginning, Framery thought they were solving the problem of noise in offices but with the help of their key customers they realized they were solving something much more significant, i.e. happiness, which brings the true value to the company's products (Framery 2018). If work makes you unhappy then your whole life is unhappy, says Hällfors (2018), the CEO of Framery, in his blog text. Realizing this has also been one key factor in the company's success.

Today Framery has three main products: Framery O, Framery Q and Framery 2Q, which was launched in the summer of 2018. All the production is done modularly from components produced by subcontractors. The products are tailored at the packing stage when the right installation skins and furniture are packed according to the customer's choice. (Pietarila 2016.) As the CIO said in his interview: "It is our specialty that we configure each order separately whereupon they become items that we in the end send to the end customer." Lastly the final product is assembled at the customer's office by the local dealer's installers (Pietarila 2016).

Framery's products are sold worldwide through a large sales channel consisting of dealers operating in all parts of the world (Vaaka 2018). Today over 90 % of the company's turnover comes from exports and almost half of that from the United States. According to the CEO, there is also a plan to establish a new logistics center in the United States. (Pietarila 2018)

In addition to launching a new and bigger product in 2018, some other significant changes were made. The Finnish private equity investor company, Vaaka Partners, acquired about 60 % of the company in the spring of 2018. Vaaka Partners aims to increase Framery's global growth even further by supporting the strengthening of Framery's product leadership, brand value and international sales organization. (Vaaka 2018)

The radical growth pace and great design have received a great deal of attention in the past years and Framery has won several awards in entrepreneurship, design and globalization, for example (Keto-Tokoi 2017 & Framery 2018). Framery is the global market leader in soundproof office spaces and according to the CEO, aims to keep this position in the future as well (Pietarila 2018).

Through the massive growth sprints, some growing pains have also emerged at Framery. Until today the company has been very sales-driven and thus many processes have not yet been defined. This has not been a problem before, but now that the company has grown from a start-up into a medium sized company, some internal processes are needed for defining and easing the daily workload. One major issue is master data management and its processes. With these processes missing the company cannot work as efficiently and effectively as would be preferable, and this needs to be changed (11th of June 2018 research diary).

## 3.2 Methodology

For a study to answer the set research questions, the right research methods need to be chosen and applied. Underlying the selection of the right methods there are always some wider choices and ideologies affecting these decisions. This is the research methodology. (Saunders et al. 2009, p. 106)

In order to describe these methodological choices or methodologies Saunders et al. (2009) have developed the research onion. The onion consists of six layers where each layer deepens the methodology more to the core. The layers are from outside inwards:

- Philosophies
- Approaches
- Strategies
- Choices
- Time horizon
- Techniques and procedures (Saunders et al. 2009, p. 108)

To describe the methodological choices of this study the onion model of Saunders et al. (2009, p. 108) was modified and used as a base. The onion model for this study is presented in figure 4. In this version of the model, only the chosen methodologies are shown at each layer.

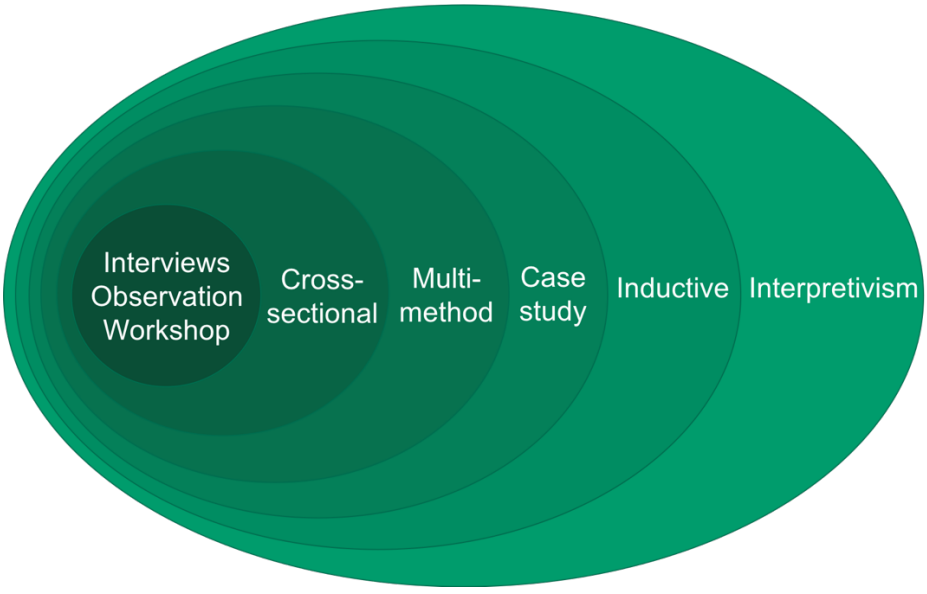


***Figure 4.*** *Research onion model (modified from Saunders et al. 2009, p. 108)*

First, interpretivism was chosen as the research philosophy. A research philosophy describes the way the world is perceived and sets some preliminary assumptions for the study. When other methodological choices are made, the commitment to the chosen philosophy needs to be considered, e.g. when choosing the research strategy, because not all strategies are suited for all philosophies (Saunders et al. 2009, p. 108). In addition to

interpretivism, Saunders et al. (2009, p. 108) have listed three other research philosophies in their onion: positivism, realism and pragmatism.

For this study, interpretivism was chosen as the research philosophy because it is human-centered and focuses on trying to understand people in their social environment (Saunders et al. 2009, p. 116). This suits to MDM development, because it requires organizational changes and development in management (Otto & Reichert 2010). In order to understand the need of the employees in the case organization, a human-centric approach is needed. The researcher is also working in the case organization, and therefore, the subjective approach of interpretivism and interaction with the research participants will come naturally (Saunders et al. 2009, p. 116).

To summarize the different aspects of the research philosophies Saunders et al. (2009, p. 119) used different paradigms: ontology, epistemology and axiology. In the case of interpretivism the ontology, meaning the reality of the researcher, is socially constructed and subjective, the epistemology describes what is regarded as knowledge in the research and in the case of interpretivism it consists of a subjective truth and social phenomena. Axiology, on the other hand describes how values affect the study which in this case means that they do because the researcher is part of the research entity. As research methods for an interpretivist research the best suited are in-depth qualitative methods. (Saunders et al. 2009, p. 119)

As interpretivism was chose as the philosophy, it is logical to continue with the inductive approach for this study. The research approach describes whether the research is testing a theory (deduction) or creating one (induction). (Saunders et al. 2009, p. 124) The inductive approach was chosen because it also considers the social aspect of the research participants and quantitative data is preferred. Due to the quantitative type of data, also a smaller group of research objects, employees in this case, are required. The idea of an inductive approach is that first the data is gathered then analyzed and from the findings and results a theory can be formed. Additionally, the inductive approach makes the whole research process more flexible. (Saunders et al. 2009, p. 126)

After deciding on the research approach, the next layer of the onion focuses on a more practical aspect of research and affects the actual material collection (Saunders et al. 2009, p. 136). First, a research strategy should be chosen. This is somewhat dependent on the chosen approach but mainly the idea is to find the right strategy to answer the set research questions. The options for a strategy are: experiment, survey, case study, action research, grounded theory, ethnography or archival research. (Saunders et al. 2009, p. 141) For this study the case study strategy was chosen.

A case study strategy helps the researcher to understand the research context better although it can be quite complex due to the fact that the borders between the research context and the outside world might be quite vague (Saunders et al. 2009, p. 145–146). The idea of a case study is to examine the object in its real environment. To make sure that the data gathered is reliable and valid to the research, often multiple data gathering methods and

sources are used. The typical methods used are interviews, observation and questionnaires. (Saunders et al. 2009, p. 146)

In this study many of the above-mentioned data gathering techniques will be used while relying on qualitative data sources. This means that the research choice in this case is multi-method. The other choices would be the mono or mixed methods. (Saunders et al. 2009, p. 151–152) This choice was quite simple due to the decisions made earlier and the type of techniques that will be used in order to answer to the research questions.

Next, the time horizon of the research needs to be decided. There are two options to choose from: cross-sectional or longitudinal. Unlike the other parts of the research onion, the time horizon is not dependent on the other selections made regarding methodology. For this study, the cross-sectional time horizon was chosen because there are certain time constraints for the whole research and especially the data gathering part. (Saunders et al. 2009, p. 155) The data will be gathered in a short period of time and due to the rapidly changing environment of the case organization it was thought that selecting a certain time "snapshot" would be somewhat easier for conducting the study.

Finally, in the center of the research onion, there are the techniques and procedures for data gathering. For this study, three main qualitative research methods were chosen to support the methodological choices presented above. The three techniques are interviews, observation and a focus group workshop. These will be discussed in greater detail in the next chapter 3.3.1.

When making methodological choices, it is always important to think about the credibility of the research as well since it is a vital part of the research design. In order to make sure that the research has not been done too subjectively, the reliability and validity of the research should be assessed. (Saunders et al. 2009, p. 156)

Reliability focuses on whether the data collection techniques or analysis procedures will produce the same results if repeated. The greatest threats to reliability are subject or participant error and bias, and observer error and bias. (Saunders et al. 2009, p. 156–157) Validity, on the other hand, is about whether the findings from a research really are what they seem. The main threats to validity are history, testing, instrumentation, mortality, maturation and ambiguity about causal direction. (Saunders et al. 2009, p. 157–158)

When using non-standardized data gathering methods, reliability is always a question because they might not be repeatable. This is because the findings present the reality of the certain time and situation. (Saunders et al. 2009, p. 327) However, this is well known among researchers because the benefit of using non-standardized methods is that they are flexible and can be adapted to the complex situations they are studying (Saunders et al. 2009, p. 328).

## 3.3 Materials collection

The material collection of this study consists of two major parts: the theoretical and literature part, and the empirical part. The focus in this chapter will be on the empirical part due to the nature of this study. However, first the literature part is discussed shortly in the next chapter 3.1.1. The empirical research methods presented in the heart of the onion model in figure 4 are described in more detail in chapter 3.2.2.

### 3.3.1 Literature

The theoretical part of this study is divided into master data (2.2), master data management (2.3) and the MDM models found in literature (2.4). The idea of the theoretical part was to get a basic understanding of master data, MDM and also the research done on these subjects.

Different methods were used in the materials collection of the literature. The method used most was the citation pearl growing strategy. This means for example that once a good article or other reference material is found, its list of references can be used to find new material or articles to be used in your own research. (Oulun yliopisto 2018)

In addition to the citation pearl growing strategy, key word searches were done in the TUT reference service Andor, Google Scholar and Google. The key words and search statements were always selected based on what was searched and on the desired results. Some quite general searches were made but also more detailed ones for specific needs. Some examples of the used search statements are:

- “master data management” OR MDM
- "process model" AND ("master data management" OR MDM)
- “product master data” OR “product MDM” OR “product MD”

Additionally, a few old master’s theses done on MDM were scanned through in order to find good reference material for the selected research topic. Some references were selected in the theoretical parts of these theses to be used in this study.

The final kay references were chosen based on the following criteria. Firstly, mostly scientific articles were used, and English was chosen as the main language of the reference material. Additionally, the articles cited most were preferred when scanning through the possible reference material.

The background and the main summary of the research done on master data and MDM is discussed in chapter 2.1. All in all, the literature part works mostly as a background and base for this entire study due to the emphasis of this study being on the empirical part.

### 3.3.2 Empirical study

Due to the nature of master data and MDM the focus of this study is on the empirical part done at the case organization. As Silvola et al. (2011) stated, the knowledge about data, such as definitions, flows and change impacts, lie within the business units of an organization. Therefore, it is important to investigate the business units when it comes to MDM.

To gather the empirical data three qualitative data gathering methods were used: observation, interviews and a focus group workshop. The methods and the decisions made in research related to them are discussed in this chapter.

**OBSERVATION**

Observation was chosen as a data gathering method in order to get a better idea of how the company works and also due to the type of research questions that try to describe how people work and should work. Observation can be participant or structured observation. For this study participant observation was chosen due to its qualitative nature. (Saunders et al. 2009, p. 288) In participant observation, the researcher is working as part of the subjects (Saunders et al. 2009, p. 289). This allowed the researcher to become a part of the organization and get a clear picture of the processes and ways of working in the organization.

Observation is an optimal choice as a method to understand the case company, Framery, better as an organization due to its quite unique place and setting. Framery is a rapidly growing company as explained in chapter 3.1 which makes the business and working environments distinctive from other companies. In order to understand this uniqueness and how it affects the daily operations, observation is a suitable method because researching the subjects is easier this way (Saunders et al. 2009, p. 290).

The main focus of observation was on the employees working with master data at the case organization. The aim of the observation was to gain an understanding of how the master data is handled and managed currently in practice, who is responsible for it and what issues have arisen from the lack of master data management in the case organization. Due to participant observation, the observation was done by working as a member of the staff in the company, observing daily work, and attending meetings where related topics to the study were discussed. Notes were taken in these meetings but mostly the purpose was to understand the research subjects and how they work in their environment better.

In participant observation, the bias of the observer has to be considered when looking at the validity of the gathered data (Saunders et al. 2009, p. 297). However, to minimize this risk of social bias most findings were verified through interviews (Saunders et al. 2009, p. 298), which was the second data gathering method.

## INTERVIEWS

In addition to observation, interviews were used as a data gathering method. The interviews were conducted internally in the case organization with employees. This was because master data aims to serve all stakeholders in an organization and in order to do so the needs of these stakeholders should be considered in the MDM initiative (Vilminko-Heikkinen & Pekkola 2013).

Due to the qualitative nature of interviews as a data source and the set time constraints for the study, data from the whole organization and all the stakeholders could not be gathered or analyzed. Therefore, some sampling had to be made to select the interviewees (Saunders et al. 2009, p. 212). In this case, non-probability sampling was chosen in order to select employees from each team working closely with master data (Saunders et al. 2009, p. 233). Both self-selection and snowball sampling were used as sampling methods (Saunders et al. 2009, p. 240–241).

Self-selection sampling was used only on the first two first interviewees listed in table 2. They were invited for an interview because the researcher knew that they had knowledge about the research subject. The rest of the interviewees were chosen based on snowball sampling. This was done by asking all interviewees who else should be interviewed on the subject. All the interviewees are listed in below in table 2. In the table both their titles and teams can be seen.

***Table 2.*** *Interviewees*

| Code | Title | Team |
|---|---|---|
| TDS | Technical Documentation Specialist | R&D |
| CIO | CIO | IT |
| OMS | Order Management Specialist | Customer Operations |
| TPM | Technical Product Manager | R&D |
| PDE | Production Development Engineer | Production Development |
| IPS | IT and Production System Specialist | IT |
| SB 1 | Strategic Buyer 1 | Sourcing |
| SB 2 | Strategic Buyer 2 | Sourcing |
| SDT | Sales Development Trainee | Sales |

In addition to the titles and teams, a code for each interviewee can be seen. This was done to match the employees from the interviews to the ones that participated in the workshop, which was the last data gathering method.

For the purpose of this study, semi-structured interviews were carried out due to their qualitative nature (Saunders et al. 2009, p. 320). All interviews were held face-to-face and one interviewee at a time (Saunders et al. 2009, p. 321). In semi-structured interviews there can be a list of questions or themes to guide the discussion, but it does not have to

be exactly the same for all interviews and therefore it can be modified to suite each interview or interviewee (Saunders et al. 2009, p. 320).

The benefits of using non-standardized interviews are that the interviewees are allowed to think out loud, which can result in realizing new things, and also more elaborate answers can be received. When there is no strict structure, the interviewees can be asked to elaborate on their answers and the discussion can flow more fluently. (Saunders et al. 2009, p. 324)

The aim of the interviews was to find out the main needs and requirements of each team for the new MDM process and gather some development ideas from inside the organization. The questions were formed based on the observation and one idea was to verify some observations through the interviews (Saunders et al. 2009, p. 298). The basic structure of the interviews for this study is presented in appendix A. As can be seen from the structure, open questions were preferred due to the fact that in non-standardized interviews, such as semi-structured interviews open questions should be used (Saunders et al. 2009, p. 337).

The structure of the interviews was developed iteratively, although not many changes were made during the period of the interviews. The sub questions from the structure were asked only if needed and if suited to the conversation. However, before proceeding to the actual questions, each interviewee was asked some background questions to define their familiarity with master data. To ensure that the interviewer and interviewee were talking about the same phenomenon, the concept of master data and product master data were clarified to the interviewees before starting the actual interview.

All interviews were audio recorded and notes were taken to ensure more active listening and to make sure nothing was missed (Saunders et al. 2009, p. 339). After the interviews the audio recordings were transcribed. This was done through data sampling (Saunders et al. 2009, p. 486). This means that all main points of the interviews were recorded but only some parts were transcribed verbatim where it really mattered, and quotations were needed.

While analyzing the interview data, one aspect that needs to be paid attention to is that the interviews were held in Finnish and therefore some interpretations might have been done while translating the findings into English for this study. In addition to this, some challenges related to the findings were already noticed during the interviews. Some of these challenges were as follows. Firstly, the level of knowledge about master data was varying considerably between the interviewees. Secondly, because the questions were not given to the interviewees in beforehand, some answers were quite brief and thirdly, some of the interviewees did not have a clear idea of their needs regarding MDM. The findings from the interviews are discussed in more detail in chapter 4.

**WORKSHOP**

Between the interviews and the workshop an organizational change occurred in the case organization. One goal of the workshop held internally in the case organization for a focus group was to determine the effects of this change on the MDM process.

The workshop was conducted with a focus group. A focus group is a group interview which has a clear and defined topic, and which encourages interactive discussion between the participants of the group (Saunders et al. 2009, p. 343). While discussing the subject, different points of view and thoughts should be shared between the participants (Saunders et al. 2009, p. 347).

The participants for a focus group are usually chosen for a certain purpose through non-probability sampling (Saunders et al. 2009, p. 343). In this study, the participants were mostly selected from the interviewees presented in table 2. However, it was thought that a few others should be invited in order to get a more complete idea of the MDM processes in the case organization. This way at least two members from all main teams working with product master data: sourcing, IT, customer operations, product development and supply chain development were present as can be seen from the workshop participants in table 3.

***Table 3.*** *Workshop participants*

| Code | Title | Team | Function |
|---|---|---|---|
| **GROUP 1** | | | |
| B | Buyer | Sourcing | Supply Chain |
| CIO | CIO | IT | Process |
| OMS | Order Management Specialist | Customer Operations | Supply Chain |
| TPM | Product Manager | Product Development | Product |
| PW | Project Worker | Supply Chain Development | Supply Chain |
| SB 1 | Strategic Buyer 1 | Sourcing | Supply Chain |
| **GROUP 2** | | | |
| COC | Customer Operations Coordinator | Customer Operations | Supply Chain |
| IPS | IT and Production System Specialist | IT | Process |
| PDE | Supply Chain Development Engineer | Supply Chain Development | Supply Chain |
| SB 2 | Strategic Buyer 2 | Sourcing | Supply Chain |
| TDS | Technical Documentation Specialist | Product Development | Product |

As can be seen in table 4, the focus group was divided into two smaller groups in order to ease the work and discussion in the workshop. The division was done so that members from all teams would be represented in both groups. The researcher acted as the facilitator of the focus group workshop (Saunders et al. 2009, p. 347).

As Saunders et al. (2009, p. 347) determined, a focus group is always focusing on a predetermined subject. Therefore, the topics of the workshop had been decided on beforehand and also communicated to the participants. The aim of the workshop was to deepen the knowledge about the main needs of each team and to discuss these amongst the participating employees. However, the main focus was on the development of the MDM process model for the case organization.

For a focus group, two interviewees are suggested (Saunders et al. 2009, p. 345). This was, however, not possible in the workshop of this study and therefore the researcher had to focus on taking notes during the session and also rely on the documentation and comments on the tasks the participants wrote down.

The step-by-step proceedings from the focus group workshop are discussed in detail in chapter 5.2. The findings are also discussed and summarized.

## 3.4 Research process

The main meetings, other observations, interviews and the workshop related to the data gathering part of this study are presented in a table in appendix B. From the observations only the most critical and relevant meetings for this study have been listed in the research diary table. The main purpose of the observation was for the researcher to become included into the case organization and to learn the ways of working and daily operations. Suiting the interpretivist philosophy, the observation was mostly done through continuous observation by attending different meetings, for example related to the PDM and WMS projects, and working as part of the IT team in the case organization. Based on the observation the questions for the interviews could be formed.

The interviews were held internally in the case organization for employees working closely with product master data. The questions for the interviews were created to deepen the knowledge about the case organization, its daily operations, issues and also gathering some improvement ideas from the employees. Thus, through the interviews a deeper understanding of master data, MDM and the process around it in the case organization could be formed. The needs, requirements and issues related to master data were discussed in the interviews and also development ideas from the employees could be gathered. The findings from the interviews are discussed in chapters 4 and appendix C.

After the interviews, the first version of the MDM process models for the case organization could be formed based on the gathered empirical data. Some ideas from literature were also reviewed at this point. However, the model was created purely based on the empirical findings due to the fact that there were no process models for MDM available in literature. The process models are described in chapter 5.1.3 and appendix D and E.

During this development phase of this study an organizational change took place in the case organization. According to the CEO, the main idea behind the change was that: “We want to transform Framery from an R&D and sales driven organization into a product and

customer-oriented organization.” In practice this change meant some modifications in the organizational structures, creating functions and reorganizing some teams. It turned out that this organizational change had hardly any effects on this research However, to minimize the possible effects, it was decided that this should also be discussed in the coming workshop.

Once the first versions of the process models had been created, an internal workshop was held in the case organization. The participants for the workshop were chosen similarly to the interviewees and therefore mostly the same people attended. The idea of the workshop was to deepen the knowledge about the organization, its employees and their needs for master data even further but also to specify some previously gathered data and to develop the defined process models even further by gathering thoughts from the employees. In addition to these, the ownership of the processes had to be defined and as mentioned before the new organizational structure had to be considered. The findings from the workshop are discussed in chapter 5.2.

After the workshop the final versions of the process models were created and defined based on the ideas gathered from the workshop. The final process models are described in chapter 6.1.1 and appendix F and G. Finally, these models could then be evaluated (chapter 6.1.2) based on the evaluation principles defined for this study in chapter 5.1.1.

# 4. MASTER DATA MANAGEMENT IN THE CASE ORGANIZATION

On the basis of the interviews an idea of the current situation of master data and MDM in the case organization could be formed. The main challenges found from the interviews are discussed in the chapter 4.1. In addition to the challenges, the interviewees were also asked to think about some development ideas for the current situation. In addition, the main needs of each team were discussed with the interviewees. The findings from the interviews are discussed in chapter 4.2.

## 4.1 Challenges in the current MDM process

Currently the product master data management process at Framery has not been defined. This has caused several problems and challenges and is increasing the amount of work for many people. In order to get a clear picture of the main challenges and issues in the current MDM process, internal interviews were held. The aim was to interview at least one person from each team closely working with the item data.

As a conclusion from the interviews and observation the main steps in the current product MDM process could be defined. The process consists of the internal processes in R&D, transferring the data to the ERP system, purchasing and receiving the product items, production and finally sending the products to the customer. Between these steps, the ownership of data is unclear, and the roles of different teams are not unambiguous.

According to the CIO of Framery, master data management is a hygiene factor in a company. This means that it will cause dissatisfaction at work if handled inadequately but cannot increase satisfaction on its own (Law 2016). This signifies that no-one will notice MDM if handled properly but it is still essential for a company's success because the effects of performing poorly will be seen company-wide (CIO).

Because the product MDM process has not been defined at Framery, it has caused many issues and challenges in the organization. The main challenges are related to the process, accessibility to data, the IT systems, products, data ownership and the product change processes. These are discussed in more detail in the next chapters on the basis of the interview findings. In addition, there were some challenges mentioned related to instructions and custom orders. The main issue with instructions was that there were none or just some related to internal processes in R&D. In the custom order cases, the issue is that there is no existing process for handling these cases, because they are being avoided whenever possible, and they are done differently case-by-case causing a great deal of additional work throughout the organization.

### 4.1.1 Process-related challenges

The main challenge according to most of the interviewees was that the process for product master data management is not really defined. There are no clear practices and there is no structure or specific schedule. Due to this, the process cannot be followed, which causes problems, misunderstandings, haste and unnecessary work. This has been observed, for example, when no-one knows who is responsible for something, leaving the task undone or when the same changes are done multiple times due to lack of communication. (3rd of August 2018 research diary) Now, most of the data management is done by putting out fires, but according to the CIO, it should be done more preventively.

According to the Technical Documentation Specialist, in growing companies, such as Framery, it is quite common to forget master data and product information. This is due to the very busy schedules caused by the eagerness of a young company and its employees (18th of July 2018 research diary). In this, sometimes chaotic, environment the sole focus is on the day-to-day operations and routine work in order to get things done. In addition, many employees at Framery are young and unexperienced and therefore do not possess much knowledge on best practices. However, this means that there are no unnecessary routines and many tasks are done through trial and error, therefore taking more time. (Technical Product Manager)

Despite the problems in the MDM process and not seeing the big picture, the production itself is working quite well (Order Management Specialist). This can also be seen from Strategic Buyer 2's comment: "Somehow this has been working, if 40 million was made in revenue last year." Nevertheless, she believes that there would be a possibility for much more if matters were handled better and according to Strategic Buyer 1, there is room for a considerable improvement in the effectiveness of the MDM process.

In busy times, for example before big trade fares, everything is drawn out of the employees. However, this extreme consumption will have to be taken back at some point through over-time leave or sick-leaves. (Sales Development Trainee) Therefore, in long-term this is not really a functional solution.

Due to the fact that Framery is still a very young company, there is a need to constantly create something new (Order Management Specialist). Because of this thrive, the big picture is often forgotten and information about changes or new products may come too late for some teams (Strategic Buyer 2). In rapidly executed changes, it is also usually forgotten that IT, especially the ERP system, is much more inflexible than the physical reality and the people working in production (Order Management Specialist).

Another challenge that was mentioned in several interviews was the issue of manual work. The fact that some work has to be done manually causes the data to be suspect for defects (CIO). Some major issues are that data has to be transferred manually from one system to another (IT and Production System Specialist) and custom orders have to be fixed by hand (Strategic Buyer 2). In addition, the bill of material (BOM) structure of the

products will have to be structured somewhat manually and some item pictures are being updated manually on the intranet site (Technical Product Manager).

The fact that the MDM process is not defined is causing loss in many ways at Framery (CIO). At least time and information are frequently lost (Technical Documentation Specialist). Another issue is that the internal communication is lacking in many ways. Because of this, the wheel is being reinvented in R&D when several teams are developing similar things simultaneously without knowledge of the overlap (Strategic Buyer 2). In addition to this some mindsets and attitudes have also caused problems, according to the CIO. MDM is thought to be a necessary evil with joint liability that just has to be done somehow and therefore its value is not recognized (CIO). Because of this, data management is only done with a minimal input and the effects of master data quality are not understood. Therefore, the quality of the produced data is varying considerably, and it is not generated in the most optimal way (Technical Documentation Specialist).

Loss can also be caused by the fact that some knowledge and tasks are very personified at Framery and too many matters are dependent only on one person (Strategic Buyer 1 & IT and Production System Specialist). This issue is extreme in the IT team, since managing all item related data in the ERP system has been the responsibility of only one person (IT and Production System Specialist). Similar situations are also visible in other teams. Additionally, many tasks are handled based on memory and are therefore dependent on one person's knowledge (Strategic Buyer 2). This can also be seen in the work of the IT and Production System Specialist. He is receiving many requests through instant messages where it is easy to forget them and there is no way of tracking the progress of these requests (IT and Production System Specialist).

In the past few years, the number of item names has grown rapidly. New items are created almost weekly (Strategic Buyer 1) and the reuse or lifecycle of items has not really been thought of (Technical Documentation Specialist). The IT and Production System Specialist also mentioned the problem of the item lifecycle: "No one is actually tracking the lifecycle of items or when they should be deleted for example." In addition, the items and their attributes are checked and corrected too rarely because there is no systematic way of doing this (Strategic Buyer 1).

Due to the many aspects of the MDM process not working well there are also problems in the item stock balances and the revisions of items. These are quite critical aspects for the whole supply chain and therefore should be fixed as soon as possible (Strategic Buyer 2). Since production is one of the key functions of the whole organization, it is curious that the processes have not yet been defined making work harder than it needs to be. This is caused by late product changes and incomplete products in production (IT and Production System Specialist). As a result, a significant amount of extra work is needed in production and IT when matters have to be adjusted and modified multiple times (Production Development Engineer & IT and Production System Specialist).

To conclude, the process is very unclear. People are going back and forth because steps are not finished, requirements or instructions are not understood, and the needs are not clear. (Production Development Engineer) In the end, it comes down to this: “If the problems with data and the MDM process are not solved, only more people will have to be hired for customer services.” In order to create a permanent solution, the root problems will have to be identified and resolved. (Technical Documentation Specialist)

### 4.1.2 Accessibility and challenges with the IT systems

Currently one challenge at Framery has been that not all data or systems are accessible for all employees. One good example of this is the product data management (PDM) system used in R&D. It contains plenty of specific information and knowledge about the products and their design but only designers and other employees in R&D have access to the system. (Technical Product Manager) Because of this all the information needed and used by others will have to be transferred from the PDM system to other platforms (Order Management Specialist). Therefore, only the designers have access to the original data which according to the Technical Documentation Specialist, is an issue.

PDM is just one example of not being able to access the information or system needed. The Technical Documentation also said that in general there are many situations where all needed information is not available, or it might take a considerable amount of time to find it. This is an issue in many different teams. For example, the latest versions of drawings are not always available and the visibility to capacity plans for production is insufficient (Strategic Buyer 1). In addition, many times the revisions of items are not communicated or not even known (Order Management Specialist & Strategic Buyer 1).

The revisions or the lack of knowledge about them is a massive problem all over Framery. According to the CIO, the visibility into the past versions of the company’s products is quite poor. This causes most problems in the customer operations team, decreasing the customer services quality. The main problem in customer operations is that there is no clear and easy way to check the current or past structure of the products, therefore making their work very time consuming. (Order Management Specialist) All information and data in a company should be reliable and as the Order Management Specialist said: “All current and old data should be available.”

One problem related to all needed data not being available and accessible is that the R&D team does not share enough information for others in the organization (Technical Product Manager). This is still not the only problem but also the fact that a great deal of necessary and business critical data is hard to find. One explanation for this is that all data is not stored in the same place. (Technical Documentation Specialist) Separate locations and the extreme amount of data causes an issue of not even knowing where to look for the needed information (Order Management Specialist).

Managing the big picture is quite hard when the data in scattered in different systems (Technical Documentation Specialist). The lack of appropriate data management, IT systems and system integrations currently cause plenty of manual work in many parts of the product lifecycle (IT and Production System Specialist). One issue with this is that data does not move automatically between systems but has to be transferred manually from one system to another (IT and Production System Specialist & Technical Product Manager).

Manual work causes the data to be suspect to defects and therefore it might not always be reliable. There is no clear process for managing data in the ERP system and this might increase the unreliability of the data in the system (Order Management Specialist). The Technical Product Manager gave some examples of this. One example was that when the data has to be transferred it is first manually put into excel sheets and then again manually entered into the second system. Another example was that all purchasing and receiving of items is not always done through the ERP system, but the manufacturing is, causing errors in stock balances. (Technical Product Manager)

### 4.1.3 Challenges in products and data ownership

IT systems and accessibility to data are not the only sources for problems with the MDM process at Framery. In addition, data ownership and product related data have caused some challenges. The main issue with new products is that they are launched too early. Often launches take place before the products are ready and finished causing many challenges including additional work in data management and production (IT and Production System Specialist). Incomplete products are launched due to the too short and tight product design schedules meaning that there is not enough time to get the products ready before the scheduled launch (Technical Product Manager).

Because of the early launches, products are taken into production while still incomplete. In order for the production to start, the item data has to be transferred into the ERP system as well even though changes will have to be made to it later on during production (Technical Product Manager). This is currently causing a lot of unnecessary work in many different teams all over the organization.

Another challenge with the product related data is that the status of items is not known or updated (Technical Product Manager). In addition, the number of items in the ERP system has increased dramatically because all the old item names still exist in the system (Order Management Specialist). Therefore, it would be extremely important to update the status and revision data of the items in order to separate old items from the ones in production. However, currently the revisioning of items is not working adequately either because there are no clear instructions for product designers on when a new revision or new item name is needed. (Technical Product Manager)

The issues with the revisions have also caused some problems with suppliers. This is because there is no clear practice for letting suppliers know about changes, so they might get confused or might not be fully informed about new revisions or item name updates (Technical Product Manager). In addition to the revisions, the structures of products, especially old versions, are not always known. This is due to the revisions not working but also because of insufficient documentation. (Technical Documentation Specialist)

Many challenges have also risen from data ownership and responsibilities. Amongst the interviewees there were many different opinions, almost as many as the number of answers, about data ownership; who is adding what data, and at which point in the product MDM process. This itself shows that there is no clear and defined structure or roles for data ownership at Framery. According to the CIO, currently on the one hand, the ownership is too personified and, on the other hand, it is too spread out and thought to be more of a common responsibility.

One of the main issues with data ownership is that data management is too personified, especially in the IT team (CIO & Production Development Engineer). ERP item data management is personified at least partially because in other parts of the organization there is not enough knowledge to handle the management (CIO). However, according to Strategic Buyer 1, the ownership of the ERP item data is shared between the IT and sourcing departments. All in all, the ownership, management and roles are unclear when it comes to item data (Strategic Buyer 2).

According to the Technical Documentation Specialist, the ownership of item data is divided amongst several teams: “There is not a single team. Nobody has ownership over the whole data.” Although the ownership has not been defined, it can still be seen as a shared responsibility at Framery (CIO).

In addition to the unclear ownership of data, it has not been clearly defined who is supposed to add what data to which systems at what point in the process. This is mostly because the responsibilities and ownership have not been defined (Strategic Buyer 1). The CIO also mentioned this in his interview, saying that nobody knows whose responsibility it is to add or manage certain data. Because of this, the sourcing team is sometimes missing some essential data related to their work (Strategic Buyer 2).

### 4.1.4 Challenges in the product change process

Framery is still a quite a young company and aims for continuous improvement, also in their products. Therefore, a large number of changes are made in various scales and timelines to the products, always starting some kind of change process. Because several changes and updates are made, they also cause plenty of challenges across the organization because everybody will always have to adjust to the new situation. The main issues with changes are the lack of information, tight schedules, and the project and process itself.

Currently there is no clear way of creating a project plan for product changes at Framery. Due to this not all projects have a clear project plan, which again has caused many challenges (Production Development Engineer). Despite of this, some progress has already been made. Currently, when going through larger change projects weekly meetings are held with a cross-functional team in order to get everything going and people informed. (Technical Product Manager)

Although progress has been made, it is still not clearly visible yet and in order for the product change process to work properly, the change project should be started in all cases early on and include people from different teams (Order Management Specialist). Now one issue, for example, has been that not enough information and time has been given for IT during the product change processes. Nevertheless, as long as the big picture of the effects of the product changes are not seen or presented, nobody will have a clear picture who will have to be informed about each change (CIO).

All effects of the changes are not adequately seen and therefore not properly communicated through the organization (Technical Documentation Specialist). The main issue with information is the lack of it. Many of the interviewees (Order Management Specialist, Strategic Buyer 1, Strategic Buyer 2 & Sales Development Trainee) said that usually the notice about changes or updates is coming too late, is insufficient or in some cases no notice has been given at all, at least not to all concerning teams. According to the Strategic Buyer 1, the only official change announcement comes via email after the change has already been taken into production. This is much too late for almost everybody in the organization because all teams should be able to prepare for the change in advance.

According to the Technical Product Manager, information about product changes is shared thoroughly in the company intranet and the emails are just a last notice to get the final change information to everyone in the organization. However, the employees are currently too inactive in trying to look for the information. Therefore, information about changes is only available to those who know where to look for it (CIO). Another issue is that there is currently no visibility as to why a change process has been started: what the trigger or impulse has been to implement the change (Technical Documentation Specialist).

The lack of information about changes has caused many problems at Framery. One challenge is that not all minor changes have been communicated to everyone causing confusion amongst employees, customers and suppliers. The Sales Development Trainee gave an example of a change that was not communicated to the Sales team and therefore not to the customers or dealers. This caused some issues at the customer's end and a lot of extra work for different parties because the change had to be fixed. In addition, communication with the suppliers is sometimes challenging when it is unclear if all changes have been communicated to the them because currently there is no clear practice concerning who should inform the supplier about changes, the sourcing team or R&D (Strategic Buyer 2).

Overall notifying about changes is quite insufficient and non-systematic (Production Development Engineer & Sales Development Trainee). However, the lack of information is not the only challenge in the product change process. Other massive issues are the short time-lines and tight schedules of the product changes and updates. This is still a challenge even though there is already some kind of understanding of the needs of other teams during a change process, but the schedules are inadequate (CIO).

Due to the tight schedules, many employees have a feeling of not being able to do their work properly or as well as possible because there is just not enough time. This is because the due dates are coming fast, and the information is shared too late for many teams to do actions. (Strategic Buyer 2) This is the case also with the sourcing team. They are included into the change process too late so that the strategic buyers do not have time to find new suppliers, negotiate with the existing ones or some promises might have already been made to a supplier. (Strategic Buyer 1)

Often the change requests for ERP item data are coming on short a notice and sometimes several changes should be made at the same time. Due to this, the IT team has to stay alert at all times. (IT and Production System Specialist) Usually the changes are also made too fast so that the item data is not ready (CIO). According to the Order Management Specialist, scheduling changes is difficult and usually not enough time is given to the IT team to implement the change to the systems because it is often forgotten that the ERP system is the inflexible part of the whole process. All in all, the most challenges with scheduling arise from the fact that the production starting date for the change is decided too late (CIO).

The process for doing changes is not really systematic at Framery. According to Strategic Buyer 2, the change process in unclear and the Technical Project Manager said: “I guess it is done differently every time if there is a change.” One challenge is that there are many of changes coming at a constant feed which makes the flood of information too extensive to handle (Sales Development Trainee). In addition, the revisioning is also unclear when it comes to changes. It is unclear whether a new revision should be created or a whole new item name. (Technical Product Manager) The Production Development Engineer summed up the challenges related to the process quite well:

> *“There are no specific rules when or if a change can be carried out. It is not just an item data issue but an issue of the whole process, since changes are done so fast and with tight schedules. The item data just has to be updated accordingly and therefore the whole process is a challenge.”*

Some other challenges related to product changes mentioned in the interviews were the effect of making a mountain out of a molehill and the issue of forgetting about data. Sometimes a big change project is started out of a small problem or an issue mentioned by only one customer even though it would not be needed (Strategic Buyer 2). The other issue is that when the thoughts are only in the physical product the data related to it is forgotten and therefore not always kept up-to-date (Technical Documentation Specialist).

### 4.1.5 Effects of challenges on the teams

There are many different kinds of challenges at Framery according to the interviewees. Some of the challenges or effects of the challenges are related to several main issues such as the revisioning of items. In this chapter, the main challenges and their effects found in the interviews are summarized and also the main effects per team are presented.

The main challenges and their effects are presented as a summary in a table in appendix C. The challenges are divided into categories based on the division in the previous chapters. Because there are so many challenges related to product master data at Framery, as evident in appendix C, it is quite impossible to try to solve all of them with one process definition. Some of the challenges and effects, such as the ownership of data being too spread out and at the same time too personified, are also conflicting and therefore to solve both of them might be a challenge.

All in all, the effects of item data related challenges are seen on a wide scale at Framery, since most teams use or at least dependent on some level of item data in their work. According to the Strategic Buyer 2, everybody expect HR and marketing use item data at Framery. Therefore, the effects on different teams are discussed.

The whole process starts from R&D, since this is the team creating the item master data (Order Management Specialist) when they are designing the products. Therefore, the effects also start from here. According to the CIO, data is the basis of the work of R&D since item data and product structures are what they produce. Therefore, the validity and rationality of the output data are the key elements of the quality of their work (CIO). Because work quality can be measured from the data output, data is an essential part of managing each product designer's own work as well (Production Development Engineer).

The second most important team effected by item data and its issues is the sourcing team. Their work is strongly based on item data and its quality in all respects (Order Management Specialist). The main job of a buyer is to ensure that productions can work as planned and has all the parts needed (Production Development Engineer). This means that data plays a significant role for the sourcing team's work so that material consumption and purchasing can be planned accordingly (CIO).

The customer operations team is not handling item data as directly as the sourcing team but is still very dependent on it and its reliability. The Customer Operations Coordinators have to stay on top of everything at all times (Order Management Specialist). This means for example knowing all offerings, being able to answer questions coming from customers, registering sales orders and handling reclamations (Sales Development Trainee & Production Development Engineer). In order for all of this to work smoothly, item data needs to be intact. . Otherwise this will cause considerable extra work either for the customer operations team or IT. (CIO)

The IT and finance teams are mostly in a supporting role when it comes to the supply chain. Despite their relatively small role in the delivery process, they are still affected by item data and its challenges. The IT team has also been responsible for managing the data in the ERP system, which means that they are responsible for the data used by many employees (Sales Development Trainee & Production Development Engineer). Because of this, they are also affected by the quality of data they receive from R&D.

On the other hand, the finance team is responsible for producing reliable internal reports based on item and other ERP data and are therefore greatly affected by it (Sales Development Trainee). In addition, it is the finance team's responsibility to produce reliable business reports for both internal and external stakeholders where item data is used for example for assessing the warehouse value through item stock balances (CIO).

Production and production development teams mostly use item data indirectly. They work with the items as physical parts but still they are affected if there are some errors in them, such as the product structures (CIO). In order to help this, there is also the production quality team who inspects new parts and therefore also monitors the quality of suppliers and their compliance with Framery's component drawings (Order Management Specialist). In addition to this, the production development team is responsible for creating the instructions for productions, which are strongly based on item data and the pictures drawn on them in R&D (Production Development Engineer).

Before the production can start, the parts need to be received, which is done by the in-house logistics team. They receive the parts as items in the ERP system and adjust the item stock balances accordingly (Order Management Specialist & IT and Production System Specialist). Thus, it is crucial that the item data is managed properly so that right parts are received and used in production (Specialist & Technical Product Manager). After production the ready modules are packed, based on workorders created from sales orders in the ERP system (Order Management Specialist). This ensures that all right parts are packed into the shipping crate (CIO).

All in all, it is very business-critical that the data is in a good shape. "Our production can't produce at the current level if the data is not intact." (CIO) This can also be seen for the wide effects for data around the organization presented previously in this chapter.

## 4.2 Development ideas from the case organization

In the interviews, in addition to trying to map out the main challenges at Framery, another goal was to gather some ideas on how these challenges could be solved. As the Technical Documentation Specialist said: "If the master data is not in order nothing is." The development and improvement ideas were gathered so that the development in the organization would be based on the needs and wishes of the employees and therefore would be easier to implement.

Some of the findings were new and not based on challenges or issues recognized before in the organization but many ideas were also based on solutions that had already been planned. The development ideas are divided into process-oriented development and the implementation of new systems. These themes are discussed further in the next chapters. In the final sub-chapter, the needs of all teams are discussed in greater detail as a conclusion of the interviews and observation.

### 4.2.1 Process-oriented development

According to the Technical Documentation Specialist, the first step of development should be mapping out the needs and wishes of all teams. This is so that the new process will properly solve the issues and challenges of the employees. This chapter is divided into nine parts based on the themes that were found in the interviews similarly to the challenges. The themes discussed are: the process, the roles of teams, data ownership, seeing the big picture, operational development, readiness for production, item data, accessibility to data and finally product changes and updates.

**THE PROCESS**

One of the main findings in the interviews was that the MDM process is not defined. In order for a product manufacturing company to function properly, the process for product MDM should be defined as a whole (Technical Documentation Specialist & CIO). There are currently some existing product related processes, at least in the R&D team, but these do not really take a stand on item data, according to the Technical Product Manager. Because the processes for product MDM are not clearly defined or coherent (Technical Documentation Specialist), the processes need to be defined, mapped and communicated properly throughout the organization (CIO).

The first step at Framery should, therefore, be to define a process model for product MDM (Order Management Specialist). According to the Technical Product Manager, the process needs to be well thought through, so that all steps and responsibilities are defined (Technical Documentation Specialist). However, it is not enough to just define a good process, but the process needs to be implemented into the organization as well, in order to get the employees committed to it (Order Management Specialist). This is extremely important in a growing company such as Framery, where people are used to working in a way that just gets matters done in the middle of a constantly changing environment.

The product MDM process should become a part of every-day work (Technical Documentation Specialist). The guidelines should be unambiguous, and the process gates clearly defined so that no shortcuts can be made (Production Development Engineer). As the Technical Documentation Specialist said in his interview: “First the baseline needs to be in shape or otherwise you can’t get anywhere.” For the company to work as a whole the processes and instructions should be followed properly (Strategic Buyer 2).

### THE ROLES OF TEAMS

The roles and responsibilities of different teams at Framery have sometimes been unclear. Some teams have had too much responsibility related to MDM and others have done tasks that should actually be the responsibility of others. These issues have appeared because the roles and responsibilities related to MDM have not been defined.

One key issue related to too much responsibility has been that the item data management in the ERP system has been the responsibility of only one person working in the IT team (IT and Production System Specialist & Strategic Buyer 1). This issue should be fixed by training another person who can help with the work load and substitute during vacations. In addition, the tasks that are mostly manual should be eliminated with the implementation of new IT systems. (IT and Production System Specialist)

Managing the item data should not be the responsibility of only one person. According to the Strategic Buyer 2, management of all item data related to commercialization, such as purchasing, should be the responsibility of the sourcing team and the responsibility of all technical aspects of the item data should be with the R&D department. Another sourcing team related issue has been that the communication practices with the suppliers have not been defined although the sourcing team should be the main point of contact, informing about changes and making new contracts, for suppliers (Strategic Buyer 1).

According to the Technical Documentation Specialist, one issue has been that there is not one team responsible for the whole lifecycle of the products and the data related to it. Because of this the big picture of product data management has been missing. Therefore, it was suggested that a new product management function should be created with the role of product lifecycle management. In the future, also the ownership of product MDM should be with this function. (Technical Documentation Specialist)

### DATA OWNERSHIP

In the interviews many conflicting ideas were presented related to data ownership (Technical Documentation Specialist, Strategic Buyer 1 & Order Management Specialist). All in all, the main issue was that the ownership and roles related to data and data management have not been defined at Framery (Production Development Engineer) and therefore nobody knows who should be responsible for what.

There is not only one solution to the issues with data ownership. The interviewees had a few different ideas for the development of data ownership. One idea was that the R&D teams should be the owner of all product related data, including item data. This means that that the responsibility of item data quality and all its aspects, such as completeness, reliability and timeliness, should be the responsibility of the R&D teams. (CIO) Another slightly different approach was that the responsibility should be divided amongst different teams so that everybody is responsible for the data they are adding or editing, however

keeping the ultimate ownership and responsibility of data history with the R&D department (Order Management Specialist).

One other suggestion was that one function should own the whole MDM process and define the roles and responsibilities of other functions. In addition, there would be a data superuser in each team who should be responsible for the team's MDM. (Technical Documentation Specialist) The process owner could in this case be the possible new product management function that the Technical Documentation Specialist suggested.

**SEEING THE BIG PICTURE**

One key factor in developing the product MDM process at Framery is adding transparency to other's work and therefore increasing the visibility for the bigger picture. Currently one issues has been that employees focus too much on their own work and the task at hand and do not see the big picture or the company as a whole. According to the Technical Documentation Specialist, seeing the big picture would also help in the data quality issues because in order to create good quality data for others to use, the needs of others need to be understood.

One way of increasing visibility would be to increase the cooperation between teams (Strategic Buyer 1). Cooperation and collaboration are essential in understanding others and seeing the whole picture. For example, one big step towards transparency would be increasing the cooperation between the sourcing and customer operations teams because much of their work is interconnected. (Strategic Buyer 1) This is, for instance, because many of the parts used in the products are sales driven which means that they are ordered from suppliers only once a sale has been made. Due to this the teams should work more closely together in order to increase productivity and make work more efficient.

Another way of increasing visibility and understanding of other's work would be to increase information sharing and communication between teams. Some examples of these were also given in the interviews. For example, the capacity plans for production and packing should be shared in the organization well in advance so that all teams could plan their work accordingly (Strategic Buyer 1). This has been an issue of late planning due to the lack of forecasting in sales, sourcing and production. However, there is already a solution at hand. There will be a new Forecast and Planning Specialist starting whose responsibility will be to develop a systematic way of forecasting which, in the end, will help in the capacity planning for production and communication in the organization (Sales Development Trainee).

Ultimately seeing the whole picture, at least with the products, is dependent on life-cycle management. This has been somewhat missing at Framery and therefore should be improved (Technical Documentation Specialist & CIO). With proper life-cycle management it is possible to achieve what the CIO described as the foundation for MDM: "It is actually the foundation for item data management that we have data about what we have done in the past, what we are doing now and what we will be doing tomorrow."

**OPERATIONAL DEVELOPMENT**

According to the interviewees (CIO, Technical Product Manager & Strategic Buyer 2), there is plenty of room for improvement in the day-to-day operations at Framery. Some main targets for improvement are the mind-sets and know-how of employees, organizational culture, data quality, tools (CIO) and practices (Sales Development Trainee).

The main purpose of tools is to help employees in their work. Once these are working properly, they should minimize the amount of manual work, which has also been one of the greater issues at Framery (Technical Product Manager). Some examples of tools still needed are some kind of tracking for item data (Strategic Buyer 2) and also a common project tool (Sales Development Trainee). The item status tracker is needed so that all teams will know when something in the item data has changed and can do the changes accordingly. In addition, a common project tool is needed especially for product launch projects where many teams are working together (Sales Development Trainee).

Finally, the sole key solution to the operational development and helping the day-to-day work is to get some systematic practices into use. One very crucial solution for this is to slow down the pace of doing daily work at Framery (Technical Product Manager). This is the only way of getting the processes and practices in order and to the needed level of the sized company Framery has grown into in the past years. According to the Sales Development Trainee, there has already been some discussion about limiting product updates only to a few specific times a year, for example before big trade fairs. This would be essential so that all teams would be able to properly prepare for the coming changes. Systematic updates would also help in the work of ERP data management (IT and Production System Specialist).

All in all, many aspects should be developed and made more efficient in the day-to-day operation at Framery. One additional development idea would be to improve internal communication, especially in the R&D teams so that the wheel would not have to reinvented (Strategic Buyer 2). The CIO concluded this well: “We need a model that is clear and defining, where responsibilities are shared, and where internal communication is emphasized.”

**READINESS FOR PRODUCTION**

Currently one issue at Framery has been that incomplete products are taken into production. This should never be the case and some structure should be brought into the process (Technical Product Manager). One way of doing this is by establishing clear practices for evaluating products or product changes. After the evaluation the decisions regarding readiness for production should be made based on the evaluation. In addition, the products should not be introduced to the market before they are ready for production. (CIO)

Although the final production starting date should not be decided until the product is actually ready for production, some preliminary target date should be decided well in

advance and communicated throughout the organization so that all teams have enough time to do their preparations before the product launch and production start (CIO). However, as said before the products cannot be taken into production until finished, and therefore the target date should not be set in stone but should be flexible if needed.

In the end, the whole design process needs more time and flexibility (Technical Product Manager & IT and Production System Specialist). There should be enough time for all phases in the process so that it can function, and the products get finished well on time before production starts (IT and Production System Specialist).

**ITEM DATA**

At Framery, there have been several challenges related to item data. The most common ones are the status and revision of items not being tracked and the process or names not making that much sense. According to the Technical Product Manager, there should be a clear process established for revisioning of items. Now it has sometimes been unclear during product changes whether a new item should be created or just a new revision (Technical Product Manager).

In order to manage items properly, there should be a clear and systematic process for tracking the status and status changes of items (Order Management Specialist). It should never be unclear which items are used in production, which are old parts, and which are still in prototype phase (Strategic Buyer 1 & IT and Production System Specialist). Also keeping the status information up-to-date at all times and in all systems needs to be handled better and someone should be responsible for it (Strategic Buyer 2). According to the IT and Production System Specialist, the status tracking should mainly be the responsibility of the R&D department.

Once the product MDM process gets defined and put into use, handling item data will hopefully get much easier. Nevertheless, plenty of information is related to a single item that different people are responsible for (CIO). Despite of this, in the process special attention should be paid to the phase where a product is changed from a prototype into a production version. At this stage, the item data also needs to be modified for production. (Order Management Specialist) In addition to this, the whole item data mass is in need of for some renewal (Technical Product Manager). Currently all item names are not descriptive or uniform and this should be changed so that they would be easier to understand (Strategic Buyer 2).

**ACCESSIBILITY TO DATA**

The first step in managing accessibility is ensuring that everybody has access to all data needed for their work. If all needed data is not accessible easily, meaningful work will suffer. (Technical Documentation Specialist) On the other hand, one of Framery's values is transparency and therefore all existing data should be available for all employees (Production Development Engineer & CIO).

Of course, there are some exceptions to the full transparency due to regulations, but this guideline should be followed to the best possible extent. Once the data is available to all, the quality of data becomes even more important and the data has to be kept up-to-date (Production Development Engineer). Finally, in order to make data sharing possible and as easy as possible some platforms need to be established. For example, the sourcing team gets plenty of information from suppliers but currently they have no clear place or way of sharing all of this information (Strategic Buyer 1).

**PRODUCT CHANGES AND UPDATES**

Currently most product changes and updates have caused some kind of disturbance, because they are not planned well, and there are so many of them coming constantly. “We should aim for a situation where changes are not made here and there, but instead multiple changes are done at the same time.” (Order Management Specialist). In order to achieve this, there should be a clear process created for product changes where responsibilities are defined and there are some guidelines for communication (Strategic Buyer 1).

There should also be more time to implement changes (IT and Production System Specialist) and some indication for needed data updates (Production Development Engineer). These could also be solved by defining the right kind of process. One other key element would be to improve the communication about upcoming changes (Technical Product Manager & Sales Development Trainee). According to the Order Management Specialist, the information about concrete changes and updates in products should be shared around the organization already at least two months before the change in production. In addition, it would be good not to just inform about the change but also about the reasons behind it (Strategic Buyer 1).

### 4.2.2 Implementation of new systems – PDM & WMS

Because of the fast pace Framery has grown, there are still some basic tools and IT systems missing or not working properly. Therefore there has been a need to acquire two new systems: a new PDM system and a WMS. PDM stands for Product Data Management (Vance 2011a) and is used mainly in the R&D department at Framery (Technical Documentation Specialist). WMS on the other hand stands for Warehouse Management System (Vance 2011b) and is used at Framery mainly by inhouse logistics and production (Production Development Engineer).

The new IT systems were needed to ensure that everybody has all the needed tools for their work that can help with the workload and bring some structure to their tasks (CIO & IT and Production System Specialist). These systems will also help in making work more systematic and efficient (Technical Product Manager). The idea was that the processes related to the systems will be renewed together with the system implementations.

Because of this item data and product MDM are closely related to these system implementation projects. Therefore, the benefits of the new systems will be discussed in this chapter one system at a time.

**WMS – WAREHOUSE MANAGEMENT SYSTEM**

The idea of a WMS is to ease the work of inhouse logistics and warehouse workers through system automation. With the system, it is possible to manage the storage locations better and make the warehousing leaner and more efficient. (14th of May 2018 research diary) These are significant changes to the current situation since all of these aspects have been previously handled through the ERP system. One additional feature is that the production workers will be able to order more components to the production cells through the system (6th of August 2018 research diary).

The main benefit of the WMS that will be visible to most teams is the more stable stock balance tracking (IT and Production System Specialist). Through more stable stock balances less inventory adjustments will have to be made and the work of buyers will become much easier once they can actually rely on the stock balances shown in the WMS and ERP systems (Strategic Buyer 1).

The relationship between item data and warehouse management is that the items will be received through WMS and updated into the ERP system through the integration platform. After reception, the items are warehoused and the location for the items is defined in the WMS. Finally, the items are transported into the production cells and the ready modules are packed in the end. (14th of May 2018 research diary)

To summarize, WMS will make item management and tracking at the factory much easier (Production Development Engineer). The warehouse locations will no longer have to be updated into the ERP system (IT and Production System Specialist) and no space will have to be made for new items because the system will automatically find a suitable place for each pallet. All delivery lots and different items will also be easier to locate in the warehouse with the help of the WMS. (Production Development Engineer)

**PDM PROFESSIONAL**

At Framery there has already been a PDM system in use, but the old system will be upgraded into a professional version of the same system (15th of May 2018 research diary). The new system is more customizable and can be used on a wider scale at the organization (22nd of May 2018 research diary). The main benefit of the new system is that other employees outside of R&D will also have access to the system (Technical Documentation Specialist).

With the new PDM Professional the start of the MDM process will become more stable and structured through processes build into the system for the work in R&D (Technical Documentation Specialist & CIO). This will ensure a more systematic way of working (Kropsu-Vehkapera et al. 2009). Because of the effects on the process in R&D, the new

MDM process should be implemented together with the PDM implementation (Technical Documentation Specialist).

Data management will also be transferred for the most part from the ERP system into the PDM system (Technical Documentation Specialist). This will therefore change the role of the IT team from data management more into technical support (IT and Production System Specialist). All in all, data management will become easier (Technical Product Manager) once the system will take care of data related organizing, back-ups and all data will be stored in the same format (Kropsu-Vehkapera et al. 2009).

The web-based interface will make access to the system much easier (PLM Group 2018) and through better access management the product data will be accessible for all employees (Kropsu-Vehkapera et al. 2009). Because everybody will have access to the system, they will have access to up-to-date data about different attributes of the items (Technical Product Manager). All in all, this will ensure better visibility to the data needed (Production Development Engineer). For example, the sourcing and production teams will have access to current item drawings (Strategic Buyer 1).

Accessibility to the PDM system will additionally ensure that looking for product related information will become much easier because all the data is stored in one place (Technical Product Manager). This will also decrease the amount of manual work and make the work in many teams more efficient (IT and Production System Specialist). Another feature decreasing manual work is the fact that the new PDM system can be integrated into other systems (PLM Group 2018), such as the ERP system. This will remove the need for manual data transfer between the systems (Technical Product Manager).

Another benefit with PDM Professional is that product and data lifecycle management can be tracked better (CIO) through automated revision management (PLM Group 2018). Revisioning was also the benefit mentioned most often in the interviews (Strategic Buyer 1, Strategic Buyer 2, Production Development Engineer & Technical Product Manager) since this has caused several challenges as mentioned in chapter 4.1.1. Another challenge was that the item status is not tracked but this can also be solved with the new PDM system by better data management and tracking (Technical Product Manager).

Access management will allow separate folders that can be accesses with certain credentials even outside the organization (PLM Group 2018). This feature should be used with suppliers who would this way be able access item drawings straight from Framery's PDM system (Strategic Buyer 2). Finally, the main benefit of the new PDM system is that there will be uniform documentation throughout the organization and the cooperation between teams will get better (PLM Group 2018).

To conclude, the goal of the new PDM system was to ease and structure the work of product designers so that the product data is already taken into consideration at the design phase. Taking products into production will get easier and better revisioning will increase the visibility also into the history and past versions of the products. Finally, the widened

access for the whole organization into the system will make many matters possible and much easier. (CIO)

### 4.2.3 The needs of different teams

In the interviews and during the observation period, the main needs and wishes of all teams were found regarding the MDM process at Framery. These are concluded in this chapter. Below in figure 5 the main needs are presented per team. However, these are not all of the needs and wishes that were discovered in the empirical part of this thesis, but the ones shown in the figure are the most crucial ones. These and some other important needs are summarized and discussed in this chapter.

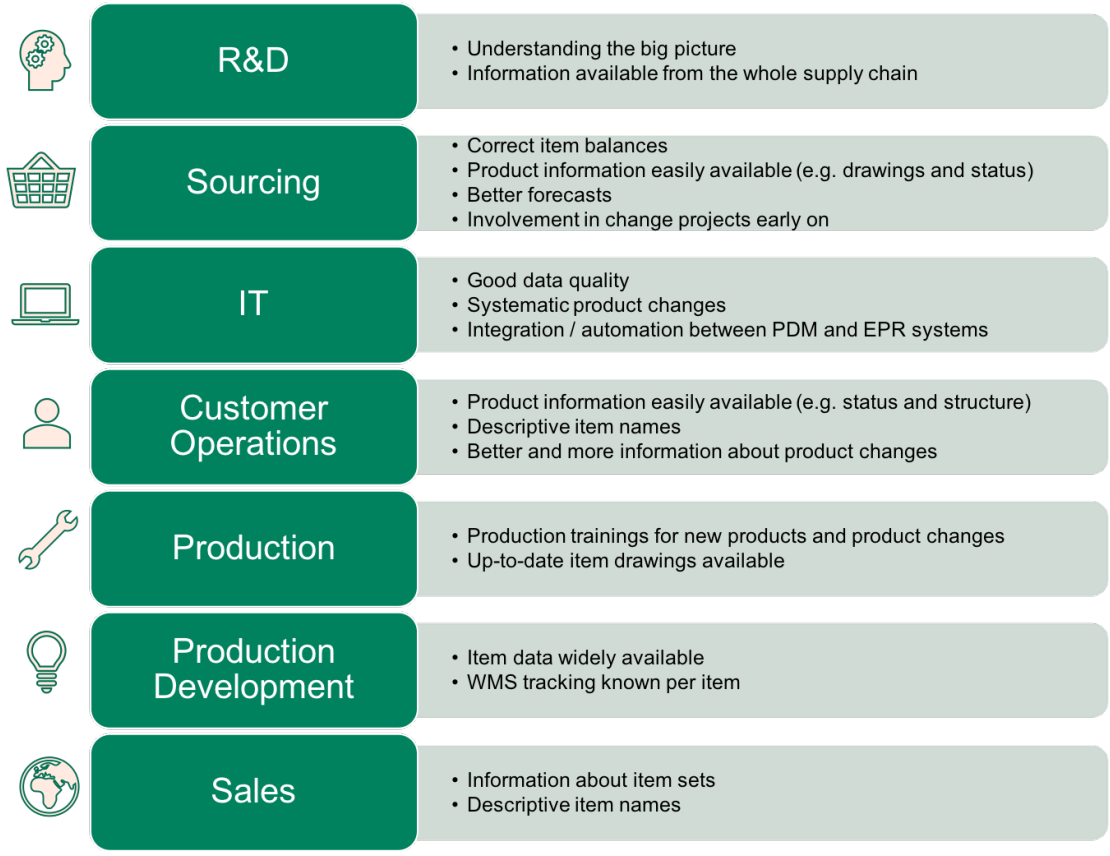


***Figure 5.*** *Main needs per team*

The whole process of MDM starts from R&D. Their main need for the process is understanding the big picture. This will ensure better data output quality through the design for X (DFX) phase that should be implemented into R&D. DFX means that already in the design phase for example purchasing and manufacturing are taken into consideration. (19th of July 2018 research diary) In order to achieve DFX successfully information about the whole supply chain is needed. This information is also needed so that R&D will know about possible problems and fix them in the next update.

Since the main requirement for R&D from the MDM perspective is to produce good quality data, they also need to get good quality data from other teams. This means that all data

should always be kept up-to-date. In addition, the employees working in R&D should have access also to the ERP system even though their main responsibilities are with the PDM system. To summarize, the main need for R&D is that the MDM process should be as simple as possible and not require extra work from them.

The sourcing team is the one most affected by item data and its quality. Therefore, they also have the most needs for the product MDM process and item data. In order to do their work properly, the buyers need the item stock balances to be correct and up-to-date. In addition, all product related information should be available and easily accessible. This means that at least item drawings should be available, item status clearly defined, and product structures should be found easily. The sourcing team also needs precise sales forecasts that should be divided into areas based on the electrical systems, such as areas using Schuko (Europe), US, UK or Italian electric systems. Better sales forecasts would also ensure better purchasing well ahead of production.

In addition, the sourcing team would like to be included in the product change projects early on so that especially the strategic buyers would have enough time to negotiate with suppliers. Another point related to product changes is that that reasons behind the product changes should be communicated and so this information could be added as an attribute field into the new PDM system. Finally, the main aspect is that all item data should be clear and unambiguous.

The most important aspect for the IT team in the MDM process is that the quality of item data should be ensured. This means that at least the timeliness and correctness should be one of R&D's priorities. The quality is important for IT because then they can produce good quality tools for employees to use and ensure good quality data also in the ERP system. In order to prepare data and ensure the correctness of all IT systems, the product changes need to be handled systematically and informed about as soon as they are known.

One issue in the IT team has been manual work. One way of reducing this is by adding an integration between the PDM and ERP systems or at least automating the data transfer on some level. This again requires good quality data from R&D, which really makes this the most important aspect for IT.

The work of the customer operations (CO) team is quite complex and consist of many different tasks. The main need for the CO-team is to have access easily to all product related data. The product structures should be available per revision and the different versions of the products should be clearly defined and documented. The status of items should also be known and there should be some information about item sets that always have to be ordered together.

In addition, the item names should be descriptive and product structures easily understood. Another need of the CO-team is that they should get more and better information about product changes well in advance. R&D should also give a physical presentation of new products for the Customer Operations Coordinators so that they can communicate

better with the customers. Possible challenges in production and product quality could also be defined in the prototype phase and communicated to the CO-team.

The production workers deal with item data only indirectly since they deal with the items as physical parts. However, they should have access to up-to-date drawings of the items and have good instructions for their work. This requires also training for new products and products changes.

For production development it is important that all item related data is available and accessible because they need all kinds of product and item related information in their work. Because all items are not going to be tracked in the new WMS system, the information about whether the item is tracked in WMS should be known and shown as an attribute of the item. One of the main aspects is that the role of production development should be quite minimal related to MDM.

The sales team does not really deal with item data on a daily basis but still they need information about item sets as well as the customer operations team does. Sometimes they might have a need to look at item data and because of this the item names should be as descriptive as possible and simple to understand.

Some other requirements that emerged during the interviews were that there should always be a named contact person for a change or new product and R&D should be able to produce a complete and flawless structure of all products. The contact person should be communicated throughout the organization, at the latest when a change or new product goes into production, and they should be available for questions related to the product change or new product. All in all, communication and knowing the responsible people were important aspects mentioned by the interviewees.

# 5. DEVELOPING THE MDM MODEL

Based on the interviews, a thorough idea of the organization's current MDM status and the issues with it could be formed. Because the most significant issue was that the MDM process had not been defined, the improved MDM model will be defined for Framery in this chapter (5.1) based on the findings from the interviews and observation.

To ensure that a process fits the context it should be used in, it needs to be evaluated (Davis 2009). For this evaluation principles will be created but also internal process validation is required because MDM is always very case and organization specific (Otto 2012). For the internal validation a workshop with the employees creating and using master data was held. The main goals for the workshop was to validate the process and develop it even further. The findings of the workshop are discussed in chapter 5.2.

## 5.1 Empirical model

Based on the interviews and observation done in the case organization the empirical process models for MDM could be formed. However, before the process definition some evaluation principles should be created to validate the reliability and relativeness of the process after the definition as well. Based on the interviews, the main development ideas for the current status of the MDM process could be found and they are turned into solutions in this chapter.

First the evaluation principles are formed in chapter 5.1.1 and after that the overcoming of the main challenges found in the interviews is discussed in 5.1.2. Finally, the actual process models are defined and describes in chapter 5.1.3.

### 5.1.1 Defining the evaluation principles

Processes are extremely important for organizations (Clear Business Outcome 2017). Therefore, it is not enough to just define a process but in order to make sure that it fits the organization and context, a process needs to be evaluated (Davis 2009). Because of this, some key evaluation methods are discussed in this chapter. The goal is to set evaluation principles for the MDM process that will be defined for Framery based on the evaluation methods and principles found in literature.

The idea of a business process is to define how a company brings value both to their customer and internally to the organization (Clear Business Outcome 2017). To ensure this, a process needs to be aligned with the organization's values and strategies (Davis 2009). This also means that what fits one company might not fit another However, some key principles for processes have been defined that should fit all organizations irrespective of the size or area of business (Clear Business Outcome 2017):

- Documentation
- Effectiveness
- Someone responsible for the process
- Creating scenarios
- Agility

Often one of the key issues is that the business processes are not documented (Clear Business Outcome 2017). This has also been the issue at Framery because the processes have not been defined. According to Davis (2009) a process model should define tasks and shown their sequence, state used recourses, describe the environment and the business objectives the process should fulfill. Once the process has been defined and documented, it is possible to find improvement points in the process (Clear Business Outcome 2017).

Effectiveness means that the aim of a process is to achieve a goal. The main purpose of a process is to bring value to the organization and its customers. On the other hand, efficiency means that the goal is achieved with as little waste as possible. Therefore, unnecessary or duplicate steps should be avoided in processes. (Clear Business Outcome 2017)

It is hard to make a process work effectively and efficiently if the process owner is missing. The owner should be one person or one team, and they should be responsible for the process as a whole. Another task of the process owner is to continuously improve the process. (Clear Business Outcome 2017)

When defining the process, there are two additional aspects that need to be considered: creating different scenarios and the agility of the process. Many times the processes are only defined from the best-case-scenario point of view and the situations where everything does not go as planned are not thought of. A wider perspective should, however, be studied while defining the process and therefore different scenarios should be considered. Another issue is the agility of a process. A company and its processes should be able to react quickly and flexibly to the changes taking place in their business environment. In addition, agility means that a process should be developed in an agile manner through cooperation between teams. (Clear Business Outcome 2017)

In addition to the key principles mentioned by the Clear Business Outcome (2017) Davis (2009) has defined 8 criteria for a good process. Some of these overlap with the ones mentioned above. The criteria defined by Davis (2009) are: effectiveness, efficiency, relevancy, validity, usability, using, reusing, managing and measuring of a process.

The effectiveness described by Davis (2009) is quite similar to the one described previously. In addition, he mentioned that the process should be simple and ease people's work. Efficiency was described similarly to effectiveness in both articles. In addition to minimizing waste, Davis (2009) talked about using recourses in a sensible way.

The relevancy of a process means that the work is done according to the process. Validity on the other hand refers to the process being sufficiently correct meaning that the process should always be validated against the customer requirements. This is due to the fact that different processes have different requirements for the scope and precision. To ensure success, all processes should be tested through verification and validation. Verification means that the process fills the needs and requirements set for the process and the validation makes sure that the process fits the context it is supposed to be used in. (Davis 2009)

The usability of a process describes the fact that the process is based on a real business process which is reproducible and predictable. To make sure that the modelled process is actually usable, the needs have to be known beforehand. In addition, the process should be manageable and modifiable. Once the process is ready and defined, it needs to be taken into use. The implementation of a new business process requires change management and should make a difference in an organization. A good process should also be reusable meaning that the best practices or some parts as such can be reused or that the process can be standardized to fit other purposes. (Davis 2009)

The process management described by Davis (2009) is quite similar to the process owner discussed by the Clear Business Outcome (2017). Davis (2009) says that the process owner should be responsible for the development of the process and they should make sure that the process is aligned with the organization's strategy and fills its needs. The owner should also be the one measuring the process (Davis 2009).

The final criterion for processes was measuring. Although creating and maintaining a meter is quite costly (Robson 2004) a good process is measurable and actually measured (Davis 2009). Because processes are what businesses do, it is extremely important in today's competitive environment to measure these in order to know how you are doing as a business (Davis 2009).

Based on the findings listed above some evaluation principles for the MDM process were created. The 11 evaluation principles are listed below in table 4 with their more detailed description. From the literature findings, only the ones best suited for MDM process evaluation were selected as the evaluation principles. The principles should work as a checklist for the evaluation of the MDM process.

***Table 4.*** *Evaluation principles and descriptions*

| Evaluation principles | Description |
|---|---|
| Documentation | Documentation defines tasks and their sequence, used recourses, environment and business objectives |
| Effectiveness | A simple process that eases work of employees and additionally brings value to the company and its customers |
| Efficiency | Minimal waste through elimination of unnecessary and duplicate steps and using recourses sensibly |
| Process owner | Process owner responsible for the whole process and its measurement and development |
| Measurement | Following the success of the whole organization through process measurement |
| Relevancy | Operations should be standardized based on the process |
| Validity | Process fits the use context |
| Verification | Customer needs and requirements are met |
| Usability | Process is based on a real process and the requirements were known before definition |
| Process is used | Implementation of the process through change management |
| Reusability | Process standardization, reusing best practices or reusing parts of the process |

The process evaluation will be made after the definition and development of the product MDM process for Framery. The process will be evaluated from the perspective of all the principles listed in table 4.

### 5.1.2 Overcoming the challenges of the MDM process

After defining the main challenges with the MDM process and gathering development ideas for these challenges from the case organization, solutions could be defined for the issues. The solutions to these challenges are shown below in table 5. They are divided into the same categories as the challenges listed in appendix C. This is due to the fact that the approaches are meant to meet the challenges presented in each category. The ones written in bold text can be used for multiple challenges or categories. The solutions were created based on the found challenges and the development ideas mentioned by the employees so that they would reflect the needs of the organization in the best possible manner.

***Table 5.*** *Overcoming of the MDM challenges per category*

| Challenge category | Approaches to address the challenges |
|---|---|
| Process | Defining and documenting the process and creating instructions<br>Data viewpoint as part of daily work<br>**Seeing the big picture**<br>Improving communication<br>**Tracking item status**<br>Information sharing<br>Clearing and documenting product structure |
| Accessibility | Everybody able to access all needed data<br>Data is easy to find<br>R&D sharing all product related data<br>All data stored in the same place |
| IT systems | Needed tools available<br>System integrations / automating data transfer between systems<br>Data management processes in order |
| Products | Launching only finished products<br>**Realistic planning schedules for products and product changes**<br>**Revisioning process**<br>**Process for supplier communication** |
| Data ownership | Data ownership clearly defined<br>Roles and responsibilities defined (who is adding/updating what data) |
| Product changes | **Collected changes**<br>Clear project plans for all product changes<br>Understanding the needs of others in the change process<br>Informing about changes well in advance<br>Making clear where information can be found<br>Visibility to the reasons behind the change<br>Acknowledge the inflexibility of IT<br>Include all effected teams into the change planning<br>Deciding production starting date as soon as possible |

The approaches presented in table 5 will be implemented into the MDM process definition as well as possible. All of the above-mentioned challenge overcoming's are, however, not really MDM process related, such as general information sharing and establishing a process for supplier communication. Therefore, these cannot be solved with just a simple process definition.

In the next chapter the actual MDM process model is going to be presented and described. A decision was made to separate the MDM process of a new product and the process of a product change because they have some differences in their challenges and on how to overcome them as can be seen from appendix C and table 5 in the product changes category. In addition, it was decided not to take a stand on the internal processes in R&D since they will be redefined internally during the implementation project of the new PDM system and they don't affect the management of master data that much.

### 5.1.3 Defining the processes

Based on the internal interviews and observation two product MDM processes reflecting the current situation and the needs and wants of the employees at Framery were defined. The idea was to define the processes portraying the situation the employees would want to have after the implementation of the WMS and the new PDM system. A process definition was done because it was discovered that one of the main challenges at Framery was that the processes have not been defined. The first process is the MDM process of a new product and the second one is the process of a product change. In this chapter the process models are pictured and described, and the choices related to them are explained.

Both processes are pictured as swimming lane charts. The involved teams and teams are shown as horizontal lanes. At a principal level, a decision was made that the product management function was not created for this MDM process version because it was only suggested by one interviewee (Technical Documentation Specialist). Therefore, the swimming lanes consist only of existing teams and teams at Framery.

Another decision was made regarding the scope of the process. The whole item lifecycle is not described but the focus is only on the item data before a product or change is taken into production. For example, the production, reclamations or end-of-life of item data are not pictured in these MDM process models.

The main goals for the process definitions were to slow down the pace of working and for all teams to understand the bigger picture and the needs of other teams better (Technical Documentation Specialist). Another main goal was to define the roles of all teams better and to clarify who is responsible of what data (CIO & Strategic Buyer 1). Although everybody has a distinctive role in the organization, they should still assess the quality of data provided by others while keeping the big picture in mind. This means that the focus should still not be only on everybody's own work but on the company as a whole. The main idea is, however, that all employees are responsible for the data they are adding or editing. (CIO)

**NEW PRODUCT MDM PROCESS**

The MDM process model for new products is displayed as a whole in appendix D and the main steps from the model are summarized below in figure 6.

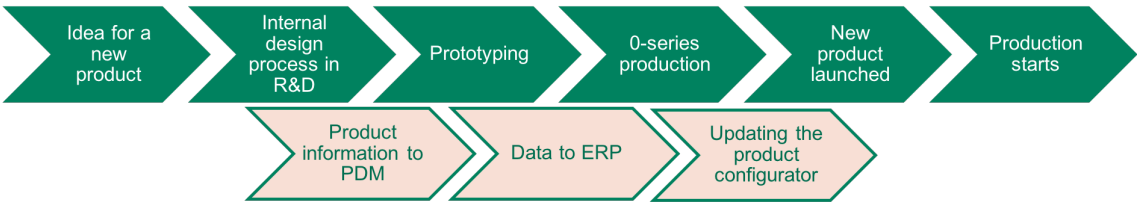


***Figure 6.*** *Summary of the MDM process for a new product*

The whole process starts from an idea or need for a new product as can be seen in figure 6. The design phase of the process starts with R&D and is done mostly internally in the function. Therefore, this phase is not described in detail. The data outputs of this phase are the item names, drawings and drawing numbers of the new product.

Before the process can move forward, the first process gate has to be passed. This gate was created to ensure that the drawings are ready to be moved further in the organization. This step is very important because R&D is responsible for the data they have produced and therefore they need to check it before transferring it for other teams to use (Technical Documentation Specialist).

This is also the point for the first go- or no-go-decision. This means that the new product is evaluated from the business perspective Some questions, such as whether there is a need or market for the product can be used in the evaluation. (Myers 2013) If the evaluation result is a no-go decision, the product can be taken back to the drawing board or killed (19th of July 2018 research diary).

Once the go-decision has been made and the data has been checked, the strategic buyers will be informed about the project and the prototype buyer can start buying the prototype parts with a generic porotype item name through the ERP system. Once the prototype parts arrive, they are received by the logistics team and then checked by the production quality team. After this the actual prototyping can begin.

Prototyping can be a very long phase and even take a year or more. This phase is mostly done internally in R&D and during this period different parts and solutions can be tried out. During the prototyping phase, some go- or no-go-decisions can be made but if the organization as a whole decides to move forward with the prototype the data output of this phase should be the bill of materials (BOM) product structure.

After prototyping the preliminary production starting date can be set. The date should be a guideline and not be set in stone if the product is not going to be ready before this. While setting the preliminary date, the process and its schedule should be considered from all perspectives and not be too strict. Once the preliminary production date has been set, the production development team can start planning the production and creating a production ramp-up plan. At this point, at the latest, the fitness for assembly has to be checked by the production function to ensure that the prototype can actually be manufactured in a modular way, similarly to the other products.

As the data output from the production planning phase the production development team should produce the production plan and instructions for production in addition to the cost and assembly analysis which can help in the next decision-making gates. The next step is indeed again a process gate. In this step the production development team needs to sign off whether the product is ready for production. If not, the product needs to be taken back to the prototyping phase or due to a no-go decision taken back to the drawing board or killed. On the other hand, if the production development team can give a go-ahead for the product the responsibility will go back to R&D.

After the go-decision from production development for the product another process gate is needed for R&D to check if the product structure is also ready for production. As shown in table 5 the structure of the products needs to be clear and simple. If the structure is not ready the product needs to be taken back into prototyping. However, if the product and its structure are thought to be ready for production, the item names should be updated into production versions if needed.

After the item names have been updated the production development team should decide which items are going to be tracked in WMS. At this point they should also create the item pallet plans. Simultaneously the 0-series and production starting dates should be set. Again, the flexibility of the schedule should be considered while deciding these dates.

Once the dates have been set, the production development team should start to plan the production worker trainings. Once they are planned the trainings can be held. At this point, it is also time to check if the item prices and suppliers have already been negotiated by the strategic buyers. If not, the negotiations with the suppliers have to be started. However, if the suppliers have been decided and prices have already been negotiated the needed supplier information can be added to the PDM system by the sourcing team. The information that needs to be negotiated and should be filled into the system are the supplier, price, purchasing category, delivery time and the delivery and payment terms for the supplier. These are also the data outputs from this phase of the process.

Before moving further in the process, R&D should once again check the product information. This is also done in the next process gate. The purpose of the next gate is to check that all needed information for production is available. If all information is not available R&D should check what is missing and either fill it in themselves or instruct the responsible person to fill in the missing information. Once all the needed information has been added, the responsibility of the item data moves on to IT.

The first task for the IT team is to transfer the item data into the ERP system. This step should be automated or at least eased by some integration between the systems as shown in table 5. However, even then it should be the IT team's responsibility to check that the data is correct in the ERP system. This way the R&D department is responsible for the data in the PDM system and the IT team is responsible for the item data in the ERP system (IT and Production System Specialist). The data output of this step are the ERP item names, which should actually be the same as the names in the PDM system.

Once the item data has been transferred into the ERP system, the data should automatically flow into the WMS. At this point the sourcing team can also start to buy the parts for the 0-series production. When the parts are received, the stock balances of the items are updated into the WMS. After receiving the new parts are again inspected by the production quality team to ensure the quality of the suppliers.

Once the parts are received and checked the 0-series production can start. 0-series production is a way of testing mass production for a new product (Keksinnöt 2018). At Framery this is done by a small group of people and the idea is to avoid disturbing the actual production lines by keeping the 0-series production separate (Production Development Engineer). When starting the 0-series production the organization needs to be informed about the product contact person from R&D who can answer all questions related to the new product.

After the 0-series production has started the sales team can evaluate and create a price for the new product. This is done by comparing the new product to existing ones at Framery and similar ones on the market (Sales Development Trainee). After setting the price the marketing team will create sales materials and product cards which are then checked cross-functionally to ensure that all the information is correct. These are later updated if changes are made to the product during the 0-series.

After the 0-series has been in production for some time, another process gate is needed. At this point the production development team needs to evaluate if everything has been working smoothly and as planned in production. If not, the R&D teams should make the needed changes or communicate the needed changes to other functions. After this the process can move on to the final process gate and go- or no-go-decision. The purpose of this gate is to evaluate if the product is ready for production. Some points that need to be considered by the R&D team during this evaluation are that only finished products should be launched and that the product structure should be very clear and simple, as explained in table 5.

If the result of the evaluation is a no-go-decision, more changes can be made or the product can be killed. This is actually also the last point where the product can be killed before the production starts. Nevertheless, if the decision is a go and the product is seen as ready for production, the product will move on in the process toward the launch. However, before the product can be launched, the product needs to be added to the product configurators by the IT team and a launch plan needs to be made by the marketing team. In addition, the R&D department needs to prepare and hold product trainings for the customer operations team and create installation instructions for the new product.

Only after all of the previous steps have been done, can the product be launched and presented to the dealers and customers. After the launch, the sales team can start to sell the new product and advertise it to Framery’s dealers. Due to the sales the customer operations team will then start to receive sales orders from dealers and customers.

Simultaneously to the start of sales, the sourcing team can start to buy the production parts. After receiving and inspecting the parts and adjusting the stock balances the production can finally start. However, the production will start only after the first orders have come in.

## PRODUCT CHANGE MDM PROCESS

The MDM process for a product change is both similar and divergent to the process for a new product. They both start with some kind of an impulse either for a new product or for a change. A product change can begin due to many different reasons, such as a customer complaint, a visual improvement idea or the need to lower costs of manufacturing (25th of July 2018 research diary). The MDM process for a product change is pictured as a swimming lane chart in appendix E and a summary of the main steps from the model is presented below in figure 7.


***Figure 7.*** *Summary of the MDM process for a product change*

As mentioned above, the process starts from an impulse for a change, which is the first step in figure 7. After this R&D will start their internal design process for the change but they will also create a change specific project plan because all changes are done differently depending on their scope and timetable. The project plan was also mentioned as a solution in table 5 and it is therefore a very important factor in the change process. Another aspect that needs to be considered at this point is that multiple changes should be committed simultaneously and only a few times a year. This was also mentioned in table 5.

Once the project plan has been created, a weekly meeting with the project team should start. The project team should consist of members from different teams in order to get the others informed better about the coming changes. This way all the teams will be better prepared and can give their input to the change already in the design phase.

During the design phase, the need for the change msut to be evaluated. This has to be done because in the past unnecessary changes have been made to the products (Strategic Buyer 2). The evaluation is done with a process gate. If the project team decides not to move in with the change the process will end. However, if they decide to move forward the change proposal will be made and presented throughout the organization. The proposal should include the reason for the change and all the specifications of the change.

After this the engineering change order (ECO) process is started. This process is navigated through the new PDM system and the idea is to get all related teams involved in the process and inform them as early as possible. During the ECO process a question is sent

to all related teams to check if they are affected by the change and in what way. All teams need to report back to R&D whether they are affected by the change or not. If no one is affected by the change the process can move on but if someone is affected, they need to report the effects and the actions that need to be taken.

After receiving the answers, R&D needs to reassess the change proposal based on the findings of the ECO process. If they need to change something, they will have to re-start the ECO process and send the question again to all teams. In all cases no changes are needed at this point, but the outlined actions need to be considered for example in the change schedule. Finally, a last feasibility study will be done before ending the ECO process.

As a result, from the ECO process an ECO summary is created. This should include all the answers and actions taken during the process. However, before moving on in the process another process gate is needed in order to check if the change should actually be made. If for example no need for the change is seen or it is too complex, the process can be ended at this point. If the decision is a go at this point, the process will move on to buying and receiving prototype parts and then to the actual prototype phase, as in the MDM process of a new product. Similarly, the output of prototyping should be the new BOM structure of the product. In this case, however, the changes should be marked in it so that it is known which item are new, which already exist, and which will be removed from production.

After the prototyping phase, R&D should assess if the product is actually ready for production. If not, it should go back to prototyping but if it is ready the preliminary production starting date for the change should be set. This is so that all teams have enough time to prepare for the change as explained in table 5. After setting the date, the production development team can start to create the ramp-up plan.

Simultaneously, all teams should start to make the needed changes before production starts. This phase is very change specific but for example, the sourcing team should negotiate prices for the new items, the production development team needs to update the production plans and instructions and the IT team has to update the data into the ERP system and make the changes needed to the product configurators. In addition, the sales team might have to adjust the pricing list and the marketing team might have to make changes to the sales materials and product cards.

The R&D team should also make sure that the item names are updated and that their status and revisions are correct. These were also mentioned as solutions in table 5 because it is very important to keep the item status up-to-date at all times (Strategic Buyer 2). After all teams have made the changes, the R&D team should check that all actions listed in the ECO summary are either done or ready to be implemented once the production starts.

After all the changes are ready, the final production starting date can be decided. Before the production can start, the necessary employee-trainings have to be held and R&D has

to communicate the change contact person for the whole organization. In addition, once the date has been set, a secondary product launch can be held if the change is considerable. After the launch or if no launch is held, the changes need to be communicated to the dealers and customers by the sales team.

After this, orders for the new version of the product can be received. At the same time the buyers will start to buy the new items and once they are received, the production for the change can start. If the change is small, old orders can also be manufactured with the new version, but more extensive changes will have to be manufactured separately (1st of August 2018 research diary).

Some aspects that have to be considered besides the process itself are that the changes might vary considerably and therefore this process might have to be adjusted accordingly (Production Development Engineer) and it is very important to keep the whole organization up-to-date about the change and make clear where all information related to the change can be found. This also applies to the process of a new product. As a summary for the main similarities and differences between the two processes, the MDM process of a new product and a product change, table 6 was created.

***Table 6.*** *Similarities and differences between the processes*

| Similarities | Differences |
|---|---|
| Starting from an impulse | Change specific project plan |
| Internal design process in R&D | More involvement of other teams |
| Prototyping | ECO process |
| Setting a preliminary production date | All teams committing changes simultaneously |
| Employee trainings | |
| Contact person from R&D | |
| (Product launch) | |
| Buying and receiving parts | |

As can be seen in the table above, there are both similarities and differences between the two processes. However, the processes work mostly in the same way and the main differences are related to the fact that the other process is for a new product and the other one was created for a product related change.

## 5.2 Workshop findings

Once the processes had been defined, an internal workshop at Framery was held. The main idea of the workshop was to develop the designed model even further and also validate it internally in the case organization. People from different teams working with item data were invited to the workshop. The agenda was sent to the focus group workshop participants listed in table 3 beforehand. The objectives for the session were: process validation, including the organizational changes to the process and defining the process ownership.

The different sections discussed in the workshop are described in greater detail below in the subchapters. Fist, the needs of the employees were revisited and the findings from the KJ-method-based exercise are presented in chapter 5.3.1. After that the processes were developed further in smaller groups and the main changes are listed in 5.3.2. Finally, the process ownership was discussed, and the six thinking hats findings are explained in 5.3.3.

### 5.2.1 Redefining the needs

Although the needs were already discussed in detail in the interviews, it was decided that they should be revisited in the workshop although most of the workshop participants were already interviewed. This was to ensure that the main needs were already considered in the defined process models and to see if some changes to them had occurred during the development period. In addition, this was a great opportunity to let the employees discuss the needs and wishes of different teams in the organization in order for them to also see the bigger picture better.

The need-finding was guided with the KJ-method to make the discussion more structured and in order to help the participants be more creative. The KJ-method is a group creativity technique invented by the Japanese Jiro Kawakita (Scupin 1997). The method was chosen because it is easy to understand and to use and it helps in keeping the discussion to the point (Spool 2004). Before starting, the participants were divided into two groups so that there were people from all teams in both groups.

The KJ-method consists of four main steps: idea generation, grouping, naming the groups and chart making (Scupin 1997; Spool 2004; Teknologia 2010). At the idea generation step, the goal is to individually brainstorm as many ideas as possible to the question at hand (Spool 2004). In the workshop, this was the step where the participants determined the needs they have for the item data and the MDM process.

After the brainstorming the groups started to work together, and everybody explained their ideas to the other group members. Once this was done, the groups proceeded to the second step of the method, grouping. Grouping means that the previously generated ideas should be grouped into “teams” that somehow fit together. At this stage it is not important to think about the relationship between the ideas or the content of the group, but the feeling is more important (Scupin 1997). The grouping should be done so that all ideas have a “team” in the end (Teknologia 2010).

Once the idea groups have been formed, they should be named (Spool 2004). This means that a suitable title is specified for each group (Scupin 1997). At this point, it is also good to see if the groups form even greater group families (Teknologia 2010). In the workshops, not many families were found because there were not that many groups to begin with. After this, the final step is creating the chart. This means that relations between the groups or group families are drawn (Teknologia 2010). These can be marked with arrows, connectors or contradictors (Scupin 1997).

As a finding from the KJ-method in the workshop the two groups had formed their own need charts. Because the needs were already discussed in more detail in chapter 4.2.3 only the key findings of the KJ-method are presented below in table 7.

***Table 7.*** *Summary of main needs for MDM from the workshop*

| Group | Needs for item data |
|---|---|
| Item content | Descriptive and unique item name<br>Clear process for naming items<br>Unique item number<br>No missing attributes<br>More attributes also in PDM system<br>Process for updating attributes |
| Item data wholeness | Data up-to-date at all times<br>Transferring data between systems standardized<br>Prototype and production data kept apart<br>Product structure known and clear<br>Item data matches the physical product<br>Managing changes better |
| Item life cycle | Process for updating item status<br>Item status is easy to see<br>Separate item names for prototype parts<br>Old items are inactivated<br>Process for item revisioning<br>End-of-life for data defined |
| Ownership of item data | Product development team checking ERP item structure<br>Ownership of product data defined |
| Accessibility | Item data is accessible<br>Data is easy to find and to use |
| Process goals | Clear process<br>Process is followed<br>Operational effectiveness |

Table 7 summarizes the needs and idea groups of both participant groups of the workshop. There are some similarities that were found already in the interviews, such as having a clear and defined process and keeping item status up-to-date, but also some new ideas were presented, such as item data matching the physical product and having a process for updating item data attributes. These main needs will again be reflected in the MDM process definition with the other development ideas that will arise from the workshop.

### 5.2.2 Developing the processes

After the need finding, the developed process models were presented to the workshop participants as a base for the next task. As a second task for the workshop, the two groups had to develop the processes even further. The main goal of the process development was that the process will be validated and the organizational changes will be included in the

process. Some questions were given to the two groups for assistance in the thought process. The questions were about finding good parts and development ideas for the process, but also to remember to include the organizational changes and to think about the data ownership during the process development.

The two processes were handled separately in the workshop in order to keep the focus on one thing at a time. In this chapter, only the main findings, comments and changes to the process from the workshop are discussed because the process itself will be described in more detail in chapter 6.1.1.

**NEW PRODUCT MDM PROCESS**

During the development of the MDM process for a new product, several ideas and improvements came up in the workshop. Overall, the participants were satisfied with the process as the Order Management Specialist said: “It would be nice if the process would actually go something like this.” Positive feedback was given about the process as a whole and about having clear steps and plenty of process gates to guide the process. The main thoughts about data ownership were that everybody should be responsible for their own data that they are adding or editing.

Many changes were suggested to the process description itself. The workshop participants thought that some production related steps could be deleted because they were not really item data or MDM related. Additionally, at the prototyping phase the main changes regarded the supplier selection. In prototyping multiple supplier candidates should be tested and the best ones should be chosen in the end. In addition, the pricing and other negotiations with the suppliers should start already when buying the prototype parts. Related to the suppliers, it was suggested that most supplier data should only be added to the ERP system and only a few main points also to the PDM system.

Another phase that needed more changes was the 0-series production. The workshop participants proposed that the products should be added to the product configurator already before this phase so that it could be tested before production use. Moreover, there should be process gate added to the quality check of the received parts to check the satisfaction for the supplier quality. Additionally, the installation instructions should be created already before the 0-series production in order to test the assembly of the new product and no real changes to the product should be made anymore during the 0-series.

One task that was almost forgotten during the development was the impact of the organizational changes to the process. However, the participants thought that the changes had no real effect on the process expect for some team names changing, such as the Production Development team becoming the Supply Chain Development team and R&D changing to Product Development.

**PRODUCT CHANGE MDM PROCESS**

The workshop participants had quite a few ideas also concerning the second process, the MDM process for the product changes. The two processes had some similarities according to the participants. Therefore, the views on the organizational changes and data ownership were roughly the same. However, this process generated more discussion amongst the participants. Still, the process got again some positive feedback, in addition to the development ideas. Special recognition was given to the cross-function actions, checking and acceptance in the process.

Responsibilities were discussed in more detail for this process since according to the participants, the process management for changes should be handled by the supply chain development (SCD) team, but the main data responsibilities should still be kept with the product development team. Another part that was discussed in more detail was whether all teams should have a say if the change will be made or not. As a conclusion some teams, such as the logistics and customer operations teams, were taken off from the ECO process and they will only be informed about the coming changes during the process.

Some smaller changes to the process model were that the change contact person in product development should be informed already right at the beginning, the first feasibility study should be done already before the first process gate and adding the production review as the final step in the process. Some bigger additions were the adding of the quality check for prototype parts, adding the 0-series in case of a bigger change and advancing the order of production parts in the end of the process.

Once both of the two processes had been developed, the processes were validated by asking the participants if they were content with the changes and willing to follow the process once it was implemented. After confirming the validation, the organizational changes were summarized once more because it was one of the goals for the workshop.

### 5.2.3 Process ownership

As the final task in the workshop the ownership of data and especially the ownership of the whole MDM process was discussed. Three scenarios that had come up in the interviews (chapter 4.1.3) were presented to the participants. The three scenarios were as follows:

1. Product development responsible for all product related data and the process.
2. *Shared responsibility* so that everybody is responsible for their own data, but product development has control over the big picture.
3. Product function is the process owner, and each team has a data super user who is responsible for the data management of the team.

In order to discuss these scenarios and possible new options the Six Thinking Hats method was used. Six Thinking Hats is an effective systematic thinking method and decision-making tool that was developed by Dr. Edward de Bono (De Bono Thinking Systems

2018). The method was chosen because it helps to perceive the problem from different perspectives (Mind Tools Content Team 2018) and therefore make better decisions and have a more versatile discussion about the subject at hand.

The idea of the Six Thinking Hats is to separate thinking into six different categories or roles (De Bono Thinking Systems 2018; The de Bono Group 2018). Each category has its own colored symbolic "thinking hat" (The de Bono Group 2018). Because each hat symbolizes a different style of thinking (Mind Tools Content Team 2018), by wearing and changing the hats it is easy to focus or redirect thoughts based on the hat you are wearing (De Bono Thinking Systems 2018).

The white hat is realistic and calls for facts. The yellow hat symbolizes optimism and tries to find opportunities and look at the benefits. The black hat is judgmental and pessimistic. The red hat is based on feelings and emotions. The green hat symbolizes creativity and tries to look for possibilities and new ideas. Finally, the blue hat is the manager who tries to ensure that the guidelines of the Six Thinking Hats is followed. (The de Bono Group 2018)

In the workshop the Six Thinking Hats were used collectively so that all the participants were always wearing the same hat during the discussion. While wearing each hat the goal of the discussion was to find the best solution to the ownership issue based on the hat they were wearing. The researcher was the one wearing the blue hat at all times during the exercise. Even with the blue hat on, it was quite hard to keep the discussion to the point and only related to one hat at a time. The discussion results are presented in table 8 per each hat, excluding the blue hat.

***Table 8.*** *Findings from the Six Thinking Hats method*

| Color of the hat | Findings from the discussion |
|---|---|
| White | Scenario 2 is the best option because product development can't be responsible for everything and IT should not be responsible for the data. In this case the product managers should be responsible for the item data of their own product and the process for all products should be the same. |
| Red | A combination of the scenarios would be good. But before the MDM process can be implemented the roles and responsibilities inside of product development need to be defined. Only after this can MDM be thought of. |
| Black | Scenario 3 can't be implemented because one person should not have too much responsibility. Also, nothing will work unless the life cycle is considered. Maybe IT should just continue with the process ownership similar to now. |
| Yellow | Scenarios 1 or 2 could work so that product development is responsible for the life cycle management and otherwise the responsibility lies where the data is created. The one responsible for the process needs to know how to utilize the knowledge around them. |
| Green | The process ownership should be with product development and the item data ownership should be with the product manager. Despite data ownership being with the product manager everybody should be responsible for their own data. The change management should, however, be with the supply chain development team. |

After the discussion with all the different hats had been finished, it was the researcher's task to conclude the discussion and suggest a solution based on the discussion between the workshop participants. As s suggestion the researcher proposed that the governance and process ownership should lie somewhere within the product function but have one responsible person, the product managers should be the data owners for their own products and that everybody else in the organization should be data stewards. For the change process another idea was created. This was that the main project and process ownership should lie with the SCD team but otherwise the roles should stay the same.

These suggestions were well received amongst the workshop participants and therefore the suggestion was decided to be the final solution to the ownership issue. Thus, the last goal of the workshop was achieved. However, the discussion and solution from the workshop can only be a suggestion to the organization as part of this study.

# 6. DEFINING AND IMPLEMENTING THE NEW MDM MODELS

Based on the interviews held at the case organization and the further development done for example through the internal workshop the final MDM models of this study can be defined. It is, however, not enough to just define processes, but they also need to be implemented. Thus, an implementation plan for the final processes should be created.

In this chapter the final MDM process models will be discussed and evaluated (6.1). This will be done for both of the two processes: the MDM process for a new product and the process for a product change. After this the process implementation and the risks related to it will be discussed in greater detail (6.2).

## 6.1 The new MDM models

On the basis of the findings from the workshop and some best practices based on literature, the MDM processes have been developed to their final form. To ensure that these processes meet the requirements set for assessment in chapter 5.1.1, the process will also be evaluated. Both of these themes are discussed further in this chapter.

### 6.1.1 Process descriptions

The MDM processes for Framery defined in chapter 5.1.3 have been developed further through the focus group workshop, described in chapter 5.2.2, and are now defined and described again in more detail. Both process models, the MDM process for a new product and the MDM process for a product change, will be described separately, as before. Again, both process models can also be seen as swimming lane charts in the appendices.

**NEW PRODUCT MDM PROCESS**

The developed version of the MDM process model for a new product is presented as a whole in appendix F and as a summary in figure 8 below. The whole process model did not change a lot from the previous version. This can also be seen when comparing the summary figures 6 and 8.

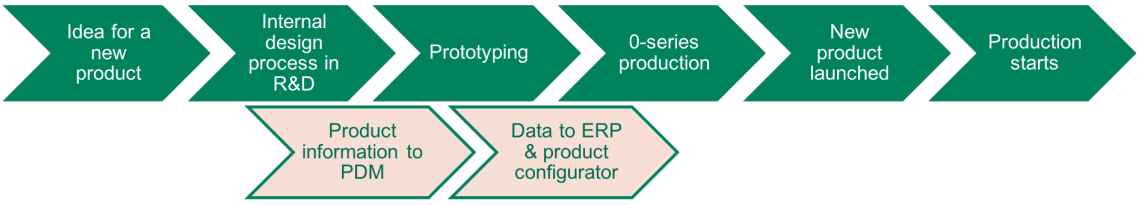


***Figure 8.*** *Summary of the developed MDM process for a new product*

At the beginning of the process, there are only a few changes and most of them were made towards the end. At the start of the process no changes were made, but still throughout the process cooperation and good communication between all teams need to be emphasized. This needs to begin already once the internal development in product development starts.

Because no changes were made, the process starts again from an idea for a new product and continues to the internal product development process. As described in chapter 5.2.3, the product managers are data owners of their own products and therefore responsible for the produced product data. The data produced by product development is stored in the PDM system and for example the item naming is guided with the system to ensure uniform naming of items.

Once the drawings are ready, the prototype part buying process can start. The first changes occur at this point since the strategic sourcing work starts at this point when the sourcing team starts the negotiations with different suppliers. In addition, the prototyping is usually done with multiple suppliers to test them. After prototyping the process continues again in the same way as in the previous version. This means that the preliminary target date for production is set and the ramp-up plan is done. After this both the supply chain development (SCD) and product development teams need to check if the product as a whole is ready for production, including the product structure and the fitness for production.

When the product and product structure are ready for production, the item names will be updated and the 0-series and production starting dates will be decided. If the suppliers or prices for parts have not yet been negotiated, these will have to be done at this stage. Once the decisions on the suppliers have been done, only the main supplier information such as the supplier name, certificates and drawings will be added to the PDM system, contrary to the previous process model version where all supplier information was added to the PDM system. When adding data into a system or editing it, all employees act as data stewards meaning that they are responsible for the data quality and they should therefore ensure the correctness of the data while editing it.

After this, all product information will be checked once more. If all information needed is available, the process can move forward. When the process moves forward, more changes have been made. The installation instructions should be created at this point and

the product contact person in product development should also be informed to all. Simultaneously, the item data and attributes will be taken to the ERP system but now the product configurator should also be updated to include the new product so that it can be tested during the 0-series production. Once the item data is in the ERP system, also all the other supplier information, such as price and delivery time, can be added to the system.

Only after all information has been added to the ERP system, can the 0-series component buying process start. In addition to the previous process model, a quality check was added to this phase. This means that once the components have been received, they will be checked by the production quality team. If the quality is not acceptable, the supplier team will negotiate quality improvements with the supplier and order a new batch of parts which will be checked again. If the quality is alright or all necessary improvements have been done, the process can again move on and the 0-series production can start.

During the 0-series production, the product sales price can be defined, and the marketing materials can be prepared, as defined in the first process model version. At the same time, the production functionality is checked and developed. Once the 0-series production is completed, product development will again check that the product is actually ready for production. If not, the product has to go back to the 0-series and development phase. However, if the product is ready, the product structure will be locked, the product configurator will be updated, and the launch plans will be finalized.

When the launch plan is ready, the new product will be launched to the market. After this, sales can start, and orders can be received by the customer operations team. Before the actual production can begin, the production parts need to be purchased, received and checked. Also, the SCD team should finalize the production starting plan. Once all of these tasks have been done the production of the new product can finally start.

The process ownership of this process was discussed in the workshop and as a result a suggestion was made. The suggestion was that the product function should be the process owner for the process of a new product.

**PRODUCT CHANGE MDM PROCESS**

The final MDM process model for a product change is presented in appendix G and a summary was also created from the main steps of this process. The summary is presented in figure 9.


***Figure 9.*** *Summary of the developed MDM process for a product change*

This process changed clearly more based on the workshop than the process for a new product. This can also be seen when comparing the summary figures 7 and 9. Firstly, the production quality team was also added to this process model (appendix G) in order to keep both processes more similar to each other. In addition, because master data should stay quite stable (Vilminko-Heikkinen & Pekkola 2013), the changes to products and therefore to the master data will have to be limited to a few times a year, meaning that the use of this process will be limited.

As in the MDM process for a new product, no changes were made right at the beginning of the process for a product change. Therefore, the process begins in the same way as in the previous version, from an impulse for a change. After this the internal planning in product development starts, a project plan is created and the weekly meetings with the multi-functional project team start. In product changes, the cooperation between teams and functions is especially important. This naturally requires good communication and due to this the contact person for the change from product development should be informed to the whole organization already at this point.

Before evaluating the need for the change, a first feasibility study is also needed. After the need evaluation, if the decision is a go, the ECO process guided by the PDM system will start as in the first process version. One change that was added to the ECO process was that not all teams have a say in whether the change will be made, and therefore they are only informed about the coming changes during this phase. The teams that will be only informed are the logistics, production quality and customer operations teams.

From the ECO process an ECO summary will be stored to the PDM system including the answers and changes done during the process. If the change decision is still a go after the ECO process, the prototype part buying can start. A quality check phase was added to the prototype part inspection similarly to the process for a new product.

A big change to the process model occurs after prototyping, since the project management is handed over to the supply chain development (SCD) team after this. After this handover, the SCD team should check the readiness for production and evaluate the need for 0-series production. If the 0-series is needed, the process will continue similarly to the 0-series phase in the process for a new product, but if no 0-series is needed due to the change being very small, a production ramp-up plan is created, and the preliminary production starting date is decided.

Once the preliminary production date has been decided and communicated the item data can be updated to the production format in the PDM system and all teams can start to make their needed changes or preparing them for the start of production as in the previous

version of the process model. At this point, it is good to remember that all employees editing master data or its attributes are acting as data stewards and should therefore pay special attention to the data quality and integrity.

After all the needed changes have been done or prepared, the employee trainings can be held, and a new product launch can be done if it is needed. Before the final production starting date can be set, the production parts need to be ordered. Once the parts are received and the starting date has been set the production for the change can finally start. Later the SCD team will evaluate once more how the production has worked for the change and if some corrections are still needed.

Although the process management changes during process for a product change the ownership of the process should stay in one place throughout the process. The best solution for the process ownership in this case would be the SCD team because they are responsible for developing the supply chain in cases such as product changes.

### 6.1.2 Evaluating the processes

Now that the processes have been defined it is time to evaluate them according to the principles defined in chapter 5.1.1. The evaluation will be done to make sure that the processes actually fit into the organization and context (Davis 2009). In table 9, presented below, all the evaluation principles and the evaluation based on them are shown.

***Table 9.*** *Evaluation of the processes*

| Evaluation principles | Evaluation |
|---|---|
| Documentation | The tasks and their sequence, recourses and the environments are defined in the models. There are no clear business objectives defined for the processes. |
| Effectiveness | The processes will guide the work of the employees and make it more effective through having a process to follow. This will then bring value to the company. MDM is an internal process and can't itself bring value to customers. |
| Efficiency | All unnecessary or duplicate steps were deleted as a result from the workshop and through the process definition. |
| Process owner | For both processes an owner has been defined. |
| Measurement | No metrics have yet been defined for the processes. |
| Relevancy | Through the process implementation operations will be standardized. |
| Validity | Processes were validated in the workshop by the employees. |
| Verification | The needs of the employees were met and confirmed again in the workshop. |
| Usability | The models describe real processes and the need for the process were known before the definition. |
| Process is used | Implementation plan still to be done. |
| Reusability | Parts of the process could be used in other process definitions in the case company. |

The previously set principles were mostly achieved very successfully which can be seen when comparing tables 4 and 9. However, the business objectives for the processes could be defined more clearly and metrics will have to be formed to measure the process in the future. Because MDM has not been implemented yet in the case organization it is hard to evaluate all aspects of the process definitions in an objective way.

All in all, as Trikman (2010) said, the success of a process relies on three aspects: fitness of the process into the business environment, continuous improvement and fitness between the process and technology. These were not part of the evaluation principles because these can be properly evaluated only after the process has been taken into use.

## 6.2 Process implementation

The implementation of a process is a very important phase of putting a new process into practice. Therefore, special attention needs to be paid to planning and preparing an implementation project for a process. An MDM process implementation is quite tricky because it requires for example disciplines, procedures, methods and individuals (Silvola et al. 2011).

In this chapter, the implementation plan created based on literature and the interviews is described (6.2.1). In addition, some risks related to MDM implementation were found and therefore these are also discussed in this chapter (6.2.2).

### 6.2.1 Implementation plan

In the interviews, also ideas about the process implementation were asked. These results and findings from literature about MDM process implementation are presented in this chapter. According to Radcliffe (2007) a process implementation should be done step-by-step so that value can be delivered at every stage. This will help in committing employees to the new process because they will not get so frustrated during the implementation.

An MDM implementation requires always organizational changes on some level, and therefore, it is very important to have a good and clear implementation plan (Vilminko-Heikkinen & Pekkola 2017). Because the idea of an MDM process model is to model the work of business units, the process also needs to be implemented into these business units (Otto 2012). In order to understand the needs of the business side during the implementation, a multidisciplinary implementation team is needed for MDM (Joshi 2007). Due to the organizational changes, also change management is required during a process implementation to minimize resistance to change (Vilminko-Heikkinen & Pekkola 2013).

One of the key aspects during a process implementation is good and constant communication. This was also one of the features mentioned by most of the interviewees. It is very important to communicate all the benefits of the new process (CIO) and try to make the employees understand the reasons behind the coming changes and the effects they will

have on each team (Strategic Buyer 1 &Technical Documentation Specialist). Also, it is essential to get the employees to understand the importance of the new processes because this will help in adjusting to the new way of working. Another feature that will help in the adjustment and change resistance is listening. All the worries of the employees should be heard and dealt with. (CIO)

Another element that was mentioned by many interviewees was the importance of training during the MDM implementation. Training is important to get a unified understanding of master data throughout the organization (Vilminko-Heikkinen & Pekkola 2013). According to the Order Management Specialist and the Strategic Buyer 2, team specific training should be held so that questions can be asked more easily. The importance of data quality, also, needs to be paid attention to during the training (Vilminko-Heikkinen & Pekkola 2013).

The maintenance management of MDM also need to be considered and planned during the implementation phase (Joshi 2007). Further development and adjustments will surely come during the life cycle of the process and a procedure needs to be in place for that. The maintenance plan for master data needs to include areas such as responsibilities, methods, guidelines and instructions for users (Vilminko-Heikkinen & Pekkola 2013).

Because quality is the most important aspect of master data, a process is also needed for maintaining its quality (Radcliffe 2007). Therefore, a continuous data quality program should be set in place additionally to the maintenance process (Silvola et al. 2011). To ensure good quality from the start, the importance of quality and the responsibility of all employees needs to be stressed during the implementation training because the lack of data quality has such wide effects on the whole business (CIO).

The goal of the implementation is for all employees to get a better understanding of the whole company and the needs of the others. This will then hopefully ensure good quality data throughout the MDM process and the master data life cycle (Technical Documentation Specialist). In order to maximize the possibility for success, risks related to the implementation also need to be identified and then minimized.

### 6.2.2 The challenges of implementation

In line with the literature (Davis 2009), the Technical Documentation Specialist also mentioned: “A process should always be based on a real and specific need or lack of a process.” If this is not considered during the process development and implementation, or the process is only created because of the need for processes, it is doomed to fail. Many similar challenges related to a process implementation need to be considered when planning the implementation.

If the need for the change is not understood by the employees that have to work according to the process, they will most likely just return back to the old ways because it is easier (IT and Production System Specialist). This is one example of change resistance, which

is one of the biggest challenges when it comes to process implementation (CIO). Resistance is caused for example by insufficient training (Haug & Arlbjørn 2011).

Although attempts to prevent change resistance should be made, resistance should still be accepted because it is very common, and it is part of the adjustment to the new way of working (CIO). Such resistance will decrease once the employees get used to the process and see the benefits from it. According to the Sales Development Trainee, a process should never complicate or slow down work because then that would mean decrease in efficiency and also increase change resistance.

Another risk related to MDM implementation at Framery is that the item data is already located in multiple systems and therefore its quality cannot be taken for granted. However, through the new system implementations (PDM and WMS) even more systems will be handling the master data in the future and therefore the quality improvements should be made before the new systems implementations.

# 7. DISCUSSION

In this chapter the theoretical and empirical part of this study will be compared (7.1). In addition, the implications of this study and the main n lessons learned in the case organization will be discussed in more detail (7.2).

## 7.1 Comparison to literature

In the literature there are no clear models or instructions found on how an MDM process should proceed or be established, because MDM and its processes are always very case and organization specific (Otto 2012). Therefore, it was hard to find any clear references or best practices for MDM in literature that could be compared to the models created in this study. Nevertheless, there are some guides found on how to conduct an MDM initiative (e.g. Radcliffe 2007; Vilminko-Heikkinen & Pekkola 2013) or handle MDM governance (e.g. Joshi 2007). Three related models were also presented in chapter 2.4.

Because MDM is such a challenging and complex concept, it is good to start an MDM initiative with smaller segments depending on the business (Snow 2008). This will ensure success much faster and is also easier for the management level to accept. Because the case organization is a manufacturing company, the MDM establishment was started from product, and more specifically item master data, which made the most sense for the case organization.

One part that is clear in literature, however, is that steps, roles, responsibilities and ownership should always be defined in an MDM process model (McGilvray 2006). Thus, these were paid special attention to when defining the processes of this study. One reason behind the need for defining and developing these processes was that changes were made to master data constantly. As found in literature, master data should be kept stable and changes to it should not be done very often. Therefore, this was one improvement point for the new process implementation, namely improving the stability of master data by limiting the item data changes only to a few times a year.

The process development was started in this study by investigating the needs and wants of people through interviews because an MDM initiative should always start by understanding the needs of different stakeholders in the case organization (Vilminko-Heikkinen and Pekkola 2013). Due to the importance of finding out about the needs and requirements, this phase was repeated also in the focus group workshop of this study. The workshop was also organized because the understanding of the big picture of the MDM process requires cooperation between different teams and functions (Silvola et al. 2011).

Once the main needs have been defined, it is important to engage and involve the organization in the development process (Vilminko-Heikkinen & Pekkola 2017). The main

purpose of committing people to the initiative is to ensure that MDM becomes a part of daily operations in the organization (Vilminko-Heikkinen & Pekkola 2013). One of the key aspects at this stage, in order to ensure the success and good quality MDM, is that the management level supports the initiative and is committed to it (Haug & Arlbjørn 2011; Silvola et al. 2011; Vilminko-Heikkinen & Pekkola 2017). This was not an issue in the case organization, since the CIO is the one who gave the assignment of defining and developing the product MDM process.

For an MDM initiative to be successful cooperation between different teams and functions in the organization is required (Vilminko-Heikkinen & Pekkola 2017). This means that also the business side should be involved in the process already in the development phase (Vilminko-Heikkinen & Pekkola 2013). Due to this, people, especially the ones that will be affected by the changes, were involved with the MDM initiative from the beginning also in this study for example through the interviews and the workshop.

Another purpose of the workshop was to achieve a consensus of the objectives amongst the business people (Vilminko-Heikkinen & Pekkola 2017) by discussing MDM and its process. To achieve the consensus, conflicting views and ideas will have to be solved between the different teams, which requires discussion (Fisher 2007). All in all, good communication is very important and is required to enable cooperation during the development process (Vilminko-Heikkinen & Pekkola 2017). This was maybe not paid enough attention to during this study although all the main phases were communicated to the stakeholders during the development process.

In order to be able to manage master data, data silos need to be dismantled (Smith & McKeen 2008). In the case organization, no clear data silos have been formed yet but it is important to make sure that they will never be formed. To ensure this, MDM is needed. During the new PDM system implementation the product master data will be modelled, and attributes will be defined at the case organization because according to Silvola et al. (2011) these are the requirements for good quality master data. Fixing these deficiencies at an early point of the master data life cycle will most likely only result in some additional costs and the major effects of poor data quality might be avoided (Haug & Arlbjørn 2011).

According to Smith & McKeen (2008) good quality data is reusable, easy to use and to find. The latter two were considered in the developed MDM process models in this study, but the reuse of data could have been discussed more. To ensure good quality data the use and understanding of master data needs to be unambiguous throughout the organization (Otto 2012). In addition, following the process is crucial for have successful MDM and to be able to manage data in the same way across the organization. Because of this the process description needs to be explicit and unambiguous. This part was tackled in this study by making sure that the process model was defined precisely including the sources and users of data. Also, the process implementation will be done very carefully making sure that all employees are trained accordingly.

In the case organization, no clear data governance procedures have previously been in place either meaning that data has not been managed as a resource (McGilvray 2006). However, this will change once the new MDM model is implemented in the organization. Data governance requires both IT and business perspectives and therefore should be done in cooperation with the two sides (Moss 2007), as the MDM process definition has been done. Business people are usually the data owners and stewards, and the IT team takes care of data administration (Moss 2007). This was also pictured in the MDM process model developed in this study.

The roles and responsibilities are not so easy to describe in a process model but still, according to Silvola et al. (2011) and Vilminko-Heikkinen & Pekkola (2017), they should always be defined. The definition is very important because, as mentioned in chapter 2.2.3, the lack of defined ownership, roles and responsibilities are quality barriers for MDM (Haug & Arlbjørn 2011). The ownership and roles were discussed in the workshop part of this study and a tentative decision about the division of ownership was made: the MDM process ownership should lie somewhere within the product function; the product managers should be the data owners for their own products; and all other employees should be data stewards. While dividing the ownership, it was clarified that the IT team cannot be the process owner because the process owner should always come from the business side of the organization (Radcliffe 2007; Smith & McKeen 2008).

According to Cleven & Wortmann (2010) "there is not a 'one-size-fits-all' approach for implementing MDM" and therefore the process should be defined to suite the organization in question, as this study has done for the case organization through the inductive approach. One main part when defining a process model is that the description should not be too vague (Silvola et al. 2011). Because of this the developed models in this study are described in as much detail as possible while at the same time keeping them as simple as possible without any unnecessary steps (Smith & McKeen 2008). In the end, the process model should describe where the data is created, stored and used (Cleven & Wortmann 2010; Silvola et al. 2011) as well as how it is shared (Silvola et al. 2011) and in which systems it is (Vilminko-Heikkinen & Pekkola 2013). In this study, these steps were improved between the two iterations of developing the MDM process models in this study.

In addition to having a standardized process it is good to have a standardized way of creating and using the item data in the process. This will be implemented with the new PDM system enabling unified terms and concepts (Vilminko-Heikkinen & Pekkola 2017). To achieve this, data standards need to be defined meaning that the item data content will have to be modelled at the attribute level and as any master data the item data has to be stabilized (Vilminko-Heikkinen & Pekkola 2013). In addition, the item naming process will be standardized through the new PDM system implementation. According to Moss (2007), the item names should be unique and consist of three parts: the prime, qualifier and class words. These will be taken into consideration with the PDM implementation and then executed through the defined MDM processes.

From the literature models introduced in chapter 2.4 the steps for establishing MDM were mostly already discussed above and most of the steps were actually followed in the MDM process development of this study despite the inductive approach. However, the missing roadmap for further MDM development will have to be created for the case organization during the process implementation project at the latest.

The seven building blocks were not really used in this study. However, to ensure the success of the MDM implementation in the case organization a clear MDM vision is still needed. A strategy has been set through the goals and the research approach but not clearly communicated in the case organization. The governance and organization have been developed through this study but will be implemented together with the process implementations. The main goal of this study was to define and develop the MDM process, so this block has certainly been fulfilled. Also, the technological choices have been made. Still, the seventh block needs to be developed during the process implementation in order to measure the success of the process implementation.

From the four MDM strategies developed by Cleven & Wortmann (2010) the best suited for this study and the case organization would be the process-driven and problem-oriented strategy. This would be the right option because it also considers the business perspective which has been lacking at the case organization but also the most issues in the case organization are process and operations related which can be solved by choosing this MDM strategy.

## 7.2 Case organization point of view

All in all, this study has been very important and eye opening for the case organization. The Supply Chain Manager told the researcher (10th of December) that the research topic is really important for the company and should actually be a strategic level project. Therefore, he suggested that the results should be presented to the supply chain management level once the study is finished.

One of the main benefits of this study for the case organization has been that the issues have now been recognized and have been raised on the table. This study alone will not solve all the issues and challenges found, but at least it is a start towards further development. Another good part is that internal communication has improved during the process development and thus the big picture of data management has become more visible to the whole organization. The process models developed in this study cannot be used for other processes or master data types because they were specifically designed to suit the needs of item master data. However, some parts of the models could be used as a basis when developing processes for the other master data types in the case organization.

The main issue in the case organization that was discovered during this study is that the product management itself might be the root cause to many of the problems and not only

the management of product master data. This is because data is always related to its physical counterparts, in this case the actual physical products. One issue is that the product function is still trying to work like a small company: in a very agile way, at a fast pace and constantly driving for new ideas. However, this is not possible anymore with the size the company has grown into. Now processes are needed to support daily operations. Therefore, many of the issues found in this study could actually be solved though the improvement of product management. Nevertheless, some steps have been taken towards this direction through the organizational change by which the management structures of the product function have been strengthened.

While developing the empirical MDM processes of this study for the case organization, the focus was very much on the process definition and not that much on MDM in general. This was because the main goal for this study and the greatest need of the case organizations was the process definition due to the fact that no MDM processes had been defined before. The absence of actual defined legacy processes made the definition work of this study quite laborious because there were no ready-made models to start from. However, this made it possible to start the work from a clean slate. In addition, committing employees to the new process was easier because the needs of the employees were actually hear for the first time. On the other hand, defining a master data governance system for the case organization is much easier when there is no legacy for this.

As mentioned previously, data or at least master data is always related to something physical. Due to this, master data management cannot be developed on its own without taking its surrounding and related processes into consideration. The item data management processes affect and are affected by at least the internal processes in product development, some processes in the supply chain and many data related processes throughout the case organization. Due to these the processes in an organization should be developed together as a whole although implementing the changes should be done gradually to limit complications and change resistance.

Once the processes of this study have been implemented in the case organization simultaneously with the PDM implementation, the work with master data has to continue. Through the established data governance, item data will be kept in good shape, but other initiatives will most likely also be started. There has already been some discussion about developing MDM at least for customer master data as well.

# 8. CONCLUSION

This chapter concludes the present case study research. As the first conclusion the objectives are discussed and how the research questions have been answered in this study (8.1). After this an overview of the findings is presented (8.2) and in the end possible future research topics are suggested and reviewed (8.3).

The research process of this study went mostly as planned before in the research plan. The schedule expanded a little bit due to the growing amount of daily assignments while working in the case organization. The most challenges in the process were caused by the broadness of the chosen research topic and the large number of issues found in the case organization. Due to these the big picture was quite hard to form. Also, the unexpected organizational change during the research process caused the researcher to take a step back from the research and having to look at it from another perspective. In the end, the objectives set by the case organization were met through this study, as discussed in the next chapter.

## 8.1 Meeting the objectives

The main goal of this study was to develop a product MDM process model for the case organization. Since this was the core of this study and all findings are based on it, it is justified to say that this goal was met through the conducted study. The MDM process has been developed, described, validated and iterated during the process of this study. In the actual process model the life cycle of item master data is described until the start of production in a continuous way picturing the responsibilities and the creation, modification and using of the data. The process definition was done in an explicit way but still leaving out all unnecessary steps.

Another goal for this study was to create an implementation plan for the developed MDM process. This has been presented in chapter 6.2 where the main aspects to consider during the implementation of the MDM process were discussed. In addition, some discovered risks related to the implementation were reviewed. The final goal was to commit the employees to the new process. This was done by involving them in the process development through the interviews and the focus group workshop but also discussing the development openly. Another action point on this was that the processes were developed based on the actual needs of the employees. In addition, the division of ownership and responsibilities were decided in the workshop (5.2.3) and agreed upon by the employees.

In addition to meeting the set goals, the validity of this study can be assessed based on how the set research questions were answered in this study. The research questions were presented in chapter 1.3 and were defined based on the objectives set by the case organization and the findings from previous research. In order to meet the challenges related to

master data they first have to be discovered and defined. In this study, this was done through the interviews and revisited during the workshop. Based on the discovered challenges the process models for MDM could be created with the idea of overcoming the discovered challenges such as having too many changes to master data too often and the ownership for the process or data not being defined. The processes developed were also validated in the workshop and more ideas for improvement were gathered to create the final MDM process models. The main point throughout this process development was to consult the different stakeholders regarding their needs and issues in their daily work in order to be able to answer these needs through this study.

As discussed in the literature, the process ownership should always lie within the business side of an organization. This was strictly followed as the ownership and roles were defined for the MDM processes. The ideas for these were gathered from the interviews and discussed again in the workshop where a decision regarding the ownership was also made. In addition, some models related to MDM and its process development could be found in literature (chapter 2.4) but they were not really used during the process development of this study due to the inductive research approach. However, as discussed in chapter 7.1 the discovered models did actually not vary a lot from the process definition process conducted for this study or the created model.

The second main question regarded the development of the MDM process model more specifically. As mentioned above, some models related to MDM establishment could be found in the literature but in this study the MDM models were created based on the data gathered with qualitative research methods in order to answer to real issues and to fulfill the specific needs of the case organization. But in the end the development process of this study was not that different from the steps defined by Vilminko-Heikkinen & Pekkola (2013), which were discussed in chapter 2.4.

The commitment of employees to MDM is extremely important to minimize change resistance and to make MDM a part of daily operations in an organization. Therefore, this was set as one of the research questions. The commitment was mainly done by including the stakeholders in the development and by creating the process with a need-based strategy which can improve the commitment. After the development of the processes an implementation plan was created for them in chapter 6.2.1. The main findings from the plan were that communication and training need to be emphasized during a process implementation. Finally, the effects of the developed MDM process were discussed in chapter 7.2. This was an important part to consider due to data always being affected and affecting the physical aspects around it and other processes operating around it as well.

To assess the reliability of this study, the analysis carried out can be evaluated and the replicability should be discussed. Reliability is always a question when making qualitative research because it might not be replicable due to the specific time and context the study has been conducted in. However, in this study one aspect increasing the reliability is that the interviews were conducted based on the interview structure (seen appendix A). Despite the inconsistencies of semi-structured interviews, a deeper and broader view of

the case organization could be formed through the more fruitful and open discussion with the interviewees. In addition, participant observation and a focus group workshop are complicated methods to repeat in exactly the same manner.

While assessing this study, some criticism should be made on the chosen research methods and their application. The interview themes could have been sent to the participants beforehand to ensure that all interviewees had answers to the questions. However, not sending the questions resulted in more spontaneous and honest answers. The issue with participant observation is that taking notes and documenting the process is quite challenging. Still, the main point of the observation was to understand the case organization better and this study did succeed in that. Finally, the focus group workshop did not really go as planned in all respects, such as the six thinking hats method where the discussion ended up being quite unstructured due to the lack of using the blue hat by the researcher. Despite these issues the results from the discussion were better than expected and in the end a decision could be made on the data and process ownership, which were the actual goals.

Some other challenges that had to be faced during this study where the organizational change and the MDM process being divided into two processes. The organizational change did not, in fact, fit the cross-sectional time horizon chosen for this study and therefore it was actually executed based on two cross-sectional snapshots, before the organizational change and after it. In the end, the two parts did not differ that much from each other. Then, a positive aspect to discuss is the division of product MDM in the case organization into two processes in this study. They were divided due to the many differences and the specific issues in the product changes. Still, if the MDM process had been described in a more general and vague way, it probably could have been described in one process. In this study, this would, however, not have made sense because MDM should always be described explicitly to be able to follow the process.

In the end, not enough emphasis was paid to MDM as a whole or the governance of master data. The MDM development in the case organization was mostly discussed through the process model definitions and the other aspects of MDM were only mentioned as part of the process model. However, due to the needs of the case organizations the focus of this study was kept on the development of the processes. Still, for example, data and process ownership were discussed in a detailed way, because they are important aspects of MDM.

## 8.2 Overview of the study

The main achievement of this study has been the development of the product MDM process models for the case organization. This was both an answer to set research questions and the desired result of the main goal set by the case organization for the study. Despite being able to answer the set targets, all discovered issues cannot be solved by this study alone. Still a lot of work and further development is needed at the case organization both regarding the item master data and product management, but also other master data types should be worked out and management procedures should be set up for them.

In the past the operations in the case organization were very function oriented and the business point-of-view and big picture had many times been forgotten. Therefore, one achievement of this study has been that the big picture is seen better, and the company has been considered as a whole during the process development process. However, there is a need to focus more on the business as a whole when reorganizing other processes in the organization as well. This means that the affected and related functions should always be included in the development process. Through these improvements, it is actually possible to create a customer and product centric business which was the goal mentioned by the CEO in the organizational change announcement.

One key finding of this study has been that all issues do not come from issues with data and data management but also from product management and the mind sets of people. Therefore, all issues cannot be solved through data management, but actions are required also from the product function. Nevertheless, this study has been a good start in changing the mind sets and to start the development towards a more functional, stable and standardized future for the case organization.

The implications of this study are mostly practical in the field of MDM research. This study is a case example of how to develop MDM for an organization with an inductive approach and through qualitative research methods carried out in one case organization. The literature review worked mostly as a background for understanding the subject better and as a basis for creating the research questions even though the actual literature findings were not used in the empirical part of this study.

## 8.3 Future research

MDM has already been researched quite extensively in different contexts but there are still some topics that could be researched more. First, despite the processes of this study being developed for a certain organization and to meet its specific requirements, the models could be tested in another, similar manufacturing company to validate the processes in a more general way. This could create comparable data, which might be interesting for future research as well.

The MDM models created in this study could be generalized more by creating a questionnaire study on the basis of the interview structure questions. This way more data could be gathered even from multiple organizations. The results from the study could be more general and universal than the findings from this study done in one organization.

In the case organization, more research regarding MDM could also be conducted. For example, the three literature models presented in chapter 2.4 could be tested in an inductive study when starting MDM initiatives for other types of master data. In addition, some parts of the models created in this study could be used when creating new MDM models

for the case organization. In addition, other processes could be developed through different research methods in the case organization because not many other processes have been defined yet.

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# APPENDIX A: INTERVIEW STRUCTURE

**Background questions**

- Is master data familiar as a concept?
- Do you use data in your daily work?

**The current state in the organization**

1. How does the product MDM process currently proceed in your opinion?
    a. Who are enriching data? At what point?
    b. Who are handling and using master data during the process?
    c. Are there some instructions related to the process?
    d. What is the role of your team in the process?

2. How is product master data / item data visible in you work?

3. How do different teams participate in the MDM process?
    a. What data do you receive from other teams?
    b. What data are you giving to other teams?
    c. How is master data affecting them?

4. Does the current process / do the current operations function properly in your opinion?
    a. Why / Why not?

5. How does the product change process proceed currently?
    a. What phases are there in the process?
    b. Who is informed? How?

6. What challenges / problems are there in the current operations or ways of working related to MDM?

7. How are the responsibilities related to data demerged currently?
    a. Who is responsible for data in your team / other teams?

**Need finding and setting a target situation**

1. How should the MDM process be developed in your opinion?
    a. How can the challenges be met?

2. How should the MDM process look like in your opinion?
    a. Who are enriching data? Should it be changed from the current state?
    b. How should the life cycle management be developed?

3. What should the role or your team be in the future?
    a. What data do you need from other teams during the process?

4. What challenges is PDM pro system going to overcome for you team?

5. What challenges is WMS going to overcome related to item data management?

6. What needs / requirements does your teams have related to product master data or its management process?
    a. What kind of data? When do you need it?

7. What needs do you think other teams have related to master data or MDM?
    a. What data do they require from your team?

8. Who should have the responsibility / ownership over the data at each phase or the MDM process? (management, quality, enrichment)

9. How should the implementation of the new process be done?
    a. What risks are there related to the new process?
    b. What needs to be considered during the implementation?

# APPENDIX B: RESEARCH DIARY

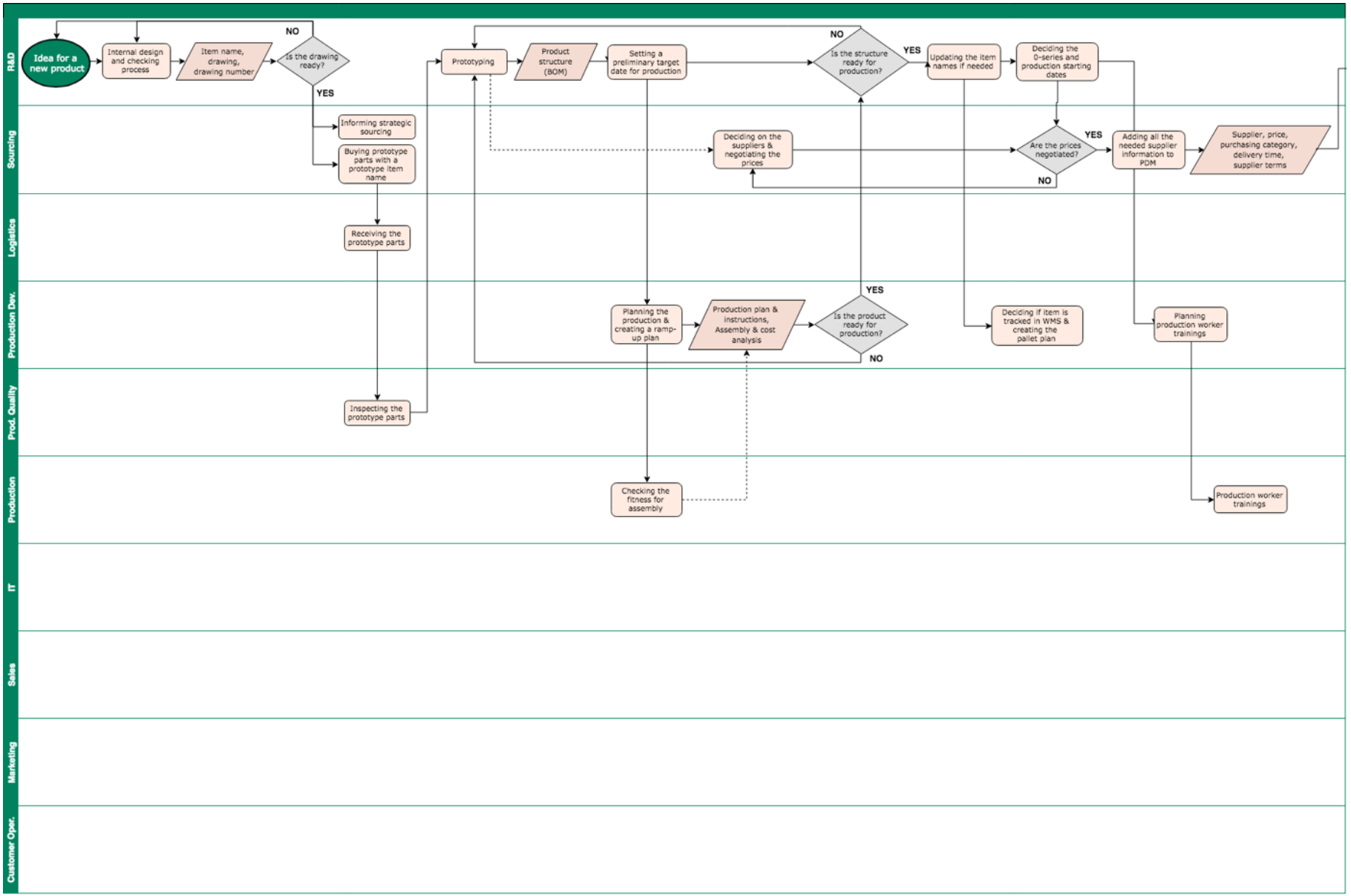
| Date | Participant(s) | Purpose of meeting / discussion |
|---|---|---|
| 14th of May 2018 | CIO, Technical Application Specialist 1, Production Development Engineer, Software Providers | Overlook of WMS project |
| 15th of May 2018 | CIO, IT and Production System Specialist, Product Manager, Technical Documentation Specialist | PDM pro introduction for IT team |
| 22nd of May 2018 | Customer Service and Delivery Director, Head of Supply Chain, Order Management Specialist, Production Development Manager, Strategic Buyer, Technical Documentation Specialist | PDM pro kick-off meeting |
| 11th of June 2018 | CIO | Discussion about the study subject and its meaning |
| 21st of June 2018 | Technical Documentation Specialist | Interview |
| 27th of June 2018 | CIO | Interview |
| 5th of July 2018 | Order Management Specialist | Interview |
| 5th of July 2018 | Technical Product Manager | Interview |
| 6th of July 2018 | Production Development Engineer | Interview |
| 6th of July 2018 | IT and Production System Specialist | Interview |
| 6th of July 2018 | Strategic Buyer 1 | Interview |
| 6th of July 2018 | Strategic Buyer 2 | Interview |
| 18th of July 2018 | D&CR Trainee | Discussion about the study subject |
| 19th of July 2018 | CIO, IT and Production System Specialist, Technical Documentation Specialist | PDM pro status meeting with IT team |
| 20th of July 2018 | Sales Development Trainee | Interview |
| 25th of July 2018 | Product Manager, Technical Documentation Specialist | Meeting about the item names in the PDM pro system |
| 1st of August 2018 | Buyer 1, Buyer 2, CIO, Sourcing Director, Technical Application Specialist 2 | Status update meeting about the sourcing applications |
| 3rd of August 2018 | CIO, IT and Production System Specialist | Discussion about the study subject |
| 6th of August 2018 | CIO, IT and Production System Specialist, Production Development Engineer, Technical Application Specialist 1 | Meeting about WMS implementation |
| 9th of August | Whole organization | Announcement about the organizational change |
| 31st of October | List visible in table 3 | Focus group workshop |

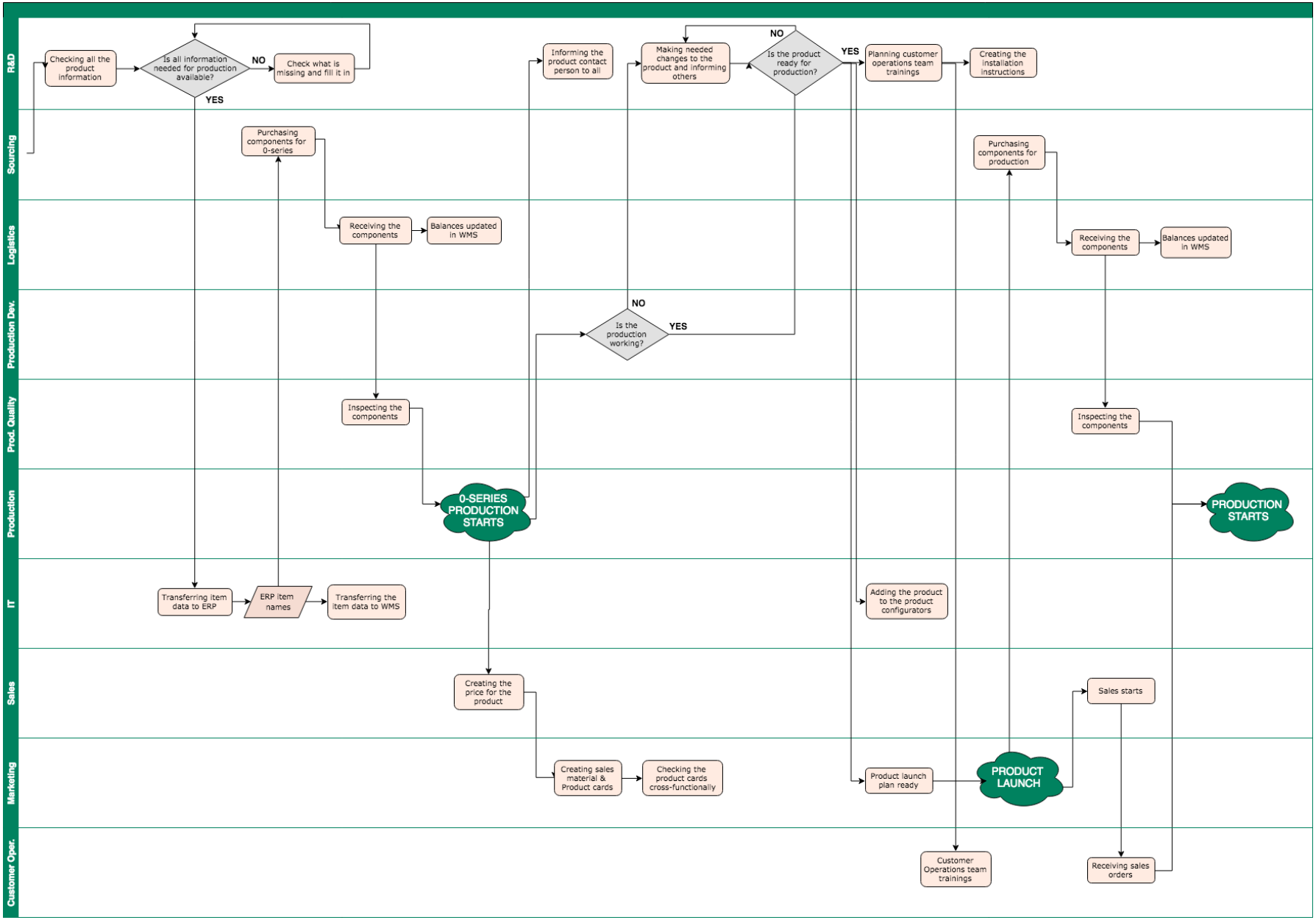
# APPENDIX C: SUMMARY OF THE MAIN CHALLENGES IN MDM FOUND IN THE INTERVIEWS

| Challenge category | Challenge | Effects |
|---|---|---|
| Process | Process not defined.<br>Forgetting about data management.<br>Unexperienced employees.<br>Not seeing the big picture.<br>Lack of internal communication.<br>Mindsets.<br>New items on a weekly basis.<br>Item status not tracked.<br>Memory based processes. | Busy schedules of employees.<br>Powering through busy times.<br>Loss.<br>Incorrect item stock balances.<br>Manual work.<br>Personification of data management.<br>No process for item revisions.<br>Product structure not always known. |
| Accessibility | Everybody doesn't have access to all systems or data.<br>Data is hard to find.<br>R&D department is not sharing enough information.<br>All data is not stored in the same place. | Need to transfer data for one system to another where data is accessible.<br>Hard to find needed data.<br>Managing the big picture of data is difficult. |
| IT systems | Lack of correct tools.<br>All systems not integrated.<br>Data not moving automatically between systems.<br>No process for managing data in the ERP system. | Transferring data between systems manually.<br>Finding data is time-consuming.<br>Product structures not known.<br>Manual work.<br>Data reliability.<br>Errors in stock balances. |
| Products | Products launched though not completed.<br>Too tight design schedules.<br>No process for revisions.<br>No practice for communication with suppliers. | Additional work in IT and production.<br>Incomplete products in production.<br>Constant data updates or changes to the ERP system.<br>Old product structures not known. |
| Data ownership | Amount of data large in the ERP system.<br>Data ownership unclear and not defined.<br>Ownership of data personified in IT.<br>Responsibility spread out.<br>Data related roles unclear. | Item status not known or updated.<br>Conflicting ides of ownership.<br>Unclear who should add, update and manage data.<br>Not all needed data is added or kept up-to-date. |
| Product changes | Product changes and updates coming too often.<br>No clear project plans or processes.<br>Big picture of effects not seen.<br>Official change announcement only after implementation.<br>Information about changes available but hard to find.<br>Employees too inactive in searching for information. | Insufficient communication.<br>Sourcing team included too late.<br>No time to negotiate with suppliers.<br>Change requests coming to different teams on short notice.<br>Production date decided too late.<br>Adjusting to constant changes.<br>Not enough information shared.<br>Teams don't have time to prepare for changes. |

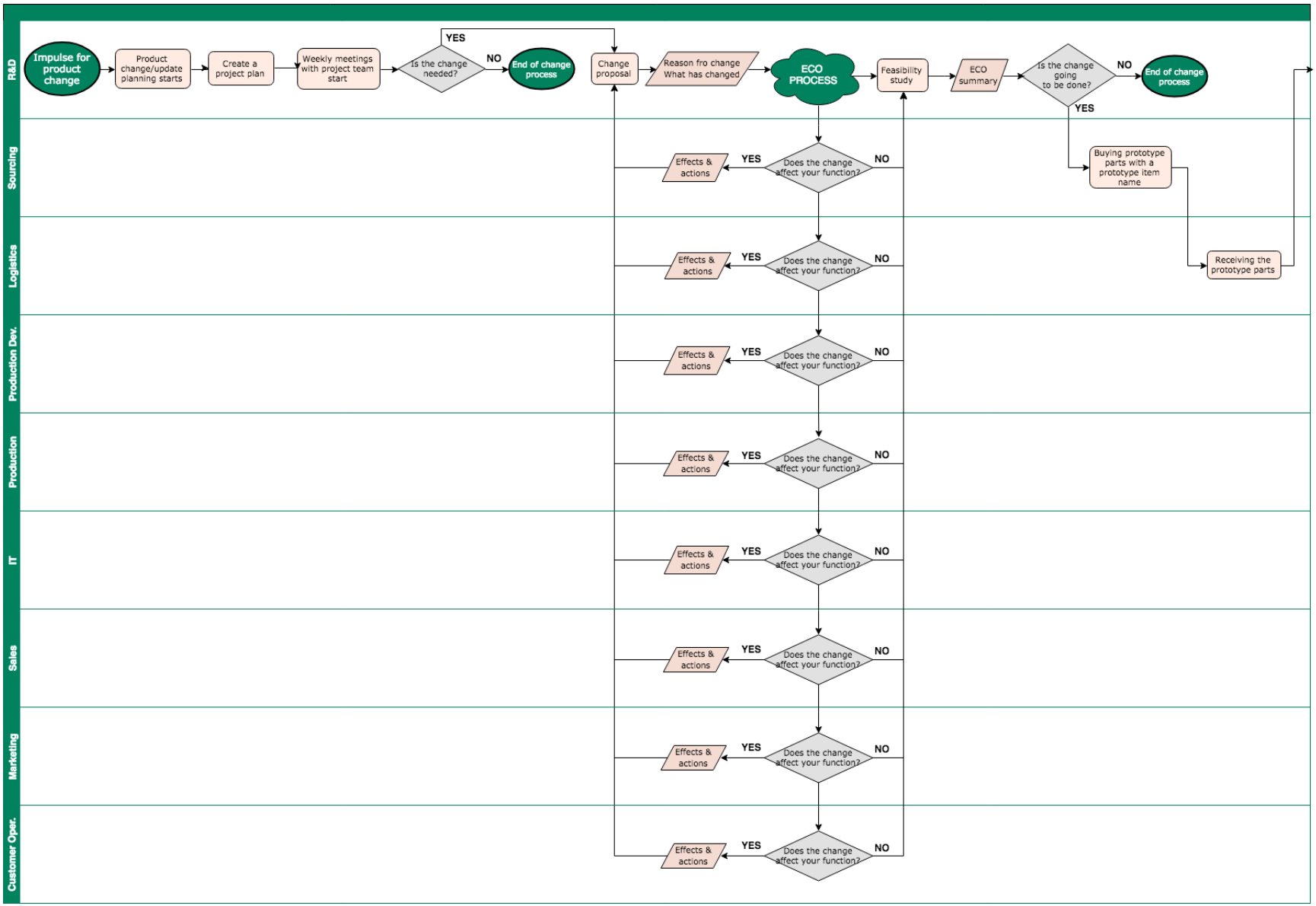
| | | |
|---|---|---|
| | No visibility to why the change process has started.<br>No practice for supplier communication.<br>Short time-line and tight schedule for changes.<br>ERP system inflexible with changes.<br>No process for revisions.<br>Big changes from small problems. | Information available only to those who know where to find it.<br>Confused suppliers because not all changes are communicated.<br>Employees are not able to do their work properly.<br>Need to stay alert at all times.<br>Data not ready for production.<br>Scheduling is hard without information.<br>Data not always up-to-date. |

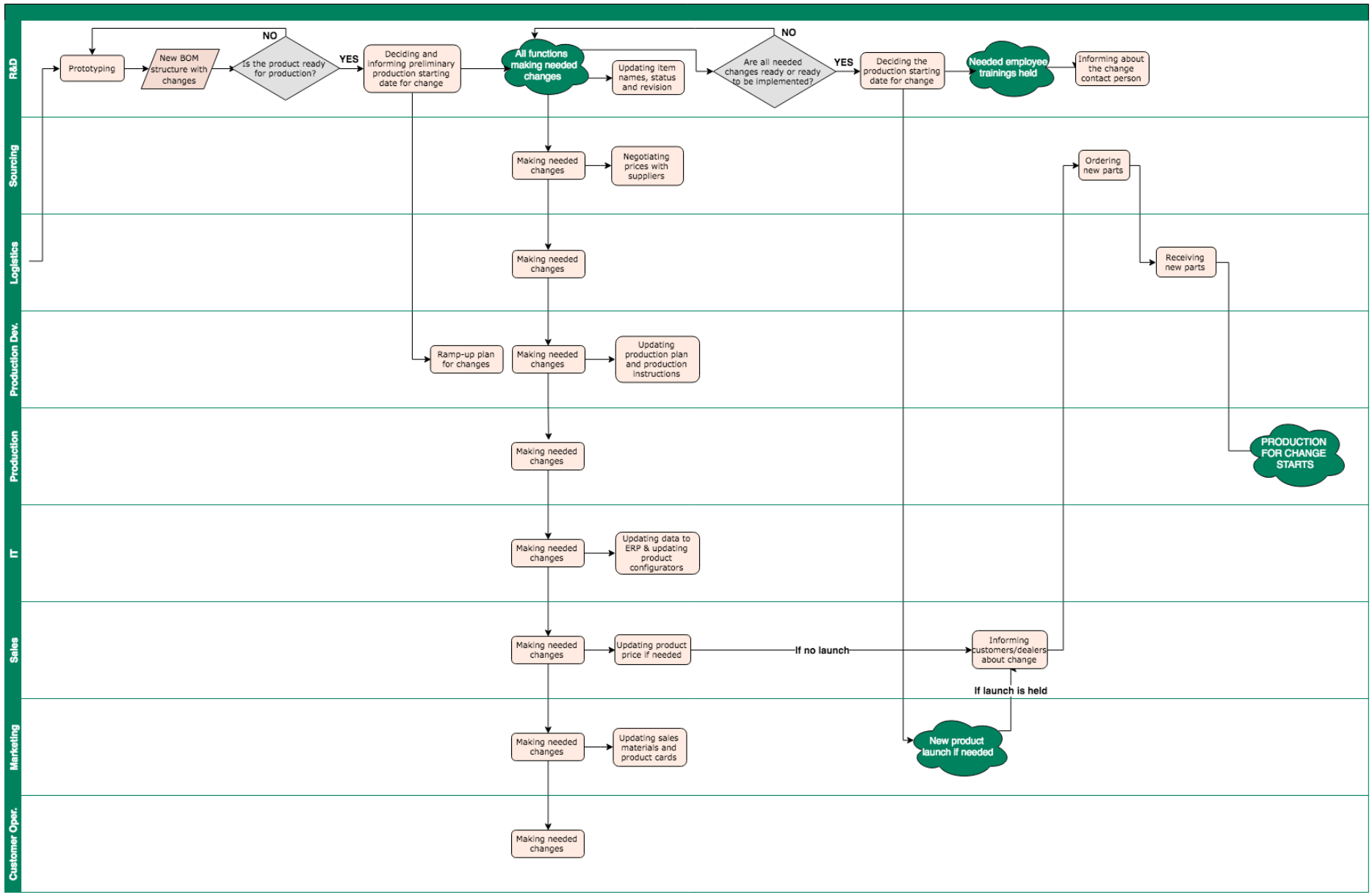
# APPENDIX D: EMPIRICAL PROCESS MODEL FOR A NEW PRODUCT



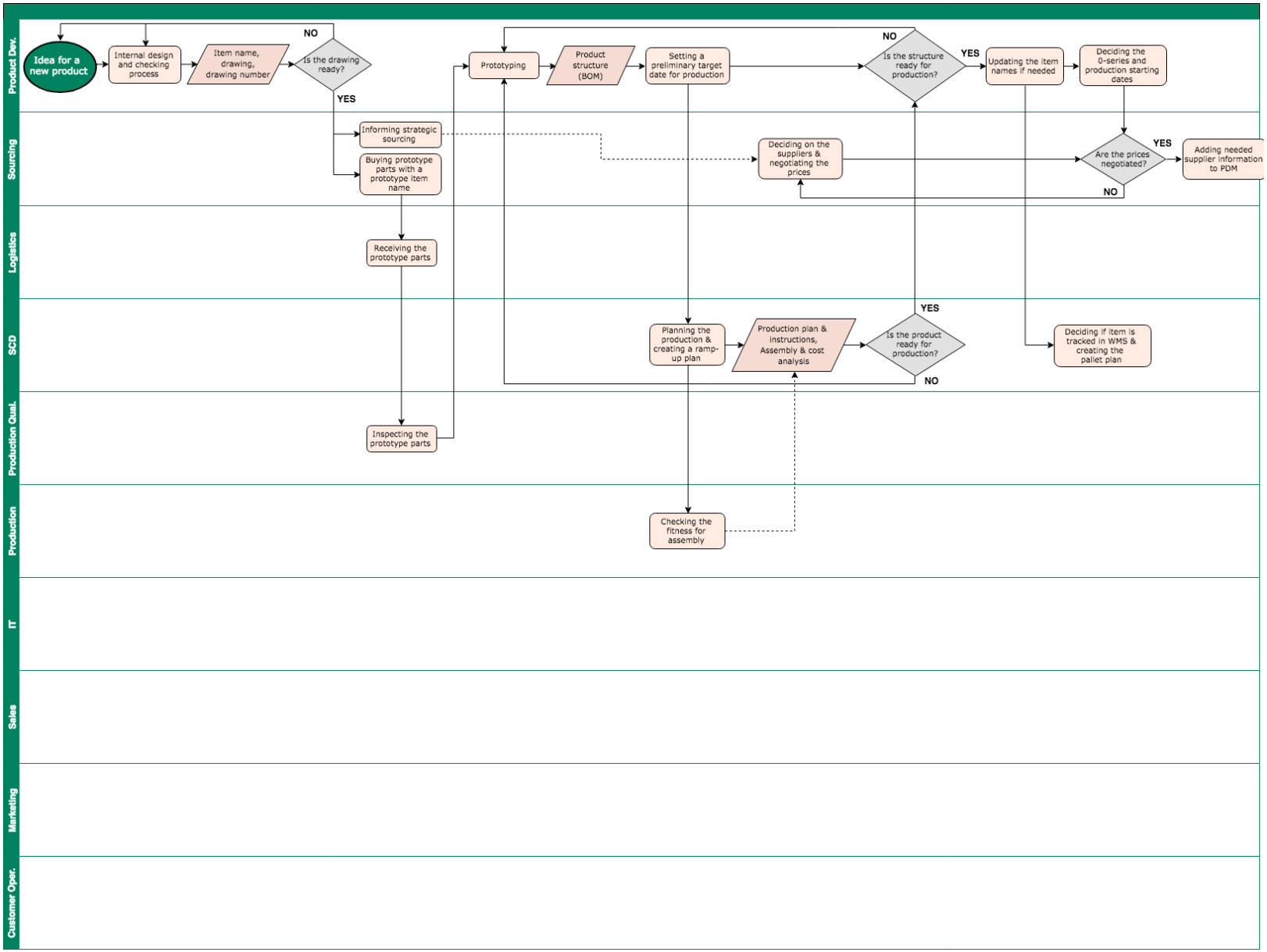

R&D
Sourcing
Logistics
Production Dev.
Prod. Quality
Production
IT
Sales
Marketing
Customer Oper.
Checking all the product information
Is all information needed for production available?
NO
YES
Check what is missing and fill it in
Informing the product contact person to all
Making needed changes to the product and informing others
NO
Is the product ready for production?
YES
Planning customer operations team trainings
Creating the installation instructions
Purchasing components for 0-series
Receiving the components
Balances updated in WMS
Purchasing components for production
Receiving the components
Balances updated in WMS
NO
Is the production working?
YES
Inspecting the components
Inspecting the components
0-SERIES PRODUCTION STARTS
PRODUCTION STARTS
Transferring item data to ERP
ERP item names
Transferring the item data to WMS
Adding the product to the product configurators
Creating the price for the product
Sales starts
Creating sales material & Product cards
Checking the product cards cross-functionally
Product launch plan ready
PRODUCT LAUNCH
Customer Operations team trainings
Receiving sales orders

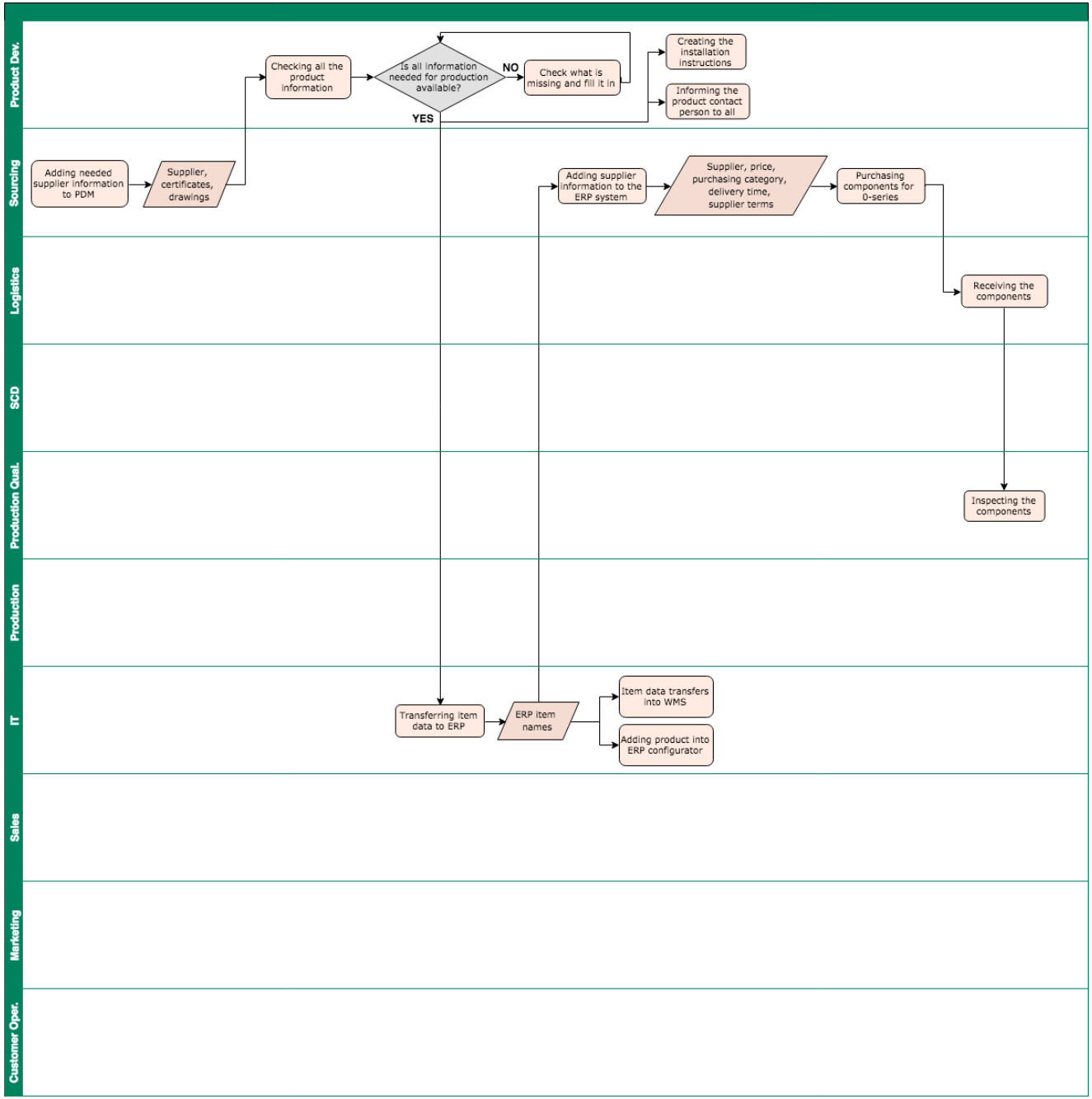
# APPENDIX E: EMPIRICAL PROCESS MODEL FOR A PRODUCT CHANGE

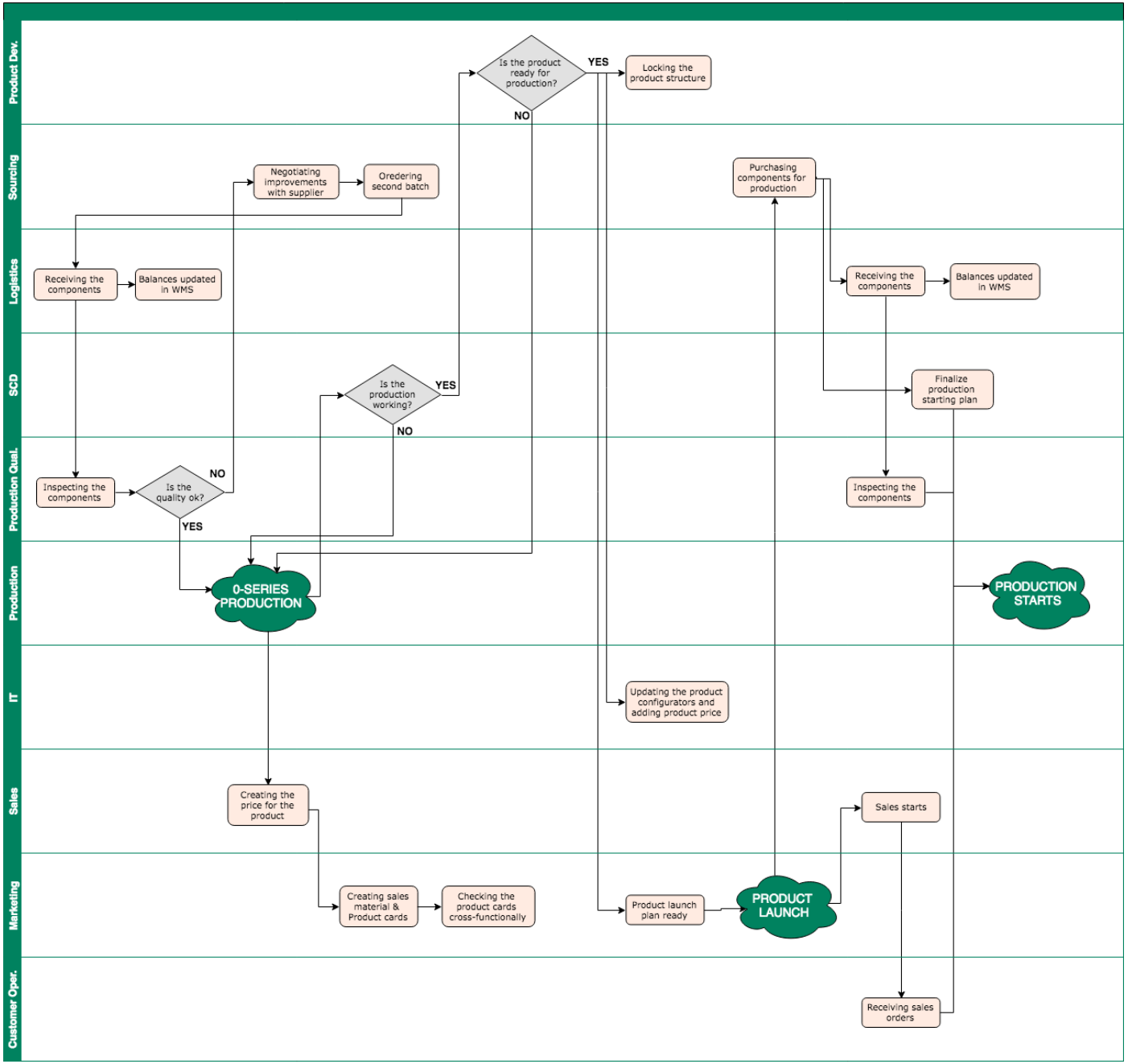



R&D
Sourcing
Logistics
Production Dev.
Production
IT
Sales
Marketing
Customer Oper.
Prototyping
New BOM structure with changes
Is the product ready for production?
NO
YES
Deciding and informing preliminary production starting date for change
All functions making needed changes
Updating item names, status and revision
Are all needed changes ready or ready to be implemented?
NO
YES
Deciding the production starting date for change
Needed employee trainings held
Informing about the change contact person
Making needed changes
Negotiating prices with suppliers
Ordering new parts
Receiving new parts
Making needed changes
Ramp-up plan for changes
Making needed changes
Updating production plan and production instructions
PRODUCTION FOR CHANGE STARTS
Making needed changes
Making needed changes
Updating data to ERP & updating product configurators
Making needed changes
Updating product price if needed
If no launch
Informing customers/dealers about change
If launch is held
Making needed changes
Updating sales materials and product cards
New product launch if needed
Making needed changes

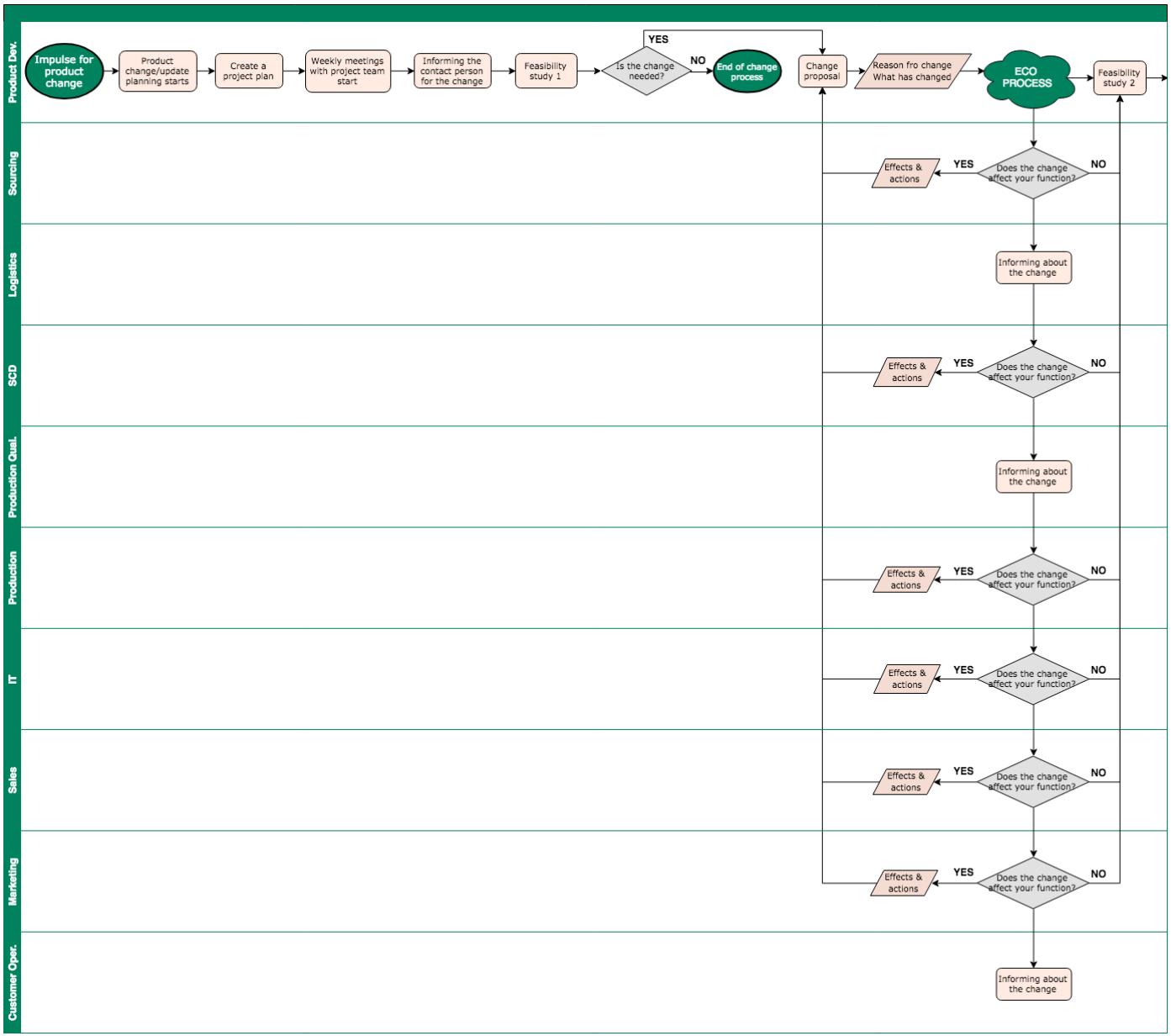
# APPENDIX F: DEVELOPED MDM PROCESS MODEL FOR A NEW PRODUCT

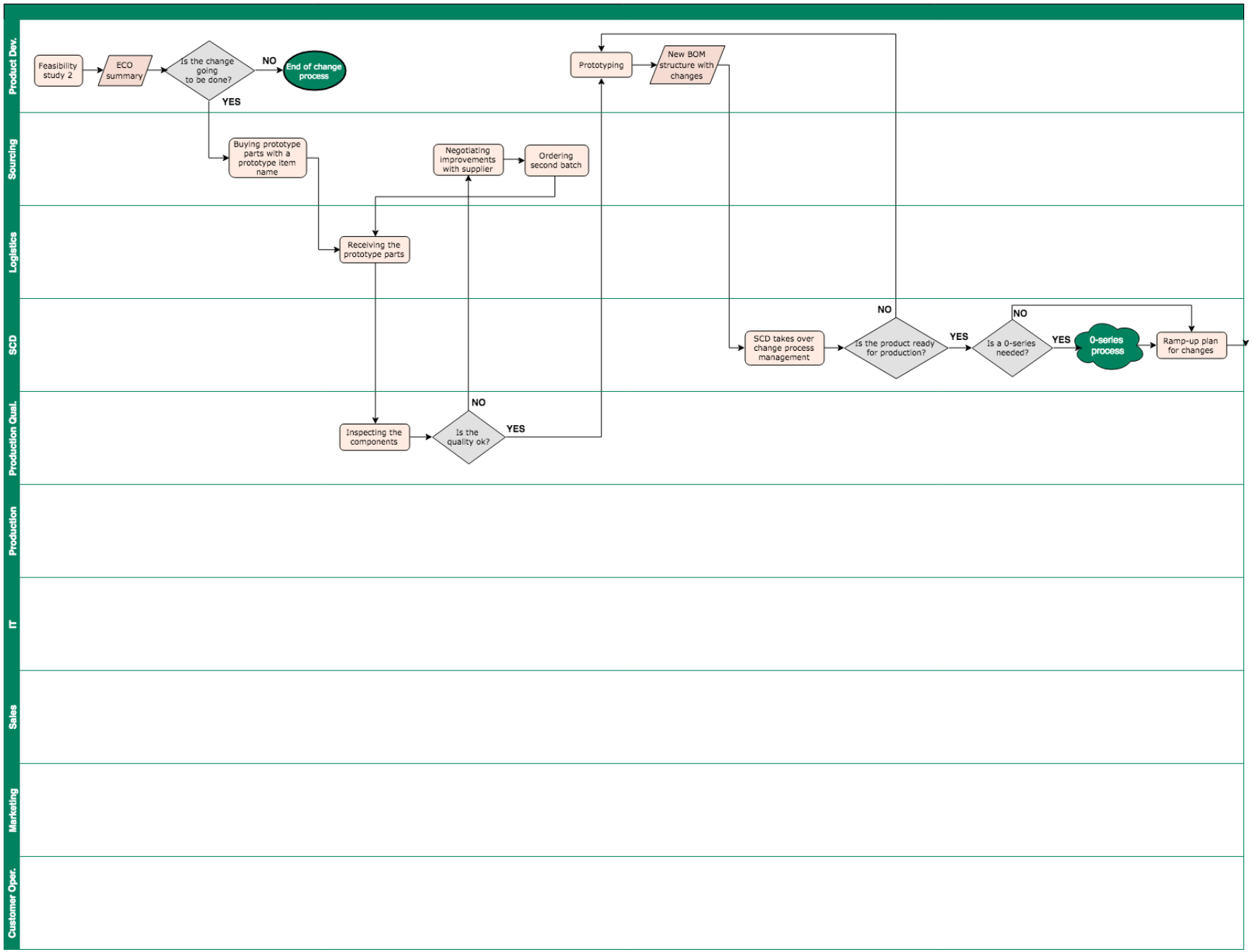


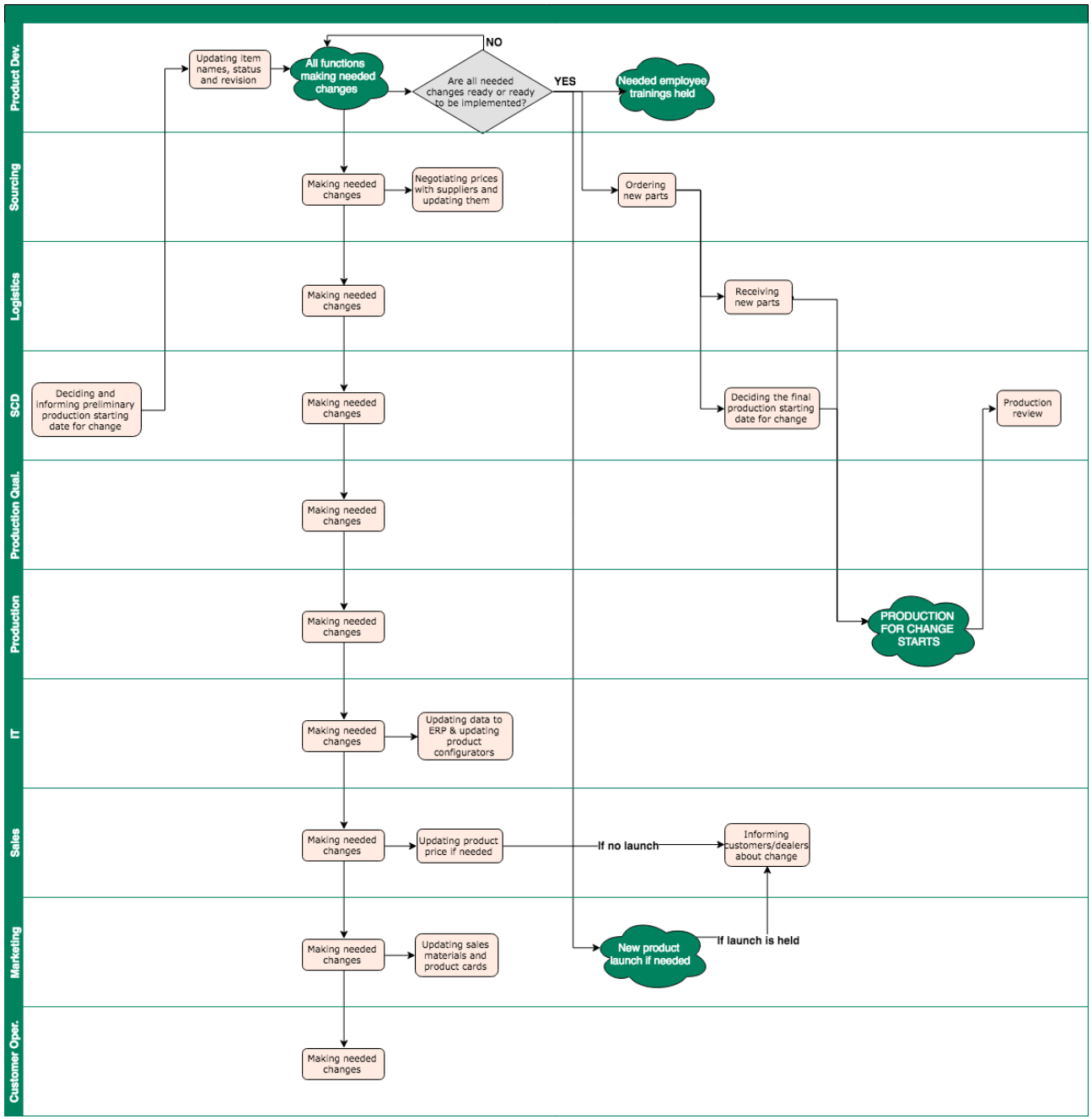

Product Dev.
Sourcing
Logistics
SCD
Production Qual.
Production
IT
Sales
Marketing
Customer Oper.
Checking all the product information
Is all information needed for production available?
NO
YES
Check what is missing and fill it in
Creating the installation instructions
Informing the product contact person to all
Adding needed supplier information to PDM
Supplier, certificates, drawings
Adding supplier information to the ERP system
Supplier, price, purchasing category, delivery time, supplier terms
Purchasing components for 0-series
Receiving the components
Inspecting the components
Transferring item data to ERP
ERP item names
Item data transfers into WMS
Adding product into ERP configurator


Product Dev.
Sourcing
Logistics
SCD
Production Qual.
Production
IT
Sales
Marketing
Customer Oper.
Is the product ready for production?
YES
NO
Locking the product structure
Negotiating improvements with supplier
Oredering second batch
Purchasing components for production
Receiving the components
Balances updated in WMS
Receiving the components
Balances updated in WMS
Is the production working?
YES
NO
Finalize production starting plan
Inspecting the components
Is the quality ok?
NO
YES
Inspecting the components
0-SERIES PRODUCTION
PRODUCTION STARTS
Updating the product configurators and adding product price
Creating the price for the product
Sales starts
Creating sales material & Product cards
Checking the product cards cross-functionally
Product launch plan ready
PRODUCT LAUNCH
Receiving sales orders

# APPENDIX G: DEVELOPED MDM PROCESS MODEL FOR A PRODUCT CHANGE




Product Dev.
Sourcing
Logistics
SCD
Production Qual.
Production
IT
Sales
Marketing
Customer Oper.
Feasibility study 2
ECO summary
Is the change going to be done?
NO
End of change process
YES
Buying prototype parts with a prototype item name
Negotiating improvements with supplier
Ordering second batch
Receiving the prototype parts
Inspecting the components
Is the quality ok?
NO
YES
Prototyping
New BOM structure with changes
SCD takes over change process management
Is the product ready for production?
NO
YES
Is a 0-series needed?
NO
YES
0-series process
Ramp-up plan for changes


Product Dev.
Sourcing
Logistics
SCD
Production Qual.
Production
IT
Sales
Marketing
Customer Oper.
Updating item names, status and revision
All functions making needed changes
Are all needed changes ready or ready to be implemented?
NO
YES
Needed employee trainings held
Making needed changes
Negotiating prices with suppliers and updating them
Ordering new parts
Receiving new parts
Deciding and informing preliminary production starting date for change
Deciding the final production starting date for change
Production review
PRODUCTION FOR CHANGE STARTS
Updating data to ERP & updating product configurators
Updating product price if needed
If no launch
Informing customers/dealers about change
Updating sales materials and product cards
New product launch if needed
If launch is held