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**PRODUCT INFORMATION MANAGEMENT
CHALLENGES IN B2B E-COMMERCE: A CASE STUDY
IN SPARE PARTS BUSINESS**



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ABSTRACT

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The purpose of this Master's thesis is to define what product information management (PIM) challenges can arise in business-to-business (B2B) electronic commerce (e-commerce). The thesis is carried out as a unity of literature research and qualitative study, which was commissioned by an industrial manufacturing company participating to this study in need of declaring the management challenges of their product information in their spare parts e-commerce, so PIM can be enhanced and e-commerce customer experiences improved. First, a literature review is conducted to introduce prior research to the studied phenomenon and its background factors. Based on the literature review results, a theoretical framework is created and utilized as the basis of the following empirical research and the analysis of its results. The empirical research is carried out as a single case study through qualitative semi-structured interviews, created from the basis of the framework. Together, the literature review and the empirical study results show, that PIM challenges manifesting in B2B e-commerce are related to mainly information systems, organizational aspects, and product information. In more detail, information system -challenges are related to the use and integration of many systems, the data transfers and formats, and the system features and updates. Organizational challenges are associated with processes, standards, and people. Product information -challenges are related to the vast amount and heterogeneity of product information, defining its overall quality, ensuring the quality features, manipulation of product information and its quality, and customer requirements. As a conclusion it can be stated that the empirical study results strongly reflect the theoretical framework contents, and that the different challenges are highly interrelated. This thesis offers new information on the scarcely studied connection of PIM, B2B e-commerce, and after sales business regarding the possible challenges that could arise in e-commerce operations.

Keywords: e-commerce, business-to-business, B2B, product information management, PIM, challenges, spare parts

TIIVISTELMÄ

Mattila, Salla

Tuotetiedonhallinnan haasteet yritystenvälisessä verkkokaupankäynnissä: tapaustutkimus varaosaliiketoiminnassa

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Tämän Pro gradu -tutkielman tarkoitus on selvittää, mitä tuotetiedonhallinnan haasteita yritystenvälisessä verkkokaupankäynnissä voi esiintyä. Tutkielma on toteutettu toimeksiantona teollisen valmistuksen yritykselle, joka samalla osallistuu tutkimukseen. Yrityksellä on tarve selvittää tuotetiedonhallinnan haasteensa koskien varaosaliiketoimintansa verkkokaupankäyntiä, jotta tuotetiedonhallinnan menetelmiä ja täten verkkokaupan asiakaskokemuksia voidaan parantaa. Tutkimus aloitetaan toteuttamalla kirjallisuuskatsaus tutkittavaa ilmiötä ja sen taustatekijöitä aiemmin käsitellessä tutkimusten esittelemiseksi. Kirjallisuuskatsauksen pohjalta luodaan teoreettinen viitekehys, jota tullaan hyödyntämään empiirisen tutkimuksen sekä sen tulosten analysoinnin perustana. Empiirinen tutkimus toteutetaan yksittäistapaustutkimuksena kvalitatiivisia puolistrukturoituja, viitekehysten pohjalta luotuja haastatteluja hyödyntäen. Yhdessä kirjallisuuskatsauksen kanssa empiirisen tutkimuksen tulokset osoittavat, että yritystenvälisessä verkkokaupankäynnissä esiintyvät tuotetiedonhallinnan haasteet liittyvät pääasiassa tietojärjestelmiin, organisationaalisiin tekijöihin ja tuotetietoon. Yksityiskohtaisemmin, tietojärjestelmähaasteet liittyvät useiden järjestelmien käyttöön ja integrointiin, datasiirtoihin ja -formaatteihin, sekä järjestelmäominaisuuksiin ja -päivityksiin. Organisationaaliset haasteet liittyvät prosesseihin, standardeihin sekä ihmisiin. Tuotetieto haasteet liittyvät tuotetiedon suureen määrään ja heterogeenisyyteen, tuotetiedon korkean laadun määrittämiseen, laadun ominaisuuksien takaamiseen, tuotetiedon ja sen laadun manipulointiin sekä asiakasvaatimuksiin. Yhteenvetona ja johtopäätöksenä voi todeta, että empiiriset tutkimustulokset peilaavat vahvasti teoreettisen viitekehysten sisältöä, ja todennetut erilaiset haasteet liittyvät vahvasti toisiinsa. Tämä tutkimus tarjoaa uutta tietoa vähäisesti tutkittuun tuotetiedonhallinnan, yritystenvälisen verkkokaupankäynnin ja jälkimarkkinaliiketoiminnan yhteyteen liittyen mahdollisiin haasteisiin, jotka voivat verkkokaupankäyntitoiminnassa nousta esille.

Asiasanat: verkkokaupankäynti, yritystenvälinen liiketoiminta, B2B, tuotetiedonhallinta, PIM, haasteet, varaosat

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INDEX FOR USED ABBREVIATIONS AND ACRONYMS

B2B	Business-to-business
B2C	Business-to-consumer
B2G	Business-to-government
C2B	Consumer-to-business
C2C	Consumer-to-consumer
E-business	Electronic business
E-commerce	Electronic commerce
ERP	Enterprise resources planning (system)
IBM MC	IBM Management Center -software
ICT	Information and communications technology
ID	Identifier
ILM(ari)	Information lifecycle management -system
IS	Information system(s)
IT	Information technology
M-commerce	Mobile commerce
MRO	Maintenance, repair and operations
OEM	Original engineering manufacturing (product)
P2P	Peer-to-peer
PDF	Portable document format
PDM	Product data management
PIM	Product information management
PLM	Product lifecycle management
SAP	Systems, Applications and Products in Data Processing -software for ERP
SKU	Stock keeping unit
TIF	Tagged image format
QA	Quality assurance

1 INTRODUCTION

One of the most important and ubiquitous information technology (IT) features used within organizations on an everyday basis is the Internet: it enables organizations to perform many tasks faster and more effectively. Among the most beneficial uses and benefits companies can gain from IT and the Internet is the possibility to place product information online and sell products through electronic commerce functions (DeLone & McLean, 2004; Earl, 2000; Zhu, 2004).

Electronic business operations were introduced already over twenty years ago (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002; Wenninger, 1999). Since, e-commerce - short for electronic commerce - has been a major activity businesses have leveraged in order to gain competitive advantage in the everchanging business environment (Fauska, Kryvinska, & Strauss, 2013) driven by information. E-commerce can be present in many different environments, out of which business-to-business (B2B) - where companies trade goods and services with one another - is the most interesting one (Ding, Fensel, & Klein, 2004). B2B is acknowledged to create the largest transactions and sales in the whole e-commerce world (Albrecht, Dean, & Hansen, 2005; Fauska et al., 2013; Manenti, 2010; Markus, 2012; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002), having globally outgrown other e-commerce types (Anders Innovations, 2015; Hoar & Sheldon, 2015) with a seven trillion US dollars revenue expectance by 2020 (Anders Innovations, 2015). Thus, it is no surprise that B2B e-commerce is a broadly studied topic in academics.

The interesting and less studied areas in B2B e-commerce field lay in industrial settings, as companies especially in manufacturing have only recently started to add more thought on e-commerce (Manenti, 2010). Additionally, in today's business environment, it is vital to be able to provide more than just goods to the customers: now is the time of services and enhanced customer orientation by providing after sales functions. After sales comprises of providing customers with services, solutions, and spare parts for the maintenance, repair, and operation (MRO) purposes of their initially purchased goods (Cohen, Agrawal, & Agrawal, 2006; Lucking-Reiley & Spulber, 2000.) A major influencer

on today's after sales and spare parts business is the conjunctive factor of e-commerce (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002).

A large part of e-commerce is the management of product information (Zhu, 2004): the key in keeping an organization's e-commerce system functioning and used properly is product information that has been clearly defined and effectively managed (Lee et al., 2006). In literature, there are three main concepts used to describe the management of product-related information: product information management (PIM), product data management (PDM), and product lifecycle management (PLM). PIM is associated with product information that is needed in marketing and sales functions; PDM is utilized for managing data related to a product's development and production; PLM refers to product information lifecycle where the development, production, and management of products and their information is enabled from inception to annihilation. (Abraham, 2014; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.)

To better serve their customers, companies must heed the effective management of product information (Kim, Kang, Lee, & Yoo, 2001; Silvennoinen, 2016), especially in spare parts business (Suomala, Sievänen, & Paranko, 2002), so high-quality product information can be ensured and good customer experiences can emerge. Customer orientation is recognized in prior research as the driving force for e-commerce (Abdeldayem, 2010): consequently, focusing on high-quality product information through its effective management should be a priority, as product information is the main thing customers must rely on when using e-commerce. Before being able to effectively manage product information to ensure its high quality and great customer experiences, companies must address the challenges they face with the management of such information.

PIM is a relatively new term to be studied on its own, but is rising in popularity because of its importance for e-commerce (Abraham, 2014; Manenti, 2010; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). In prior literature, PDM and its processes in varying situations have been noticed to be an important area of future research (Heilala et al., 2011; Kropsu-Vehkaperä, Haapasalo, Harkonen, & Silvola, 2009). While PDM and e-commerce are widely studied topics both independently and together, with or without the notion of possible challenges, the conjunction of PIM and its challenges especially in the context of spare part sales through B2B e-commerce is not. The research problem in this thesis is, thus, to clarify the challenges B2B companies can face in managing their product information for the purposes of e-commerce. The research question generated for the purposes of solving this problem is: *What product information management challenges can arise in B2B e-commerce?*

The following limitations to this research apply. Even though other e-commerce types are addressed, they are left out of consideration when discussion moves towards B2B e-commerce, PIM, and its challenges. In addition, as the focus of the thesis is on defining and clarifying the possible product information management challenges of B2B e-commerce, no specific practical solutions for facing the challenges are provided or empirically studied.

The thesis is carried out as a commission for an industrial manufacturing company, whose possible extant challenges in their B2B e-commerce product

information management functions are to be investigated and reported. The case company (further referred to as Company) is globally one of the world-leading companies in providing various lifting solutions, such as cranes, hoists, and different services, like after sales and spare parts associated with the products. The company offers an e-commerce website for its customers, where different spare parts can be browsed and purchased around the clock. Upon prior experience, it has been noted within the Company that various issues in the management and enrichment tasks of the spare parts -related product information for the purposes of their e-commerce exist – however no inquests on clearly defining those have been conducted. It is thus important for the Company to discover and define the possible existing PIM challenges of their e-commerce; the business is global and the competition is wide, so product information quality and customer experiences are factors well worth improving.

The main purpose of this thesis is to focus on defining the possible challenges companies might encounter in B2B e-commerce PIM through empirical research. To provide a theoretical basis for the study, a literature review was first conducted, utilizing the data repositories of IEEE Xplore, Google Scholar, and University of Jyväskylä's e-library for international academic material, through which the diverse databases of Dawsonera eBook Collection and Ellibs Library could be leveraged. A comprehensive cover on literature was achieved by using, for example, the following search entries with different combinations: *product information, product information management, product data, product data management, product lifecycle management, challenges, electronic business, electronic commerce, customer experience, business-to-business, after sales, and spare parts.*

The literature review showed that PIM challenges can be traced back to three interrelated viewpoints: information systems, organizational aspects, and product information. PIM challenges related to information systems usually manifest from the following categories: use and integration of various systems, data transfers and differing data formats, and system features as well as updates. The organizational challenges for PIM are related to the problematic processes, shortage of standards, and people with their varying habits. The vast amount of information, its heterogeneity, the issues in defining overall information quality and in providing the quality features, manipulation of information quality, and the customer requirements on product information are recognized as challenges related to product information itself. From these results, a framework was created for unifying the vast findings from prior literature and for supporting the empirical study: in the process, all other possible viewpoints to PIM challenges in B2B e-commerce were excluded from the study.

To add to the literature review, an empirical research was conducted for the purposes of investigating what PIM challenges can arise in B2B e-commerce. Of interest was, in relation to the theoretical framework, whether challenges related to information systems, organizational aspects, and product information exist in the operation of the selected Company; additionally, if challenges exist, to what challenge categories within the framework viewpoints do they apply. To empirically research this, a single-case study was carried out to seek answers

to the research question and solutions to the research problem. The study was conducted by interviewing the Company's customers and employees.

The empirical case study results showed, that all the PIM challenges in B2B e-commerce introduced in the theoretical framework through the three viewpoints and the categories within existed in the operation of the studied Company. It can be stated as an answer to the main research question, that PIM challenges related to information systems, organizational aspects, and product information can arise in B2B e-commerce. The literature review and the empirical study culminated in highly similar results: consequently evident is, that the empirical study strengthened the existing theory created for its purposes.

The literature review and empirical research results can be utilized both in academia and in practice. For academic purposes, the generated theoretical framework that was empirically tested and proven to be functional, summarizes a vast amount of knowledge and research on PIM challenges, and it can further be reinforced with more findings as well as utilized as a basis for empirical research. For practice, the framework offers an outline of attested PIM challenges, and could thus be utilized as a basis in detecting similar challenges within businesses. The conducted research was seen to provide much needed information, especially for the Company: the empirical research results backed up by prior literature can be utilized in discovering and realizing the interrelations of various challenges companies might have in their PIM and e-commerce. Moreover, this thesis was one of the first of its kind, if not first, in studying the conjunction of PIM, B2B e-commerce, and spare parts business, so specific new knowledge on the topic was provided for the academic community.

After this introductory chapter, the structure of this thesis is as follows. Second chapter addresses the literature on e-commerce and its types, with more focus on business-to-business trade. Customer orientation is also introduced. Third chapter examines the theory of product information management through the concept of product information and the different concepts for managing it. In the fourth chapter, resolving the research problem of defining what PIM challenges might exist in B2B e-commerce is initiated introducing the issues present in prior literature through the mentioned three viewpoints. A unifying framework for PIM challenges is also created. The fifth chapter declares the research methods used in this thesis' empirical study, as well as introduces the case company and the research material and ways of analyzing it, in addition to going through the concepts of research evaluation. In the sixth chapter, the results of the empirical study are presented by following the structure of the framework created in chapter four. The seventh concluding chapter includes the analysis of the research results through comparisons to existing literature. Additionally, research conclusions are made based on the research results analysis, and the implications of this study are addressed. The limitations to this study are reviewed in addition to addressing the success of the study. The last chapter concludes with speculations for future research paths, and with a summary on the thesis report. After the final chapter, the remaining of this document consists of references and appendixes.

2 INTERORGANIZATIONAL E-COMMERCE AND CUSTOMER ORIENTATION

In this chapter, the concept of electronic commerce will be discussed, especially focusing on interorganizational online activities and customer orientation. First the notion of electronic business is presented, followed by the concept of electronic commerce. Then, the different online (electronic) commerce types will be explained with a greater emphasis on business-to-business side. Lastly the concept of customer experience will be explained to better understand the importance of product information management in e-commerce.

2.1 E-business and e-commerce

Albrecht et al. (2005) stated, already in the beginning of the 21st century, that electronic tools had been used as channels to exchange transactional data for more than three decades, making it over four decades as of today. One of the main manifestations of this electronic exchange is online, or electronic, business. The most popular characterizations for the means of doing business in the era of information and technology are e-business and e-commerce (Earl, 2000). These two terms are utilized interchangeably in many academic research and literature, even though some (see e.g. Gupta, 2014; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002) separate them as their own concepts with subtly different definitions.

E-business, short for electronic business, refers to any business activity that can take place via the Internet. The activities can be, for example, information transfer from one business to another or from one department to another, customer service operations, and collaboration between companies. (Amit & Zott, 2001; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.) Segmented into its factors, e-business comprises the following: “business” covers all activities a company has and will undertake, and the “e” involves all the data moved and stored electronically (Easton & Araujo, 2003). Broadly, e-business can be seen as information and communications technology (ICT) that are utilized for

delivering additional customer value in order to upgrade one's business (Gupta, 2014). In addition, e-business is seen as a hypernym for a business that exists either solely or additionally on the Internet via its website, which can be used for brand promotion or e-commerce functions, or both (Cox & Dale, 2001).

As a term and as a business activity, *e-commerce* (short for electronic commerce) can be categorized under the larger umbrella concept of e-business. Individually, e-commerce is a noticeably narrower concept than e-business, as it only covers the functions of buying and selling products and services online (Ding et al., 2004; Earl, 2000; Fensel & Ding, 2001; Keeney, 1999; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002; Zhu, 2004) through different electronic mediums or systems (Easton & Araujo, 2003), usually websites. The existence and utilization of e-commerce as both a distribution and as a communication channel (Rose, Hair, & Clark, 2011) facilitates business transactions in interorganizational environments (Gupta, 2014) or between organizations and individual customers (DeLone & McLean, 2004), because the products and their information, as well as details about the company, are available online. E-commerce websites and systems can offer clear benefits to customers and to the entities providing it, when compared to traditional brick-and-mortar stores: a wider range of products can be presented and sold, product information can be organized and utilized better and more effectively, search tools can be leveraged for faster information gathering, and customization options can be offered (Abdeldayem, 2010, p. 240).

Bilgihan and Bujisic (2015) stress the importance of both utilitarian and hedonic features an e-commerce website might present to its users. A utilitarian feature for e-commerce is, for example, the access and ability for customers to search for comprehensive product information. In comparison, a hedonically valued e-commerce is defined by the enjoyment customers get from hedonic content – such as enjoyable colors, aesthetic features, and videos – when using the service. (Bilgihan & Bujisic, 2015.) Another defining, and possibly the clearest and most important feature of e-commerce is the remarkable reach it offers, as commerce functions carried out via the Internet have almost no geographical boundaries (Amit & Zott, 2001).

2.2 Types of e-commerce

E-commerce can be present in many milieus. The following e-commerce types are generally the most known ones, which are usually referred to with their acronyms: business-to-consumer (B2C), business-to-business (B2B), and consumer-to-consumer (C2C) (Albrecht et al., 2005; Fauska et al., 2013; Gupta, 2014; Manenti, 2010). Prior literature also adds to this list of e-commerce types, by recognizing the not so widely researched business-to-government (B2G) (Fauska et al., 2013; Gupta, 2014), peer-to-peer (P2P) (Albrecht et al., 2005; Laudon & Traver, 2011), and the more current phenomenon of mobile commerce (m-commerce) (Becker, Mladenow, Kryvinska, & Strauss, 2012; Gupta, 2014), that reaches through the other e-commerce types because of its applicability. In

addition, consumer-to-business (C2B) is recognized as a type of e-commerce (Bell, 2016; Gupta, 2014). This above-described e-commerce unity is visualized in Figure 1.

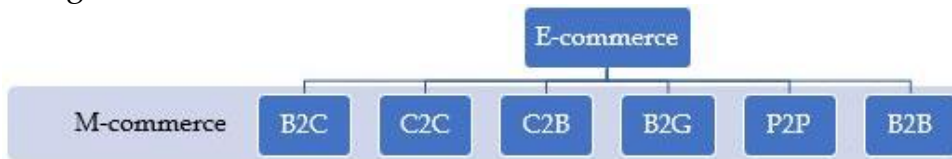


FIGURE 1 Different e-commerce types

2.2.1 B2C, C2C, and C2B

Business-to-consumer (B2C) e-commerce is agreeably the first that comes to mind when thinking about online shopping. It is also the most studied and known type of e-commerce (Fauska et al., 2013). B2C e-commerce comprises the online commerce between businesses and individual end-consumers (Fauska et al., 2013; Gupta, 2014). As an e-commerce type, B2C is unequivocally straightforward: quantities that customers buy are usually small, prices are fixed and taxation, among other regulations, lead to cost-effectiveness and clarity in the markets, which consumers find attracting (Anders Innovations, 2015). B2C e-commerce can be exploited by any company providing an e-store through which goods and services are sold directly to end-customers: great global examples are Amazon's and Sephora's e-stores. A few domestic examples are suomalainen.com by Suomalainen kirjakauppa and Verkkokauppa.com's e-store.

Consumer-to-consumer (C2C) is another e-commerce type that is certainly increasing its popularity in today's markets. According to Fauska et al. (2013) and Gupta (2014), C2C e-commerce focuses on online commerce between private, individual consumers cooperating with each other. Much like in the concept of thrift shops, C2C e-commerce encompasses the selling and buying of used goods between individuals via different websites devoted to those activities. In Finland, the most popular examples are tori.fi, huuto.net, and various Facebook second-hand shop -groups (export.gov, 2017). In addition, the trade of new goods is a possibility (Bell, 2016): websites such as etsy.com and ebay.com are known for C2C e-commerce of new products.

A much more niche type of e-commerce is the one of consumer-to-business, which is less mentioned in any literature than the other types. C2B e-commerce includes the notion of an individual consumer selling their products or services to businesses (Bell, 2016; Gupta, 2014). For example, a blogger selling advertisement space to a business is an instance of C2B e-commerce; in addition, a person could sell their innovation to a business, or someone with a specific skill can provide a service to a company in need (Bell, 2016).

2.2.2 B2G, P2P, and M-commerce

Business-to-government is another less studied e-commerce type. B2G is defined by Fauska et al. (2013, p. 51) as "a part of B2B cooperating with govern-

ment"; in other words, B2G e-commerce could be seen as a subtype of B2B e-commerce, where one business is an individual company, and the other business is government. Broadly speaking, B2G e-commerce means business activities, such as public procurement and licensing procedures, that take place between the public sector (the government) and companies (Gupta, 2014). B2G can thus be seen as its own e-commerce type rather than a subtype of another. Usually B2G e-commerce is arranged through reverse auctions, where the buyer (government) announces a tender, and the sellers (companies) respond to it (Nemat, 2011). However, companies can also put up an e-commerce website: for example GSA Advantage has set up an e-commerce website, from where governmental agencies can purchase services and products (OpenText, 2011).

Laudon and Traver (2011) introduce a type of e-commerce defined by the possibility of sharing information and work. In this peer-to-peer (P2P) e-commerce the wanted files or plain information can be traded between individuals without any intermediary company acting on their behalf (Laudon & Traver, 2011). However, P2P e-commerce usually functions through an e-commerce service, website or software: fitting examples of companies offering P2P services are Spotify and BitTorrent. Spotify leverages P2P networking to stream on-demand music on real-time, whereas BitTorrent is known for enabling anonymous file-sharing through its platform. (Investopedia, n.d..)

Mobile commerce (m-commerce), on the other hand, refers to the e-commerce activities based on the use of mobile digital devices connected wirelessly to the Internet: products and services are purchased by using, for example, smartphones or tablets (Becker et al., 2012; Gupta, 2014). An example of this could be, for instance, using Zalando's e-commerce services for buying clothes through a web browser in one's smart phone, or through the mobile application the company provides for its customers. As can be seen, Zalando belongs to the B2C e-commerce type, but as it also provides m-commerce possibilities, the company can be described to be an m-commerce company too.

2.2.3 B2B

Possibly the most interesting category of e-commerce lies, however, in the business-to-business context (Ding et al., 2004). B2B is nowadays, in fact, generally acknowledged to create largest transactions and sales in the e-commerce environment (Albrecht et al., 2005; Fauska et al., 2013; Manenti, 2010), having globally outgrown the large B2C and other (e-)commerce types (Anders Innovations, 2015; Hoar & Sheldon, 2015).

B2B e-commerce refers to the online trade of products and services between two or more companies (Albrecht et al., 2005; Fauska et al., 2013; Gupta, 2014; Manenti, 2010). Kotler and Armstrong (2010) emphasize that e-commerce in B2B field generally involves companies buying goods and services for the purposes of developing, delivering and maintaining their own products and services. A few companies commonly known for their exemplary B2B e-commerce functions are Alibaba and Grainger. Other companies as well have

moved on to interacting with each other through e-stores and e-catalogs for the purposes of supporting and facilitating the operations of information and price search, procurement, and transaction settlements (Dai & Kauffman, 2002).

Fauska et al. (2013) recognize a few defining characteristics to B2B e-commerce that separate it from other e-commerce types. In general, B2B e-commerce transactions are made with large sums of money: businesses tend to purchase in bulk amounts, and sometimes the investments made, for example, in software, hardware, and maintenance materials are large. In addition, companies transacting together are more interdependent, as business customers will not make impulse purchases, but buy only something they need for augmenting the value and quality of their own products, services or business functions. (Fauska et al., 2013.) Additionally, B2B e-commerce markets have, according to Gupta (2014), two building blocks: e-frastructure and e-stores. Where e-frastructure comprises of the architecture of the B2B field and relations, e-stores are the primary channel through which B2B e-commerce transactions between the companies are made. In other words, the e-store represents the e-commerce system, website or software, that one company offers to another in order to make the searching and purchasing of products easier. (Gupta, 2014.)

B2B e-commerce is typically structured as Archer and Gebauer (2002) describe along with Fauska et al. (2013): a supplier company creates and releases its e-commerce website, which is simply an online catalog of products that buyer companies can use to purchase products by themselves, without the help of sales assistants. The structure is exemplified in Figure 2: the links in the structure also apply to the description of e-stores, as argued by Gupta (2014).



FIGURE 2 Typical B2B e-commerce structure (modified from Archer & Gebauer, 2002, p. 27)

In their study, Fauska et al. (2013) provide characterizations of different B2B e-commerce operatives. They first divide B2B e-commerce into two main types, net marketplaces and private industrial networks, out of which net marketplaces are further separated into four sub-types: e-distributors, e-procurement marketplaces, independent exchanges, and industry consortiums. E-distributors are the most common and simplest ones of the net marketplaces, as they only link companies together by providing an e-catalog where sellers can offer their goods and buyers can purchase them. (Fauska et al., 2013.) E-procurement marketplace acts as an independent intermediary for many industries, charging an additional fee for the purchasing transactions made between companies in the

e-procurement platform, in addition to offering complementary services like content management. Independent exchanges connect a larger number of buyers and sellers within a single industry, also charging a commission fee for any transactions made within the service. (Fauska et al., 2013.) Lastly, industry consortiums serve a specific vertical market, and are operated and owned by groups of industrial companies within that market; usually participating are many suppliers, but only a few yet large buyers (Fauska et al., 2013). The second main type of B2B e-commerce consists of private industrial networks: these e-commerce providers form the largest sector of B2B e-commerce that provide customers with a possibility of direct purchasing of goods and services from a single company within a specific industry. Private industrial networks are common especially in (industrial) manufacturing. (Fauska et al., 2013.)

2.3 After sales and spare parts

In today's business environment, it is vital for companies to provide more than just goods to its customers: now is the time of services and enhanced customer orientation. By providing after sales solutions and extra services for customers, companies can benefit from additional revenues and profits. (Cohen et al., 2006.) Sadly, according to Cohen et al. (2006), too few companies have realized the power of effective after sales functions, or simply do not care to provide them. Having said that, especially heavier industries that are providing maintenance, repair and operations (MRO) have started to pay attention to the growing importance of services and spare parts; the indirect materials in MRO business are needed nearly by all companies buying manufactured products (Lucking-Reiley & Spulber, 2000), so focusing on after sales is a lucrative business.

After sales comprises of selling spare parts and offering services and solutions - such as maintenance and technical support - for customers after the initial purchase of a product or a service. Especially, when focusing on spare parts, the business includes the processes of acquiring, stocking, warehousing, selling, and delivering of spare parts in addition to the customer service functions provided by the company offering after sales options (Suomala, Sievänen, & Paranko, 2002, p. 57.) Moreover, Suomala et al. (2002) highlight the importance of taking product information management into account especially in spare parts business, which nowadays notably relies on e-commerce functions.

E-commerce is the conjunctive factor in after sales operations a company provides (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002); Internet is increasingly utilized as a sales channel for services and spare parts. However, to be successful online, attention needs to be paid on customer experiences. Unlike in brick and mortar -stores, e-commerce customers must rely on the information a company decides to provide (Reichheld & Scheffer, 2000).

2.4 Customer orientation

Oxford dictionaries defines customer as “a person who buys goods or services from a shop or business” (Oxford University Press, 2017); in academics, the same definition typically stands with a few additional remarks. For example, a customer can be an individual who buys goods and services for personal purposes. In addition, a customer might be a company or its department, which is responsible for the procurement and ordering of industrial supplies, such as spare parts, through an e-commerce website. (Lee et al., 2006.)

Customer experience is a hard concept to define, as it is a subjective and an intangible quality built around many factors (Thusy & Morris, 2004). As defined by Meyer and Schwager (2007), customer experience embodies the internal, subjective responses and reactions an individual customer might have to the direct and indirect contacts with a company. These contacts might have different features, such as feelings customers experience during the contacts, and the emotions evoked by the smells, spaces, colors, and time among many other aspects (Thusy & Morris, 2004). Thusy and Morris (2004) emphasize the fact that great experiences do not just manifest on their own, but are built over time taking different possible influences into account. From these great customer experiences, a company might reap the benefits of *customer satisfaction*. Overall customer satisfaction can emerge, if the outcome of customer experiences is more positive than negative (Meyer & Schwager, 2007; Permalla, 2006).

Online customer experience is a subjective response to emotions and reactions a customer will intuitively get when utilizing an e-commerce website (Constantinides, 2004; Rose et al., 2011). It however is, naturally, less sensual than offline customer experiences can be. In e-commerce, customers must rely only on the visual, textual, and audio incentives the company offers on their e-commerce website. Additionally, online customer experience is built around both utilitarian and hedonic features an e-commerce has. Utilitarian features are associated with the benefits customers can obtain from the use of e-commerce, such as information search and retrieval about a product. (Babin, Darden, & Griffin, 1994; Bilgihan & Bujisic, 2015; Eroglu, Machleit, & Davis, 2003.) Hedonic features, then, refer to the enjoyment customers get from using the e-commerce (Bilgihan & Bujisic, 2015) that might arise from various features, such as visually pleasing images (Chua, Jiang, & Tan, 2010).

The experiences customers have in e-commerce has gained more attention in B2B sector (export.gov, 2017), so customer orientation is considered and pursued more among organizations. Customer experience and satisfaction are important regarding the management of product information. A company cannot believe that customers will be content and transact with them simply because their e-commerce exists (Fui, Nah, & Davis, 2002). Great customer experiences require patience and a lot of work. Customers in general are not patient, and will pursue other alternatives, if an e-commerce website is not easy to use and information is hard to find. Especially in B2B environment customers want their interaction with the e-commerce website to be straightforward: in particular,

product information needs to be in order and match the customers' demands. (Fui et al., 2002.) In fact, in many earlier studies and works, product information is seen as one of the main variables affecting customer experiences (see e.g. Abraham, 2014; Chua, Jiang, & Tan, 2010; Constantinides, 2004; Fui et al., 2002; Kujansuu, 2016, 2017; Manenti, 2010; Rose et al., 2011; Zhu, 2004).

E-store customer experiences are largely dependent on the availability, accessibility and understandability of information related to the products customers are interested in (Manenti, 2010; Zhu, 2004) and thus, utilitarian features are highlighted over hedonic ones. Customers require simplicity, speed, convenience, and ease of use (Constantinides, 2004; Reichheld & Scheffer, 2000), factors that culminate in the existence, findability, intelligibility, and definability of the goodness-of-fit of product related information (Manenti, 2010). As Reichheld and Scheffer (2000) exemplify, if a customer browses from page to page and leaves without initiating any kind of transaction, he or she is most likely unable to find the needed product or information. It is thus clear, that the importance of product information and its quality is notable regarding customer experience.

2.5 Summary

In this chapter, the concepts of e-business and e-commerce were discussed. Additionally, the different e-commerce types were defined with the emphasis on B2B e-commerce, which refers to the interorganizational trade carried out through e-stores. In addition, focus was directed on after sales and spare parts business. Consequently, for the purposes of this thesis, further mentions about e-commerce refer to B2B with a special focus on after sales and spare parts, if not stated otherwise. Customer experience and satisfaction were also addressed; even though the focus of this thesis is not on customer orientation, the concept is notable in terms of product information management activities related to e-commerce. One cannot be addressed without the other, as customers' experiences strongly relate to the existence of issues with product information.

Management of product information is a large part of e-commerce (Zhu, 2004): it has become one of the most important functions for companies, especially in manufacturing industries (Kropsu-Vehkapera et al., 2009, p. 759). To better serve their customers, companies must take effective managing of product information into account, so its high quality can be ensured and good customer experiences can emerge. To achieve this, companies must figure out the challenges that stand in their way of accurate, up-to-date, and high-quality product information and its management, simultaneously hindering customer experiences.

3 MANAGING PRODUCT INFORMATION

In this chapter, the concept product information will be explained first individually through its elements of product and information, and then as the unity of said elements. Literature on the three main concepts used in academic research and other works to describe the management of product-related information – product data management, product lifecycle management, and product information management – is also summarized. In addition to the detailed explanation, the concepts will be compared to one another to gain better understanding on their differences, and to justify the selection of one as the main concept.

3.1 Product information

Product is a concept that is easy to understand, but at the same time it can have many different meanings and manifestations. For instance, a product can be defined as the most important feature a business has, which comprises the goods and services sold to customers (Lee et al., 2006; Stark, 2005). Product can also refer to raw materials and components that are needed to produce finished goods (Kalakota & Robinson, 2001). In addition, the concept of product can, according to Stark (2005), apply to a specific unique product or to a single product belonging to a product batch, range or line; product can also be a single (spare) part that belongs to a wider product family that together form an entity, which can also be understood as a product on its own. Stark (2005) additionally emphasizes that products do not have to be physical: today, many products are digital, such as software that are associated with the actual physical product.

The concept of information has been widely discussed and studied in prior literature (see e.g. Ackoff, 1989; Bellinger, Castro, & Mills, 2004; Otto & Hüner, 2009; Tuomi, 1999). The main perception is, that information is just one dimension or category for the content people process in their minds, the other categories being data, knowledge, understanding (or intelligence), and wisdom (Ackoff, 1989; Bellinger et al., 2004; Boisot & Canals, 2004; Tuomi, 1999). Information is also used quite liberally as a synonym for all these concepts, even

though some differences exist. For the purposes of this thesis, however, it will suffice to go through the meanings of data and information.

Data is associated with only symbols, raw data, attributes, and simple facts with which objects can be described. When this data is structured, categorized, interpreted, or put in a certain context, it becomes *information*. (Ackoff, 1989; Bellinger et al., 2004; Boisot & Canals, 2004; Otto, Gizanis, Österle, & Danner, 2013; Otto & Hüner, 2009; Tuomi, 1999.) The transformation from data to information is usually done by or within information systems, as some processing must be executed by the user in need of the data (Otto & Hüner, 2009). So, to be able to create information, data has to exist. (Tuomi, 1999).

In prior literature and research, the concepts of data and information are frequently used as synonyms regardless of the theoretical differences between the individual concepts of data and information. For the purposes of this thesis and for decreasing the confusion originated from the mixed use of the concepts, any further mentions on either information or data, especially when associated with products, follow the justified lead of Otto and Hüner (2009) in utilizing the concepts interchangeably. Hence, both data and information will in the future entail the theoretical contents of one another, so no additional clarifications need to be made what is meant when either is mentioned.

Product information is an essential component especially in e-commerce (Lee et al., 2006), and it refers to all the information and data related to a product a company produces and sells (Kropsu-Vehkaperä et al., 2009; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). Without product information, a product cannot be found or sold online (Abraham, 2014). Usually, product information consists of product attributes and product relations, such as categories (Lee et al., 2006), that are often managed within information systems (Kim et al., 2001). One of the most important pieces of product information – especially in industrial manufacturing where products and their spare parts can be counted in many (hundreds of) thousands – are items. Using items is a standardized way to (digitally and) systematically identify and name a physical product, a spare part, or a service. (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.) Having said that, other typical pieces of product information associated with spare parts are product specifications (Suomala et al., 2002).

As Saaksvuori and Immonen (2004) as well as Sääksvuori and Immonen (2002) state, product information can be divided into three distinct types: product specification information, product lifecycle information, and metadata of product information. Product specification information is associated with the physical and functional characteristics of a product, and can be very technically detailed or conceptually abstract. Product lifecycle information refers to the information needed and generated through the different processes or stages a product undergoes during its whole lifecycle: technology research, industrial design, manufacturing and production, use, maintenance, and disposal or recycling. Lastly, metadata is data about the product information itself, and describes details such as the format, location, creator, last editor, and editing time. (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.) Additionally,

product information can be static or dynamic (Permalla, 2006). Static information refers to the invariable product attributes and assets, such as product image or measurements. On the contrary, dynamic information, such as inventory or price, might change depending on the viewer. (Permalla, 2006.)

In the connection of industrial manufacturing, spare parts, and e-commerce, product information is the core of all business operations and inter-organizational trade (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). The key in keeping an e-commerce system functioning is product information that has been clearly defined; all processes even remotely concerned with product information require it to be accurate (Lee et al., 2006). It is thus vital, that precise definitions of products are available in “shareable, manageable, flexible, and scalable form” (Lee et al., 2006, p. 27).

3.2 PDM and PLM

Product data management (PDM) refers to the activities of systematically managing all the data related to the development, production, order-delivery processes, and end-user support of an industrially manufactured product (Kropsu-Vehkaperä et al., 2009; Liu & Xu, 2001; Philpotts, 1996; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). More specifically, as Stark (2005) argues, product data management involves role and responsibility clarifications for each piece of data, in addition to change control and protection.

The core of PDM is to ensure that all product-related data is created, stored, saved, and shared among all necessary actors in order to keep daily procedures of utilizing the data effortless (Kim et al., 2001; Kropsu-Vehkaperä et al., 2009; Liu & Xu, 2001; Philpotts, 1996; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). Nowadays, product data management is generally carried out with different information systems (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). These systems are usually a combination of distinctive features and functionalities. For example, the following are mentioned in various prior literature and research (e.g. Liu & Xu, 2001; Philpotts, 1996; Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002):

- **File and data vault**, for storing all product data and related files
- **Workflow management center**, for managing all activities that include product data, so workflows stay under control
- **Data search, retrieval, management and administration** functions, for maintaining and editing product data, item statuses, and revisions
- **Data transportation**, for transferring data between different systems
- **Change management**, for getting the right and most current data for the right products to the right destination at the right time
- **Administrative functions**, for managing data access and user rights
- **Product structure management**, for managing product categories
- **Item management**, for maintaining the standardized identification of products, and

- **System interfaces**, for connecting the different information systems containing product data together.

The main goal of PDM is to provide help in monitoring the information and data masses that are used in designing, manufacturing, and maintaining of products. Additionally, a PDM system integrates information from differing processes and varying applications across heterogeneous data and system boundaries, in addition to controlling who can create, access, edit, and share the data. (Kim et al., 2001; Philpotts, 1996; Smith & Mckeen, 2008; Trappey, Taghaboni-Dutta, & Trappey, 2008.)

Product lifecycle management (PLM) is a more all-encompassing framework when it comes to product data management. It refers to the information lifecycle perspective consisting of the enablement of developing, producing and managing products through different systems and methods from inception to annihilation (Abraham, 2014; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002; Trappey et al., 2008). Where PDM focuses strictly to the company's product data, PLM adds to it by focusing on the activities and processes around the data (Otto, 2012; Silvennoinen, 2016).

A product's lifecycle can be divided into five subsequent, but not strictly chronological phases (Stark, 2005): imagination, description, realization, usage, and disposal. In the first phase, the product is just an idea that has yet to be realized; in the second phase the imagined product is defined and described, but a physical (or digital) product does not exist yet; in the third phase the described product is realized in production; in the fourth phase the produced product is sold and used, and some service and maintenance can be provided for it; in the fifth and final phase the product as a whole is not used anymore, and is most likely disposed of, recycled, or disassembled. (Stark, 2005.) Within these phases there are many activities that take place, creating vast amounts of product related data. These activities, such as design, development, testing, manufacturing, maintenance, and elimination can vary from industry to industry, but when conjoined they form the whole lifecycle of a product (Stark, 2005).

Simply put, PLM widens the concept of PDM to not only managing the information of a product during its development and manufacturing, but into covering all stages of a product from "cradle to grave" (Kropsu-Vehkapera et al., 2009; Srinivasan, 2011; Stark, 2005, p. 15). Similarly to PDM, PLM concentrates on certain central functions of item management, product structure management, document management, change management, retrieval of information, and workflow and distribution management (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002), because PDM is, in fact, a fundamental component of PLM (Stark, 2005).

3.3 PIM

In the simplest sense, *product information management* (PIM) stands for the management of product information. PIM focuses on managing, maintaining, and

enriching product related information needed for marketing and selling purposes of a company's goods (Abraham, 2014; Silvennoinen, 2016). A PIM system or solution is used to administrate the most vital and all the trivial content and information a company has on its products, and to coordinate it to the touchpoints where customers and employees alike can make use of it (Abraham, 2014; Kujansuu, 2017; Permalla, 2006; Power, 2010; Swerdlow et al., 2016). In addition, PIM provides the product related information for the customers as accurate, clean, timely, and consistent as possible in a way that typical e-commerce solutions on their own cannot achieve (Permalla, 2006; Power, 2010).

The main purpose of PIM is to be a centralized and shared source of up-to-date and accurate product information, from where information can be issued for various needs; for example, forming a systematic customer experience is possible with a single PIM system as it removes the possibility of errors, overlaps, and controversy among product information that is managed in various channels (Abraham, 2014; Silvennoinen, 2016). To achieve this, PIM supports four successive processes and the featured internal actions. The flow and the functions of these processes are visualized in Figure 3, and discussed below.

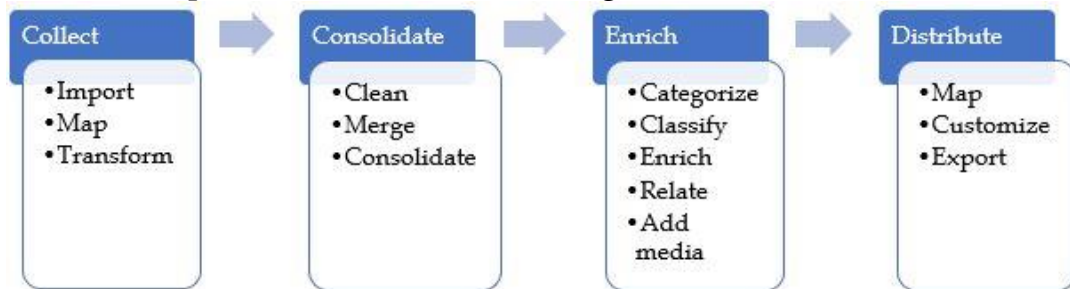


FIGURE 3 PIM processes and features (modified from Abraham, 2014, p. 4)

The first main process of PIM is collecting product information. According to Abraham (2014), product data in companies is usually generated during multiple years of operation across the organization, by many different people into various information systems. To make it coherent and useful, it all needs to be collected and sorted out. This happens by importing data of varying formats from multiple sources – such as enterprise resources planning (ERP) systems and warehouse systems –, then mapping the data to specified product attributes and lastly transforming it, if necessary, to match the standards. (Abraham, 2014.) After, the data will most likely need consolidating: only in rare cases are there no duplicate product items in the various systems from where the product data are collected for PIM purposes. To ensure that individual products have only one instance, PIM's second main process cleans the collected data by locating duplicates and by consolidating the instances and their information to create a single source of truth for each product. (Abraham, 2014.) When the product information is collected and consolidated, the third main process of enriching begins: the products and their information need to be categorized and classified, enriched, related, and attached to their designated media. In categorization products are placed into main and sub-categories; classification is done so product attributes, such as different measurements, can be managed; enriching

refers to the improvement of product data to make it more comprehensive; relating is the act of using recommendations in the e-commerce by creating different types of relations between the products, such as up- or cross-sells; adding media implies that, for example, different pictures are coupled with the right products. (Abraham, 2014.) Lastly, by initiating the fourth main process of distribution, the product information can be mapped, customized, and exported to different publication channels, such as the e-commerce system (Abraham, 2014).

According to Abraham (2014), there are several concepts in PIM that appear in the e-commerce environment. Catalog is simply a collection of products, which usually represents the whole product range of a company. Categories are smaller sub-sections of products within the product catalog. (Abraham, 2014.) Product attributes represent the properties of a product, such as name, identifier (ID), and basic measurements. Values refer to the attribute contents: is the value a line of text or a number, for example. (Abraham, 2014.) Units are the standards – such as metric and imperial systems – for the attribute values. Digital assets, such as pictures, on the other hand, are additional objects that can be attached to products. (Abraham, 2014.) Products refer to the physical products that are sold to customers, whereas variants are virtual representations of the physical products, and stock keeping units (SKUs) are virtual items that identify the variants (Abraham, 2014). The concepts are summarized below (Table 1).

TABLE 1 Key PIM concepts (collected from Abraham, 2014)

Concept	Definition
Catalog	Collection of products
Category	Smaller sub-section of the product range
Attributes	Product properties
Values	Attribute contents
Units	Value standards
Digital assets	Accessory resources of products
Products	Physical products sold to customers
Variants	Virtual representations of physical products
SKUs	Virtual items for variant identification

As PIM focuses on the management of product information for the purposes of marketing and selling the products, certain functionalities need to be supported. Some main functionalities are as follows: category management, classification and attribute management, catalog management, data quality management, product localization management, user management, publication management, data export/import management, workflow management, data quality management, master data management, product enrichment, unit of measurement management, and mass mutation (for more, see Abraham, 2014).

Many of these PIM processes are very similar or the same as the functionalities in PDM: category management, classification and attribute management, and catalog management (Abraham, 2014) all relate to the PDM's product structure management. Data quality management and product localization management (Abraham, 2014) are much alike the function of data search, retrieval,

management, and administration in PDM. User management in PIM (Abraham, 2014) means the same as administrative functions do in PDM. PIM's publication management and data export/import management (Abraham, 2014) counter PDM's data transport functions. Both PDM and PIM have workflow functions to manage the product data activity flow. The change management of PDM includes the data quality management, master data management, and product enrichment processes of PIM. (Abraham, 2014.) Lastly, unit of measurement management and mass mutation function are not specifically a part of any PDM function. The former supports the activities of unit type management and standard unit recognition, whereas the latter supports the possibilities of, for instance, categorizing multiple products simultaneously. (Abraham, 2014.)

3.4 Summary and comparison of concepts

In chapter three the concepts of product information, PDM, PLM, and PIM were explained in detail with the help of prior literature and research. Product information was described to be an essential component of e-commerce that entails all data and information a company has on a specific product. PDM, PLM, and PIM, on the other hand, are all concepts for managing product information.

Despite the differences in definitions and practice, the vast extant literature utilizing one or more of the three concepts of PDM, PLM, and PIM shows that they are often used quite liberally as synonyms. For example, Abraham (2014) lists several acronyms that are used when referring to PDM, out of which PLM is one. Silvennoinen (2016) also highlights that PDM is often mistakenly seen covering PIM requirements. However, the concepts are, in fact, not synonyms (Silvennoinen, 2016). When PIM includes the management of product information concerning the functions and purposes of sales and marketing, PDM upkeepes the manufacturing and development related data and information of a product; thus, PDM has nothing to do with sales and marketing. It is however, alongside PIM, a part of PLM, which in turn is concerned with the company's internal processes throughout the whole lifecycle of a product. (Abraham, 2014; Kropsu-Vehkaperä et al., 2009; Otto, 2012; Silvennoinen, 2016.)

In this thesis, PIM will be adopted as the main concept for product information management, as it best relates to the functions of maintaining and enriching product information within the context of e-commerce. Hence, any further mentions of product information management refer to PIM for B2B e-commerce purposes, limiting PDM and PLM, and the other e-commerce types out of discussion. Also, any further mentions of products refer to spare part products because of this thesis' focus, limiting other product types out of discussion.

4 PIM CHALLENGES IN B2B E-COMMERCE

Like almost any organizational function, e-commerce and its product information management can face challenges. The challenges for PIM in e-commerce context vary quite a bit in prior research (see e.g. Abraham, 2014; Ding et al., 2004; Fensel & Ding, 2001; Kropsu-Vehkaperä et al., 2009; Manenti, 2010; Otto, 2012; Permalla, 2006; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). In addition, the focus of the prior studies varies: some are concerned more with the challenges found in e-commerce, while some focus on the challenges that arise from product information management in general. These different challenges can, however, be present in the unity of the two concepts. It should also be noted that as PIM, PDM, and PLM are sometimes used as synonyms, findings on challenges studied under any of the three contexts are addressed in this chapter, and recognized as PIM challenges in B2B e-commerce.

Three main viewpoints for the challenges can be recognized from prior literature: information systems, organizational aspects, and product information, as also Kropsu-Vehkaperä et al. (2009) note. This chapter will explain what product information management challenges can arise in B2B e-commerce by discussing these viewpoints in detail and by providing examples of challenge manifestations introduced in prior literature and research. Additionally, a framework is created to unify the vast literature on the studied topic.

4.1 Information system -challenges

The management of product information has been described to be an intricate challenge, especially in manufacturing industry (Trappey et al., 2008). The database of product information is in most cases unmaintainable without an information system designed for the purpose (Solteq, 2017). However, even though information systems make our lives easier, no system comes without issues. Some of the main challenges in PIM can, in fact, be traced back to the information systems in use (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002): either there are too many systems that are all used for specific PIM tasks, or the few systems in use do not function well together, or separately.

4.1.1 Use and integration of various systems

The principal manifestation of information system -challenges is fairly common in many companies: product information is usually stored in numerous different systems (Abraham, 2014; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002) that need to integrate and conjoin product data (Ding et al., 2004; Fensel & Ding, 2001; Kropsu-Vehkapera et al., 2009) for the purposes of e-commerce. This can lead to disjointedness of product information, a condition prone to yield problems if any one of these systems is corrupted.

Within incumbent companies in an industry that has matured, the spectrum of used information systems is quite heterogeneous (Earl, 2000; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002; Toews, 2012): there usually is a large number of different old and new systems in use, all meant for slightly or distinctly different purposes. All the systems are not principally meant for PIM activities, but they might entail product information that is needed in the e-commerce system. Because of this, the necessity and requirement for integration between the systems is quite high. (Earl, 2000; Permalla, 2006; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002; Toews, 2012.) This applies especially to companies with legacy systems still in use; legacy systems are hard to retire because of the product information that is still stored within them. Thus the legacy systems must be integrated with all the other systems (Toews, 2012). Having said that, there lies a problem: legacy systems might conflict with other systems making the integration process very arduous, or even impossible (Hoar & Sheldon, 2015; Robinson, 2016), because the systems might not even have been designed to be integrated (Columbus, 2016). This is why system integration is usually a costly, and a tedious challenge (Bernstein & Haas, 2008).

The complexity of integrating many distinct systems together so that all product related information can be accessed, managed, and transferred to the e-commerce usually renders further challenges. For example, Toews (2012) highlights that heterogeneous sources of data complicate the sustenance of its consistency and interpretation. The systems often also overlap in functionalities and information content (Främling, Ala-Risku, Kärkkäinen, & Holmström, 2006; Stark, 2005), making the existence of duplicate information or items more of a rule than an exception. In addition, the actual data within the various systems is commonly not equal (Orr, 1998), which can affect data quality and complicate PIM activities, such as product information updates (Toews, 2012), even further.

4.1.2 Data transfers and diverse data formats

Should the integration between the various systems be successful, there still exists other manifestations of challenges relating to the compatibility of said systems. For example, data transfer challenges are mentioned in many prior research and literature (e.g. Bernstein & Haas, 2008; Kropsu-Vehkapera et al., 2009; Kujansuu, 2017; Liu & Xu, 2001; Permalla, 2006; Saaksvuori & Immonen,

2004; Stark, 2005; Sääksvuori & Immonen, 2002; Wenninger, 1999). In some cases, transferring information between various systems is rather slow (Kropsu-Vehkapera et al., 2009) and technologically demanding (Wenninger, 1999), especially in the case of legacy systems (Stark, 2005). The migration of data requires a lot of manual work (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002), and thus has to be planned carefully to avoid the problems arising from the possible unsuccessful or delayed transfers; the editing, enriching and management of product information rely on the smooth flow of data between the systems (Kujansuu, 2017; Liu & Xu, 2001; Permalla, 2006). If this cannot be ensured, product information will not be available in the e-commerce.

Having said that, the successfully transferred information is usually in various formats because the various systems in use support distinct types of information. In fact, the differing data formats within the hardware and software used for PIM functions are recognized as one of the main challenges for the information systems viewpoint (Bernstein & Haas, 2008; Kim et al., 2001; Philpotts, 1996). As Stark (2005, p. 239) states: "-- data in a file often remains understandable only to the program that wrote it." Hence, the transferred but still incompatible pieces of information usually need to be converted, interpreted, translated, and synchronized to achieve cohesion of product information.

4.1.3 System features and updates

The various information systems used in PIM activities might not always function as they should. In addition to the system integration, data transfer, and data format challenges, the different system features and updates can cause more challenges that fall under the information system -viewpoint of PIM challenges.

As there usually are multiple systems in use for PIM purposes, the cognitive strain and workload on the departments or individuals responsible for PIM functions are extensive. Learning and remembering how to use the different systems with which various activities are performed on an every-day basis can create cognitive burden, especially if the systems are not user-friendly or if they are updated often. (Kujansuu, 2017; Stark, 2005.) In addition, other common PIM challenges associated with system features are long response times, system inconsistencies, missing features, problematic functionalities such as search fields, data access and editing rights, as well as system user rights (Stark, 2005).

Especially during and after system version updates there is a possibility for problems caused by, for instance, bugs, glitches or system failures (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). Successful system updates bring about new functionalities or modify the existing ones, which can cause stress for the users as they must learn new ways of using the systems (Stark, 2005). However, the updates or other fixes might also be unsuccessful or take long to implement, leaving the systems or their features unusable for a while. Moreover, system malfunctions are naturally possible, and might even occur more often than fallbacks caused by system updates. These issues can lead to overall discontent, and even total disuse of the systems. (Stark, 2005.)

4.2 Organizational challenges

Organizational challenges for PIM naturally relate to the organization where product information management is needed, and thus are dependent on the specific organizational structure, culture, and customs. As can be understood from prior literature (e.g. Ding et al., 2004; Fensel & Ding, 2001; Kropsu-Vehkaperä et al., 2009; Lee et al., 2006; Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002), the main manifestations of organizational challenges for PIM are usually related to the PIM processes, the (lack of) standards for PIM, and the many different people in an organization.

4.2.1 Problematic processes

Many of the PIM activities and processes in an organization are still highly dependent on manual work that can result in an inconsistent database of products and a jumble of duplicate and inaccurate product information (Abraham, 2014; Främpling et al., 2006; Lee et al., 2006; Srinivasan, 2011). The bigger the organization is and the more items there are, the more manual work is needed in the management of product information despite all the automation the various information systems might offer (Kropsu-Vehkaperä et al., 2009). The non-automatic processes are highly exposed to possible human errors, thus potentially risking the integrity and correctness of the information being managed (Kropsu-Vehkaperä et al., 2009; Philpotts, 1996; Srinivasan, 2011).

For example, product registration and item creation still largely rely on manual efforts (Lee et al., 2006). Product information also needs to be distributed throughout the whole spectrum of systems, the content of the information needs to be checked, and connections need to be made between products and their information (Kropsu-Vehkaperä et al., 2009; Lee et al., 2006; Philpotts, 1996). Additionally, possible duplicate entries of products and their information cause further manual workload, as the duplicates need to be discovered, examined for differences and similarities, and eventually merged (Abraham, 2014).

Saaksvuori and Immonen (2004), as well as Sääksvuori and Immonen (2002) list a few other possible manifestations of challenges that can arise in PIM related processes: the upkeep of product information might be tedious and highly time-consuming, and searching for existing product information could be difficult. Another challenge for PIM is usually the small group of people that generally is solely and primarily responsible for the daily management, maintenance, and enrichment of product information (Abraham, 2014; Haug, Zachariassen, & van Liempd, 2011), possibly in an international and large-scale organization, where time is a scarce resource; the workload within the group might be immense and when personnel changes occur or employees get sick, the organization loses competence and knowledge either temporarily or for good (Kropsu-Vehkaperä et al., 2009). Additionally, a typical dilemma is that knowledge related to a certain product is usually in the “hands” of a certain individual, such as a product manager. When information on a product is

needed, the person responsible for it needs to be available and willing to help, if others need the information they possess. (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.)

In a company where PIM processes are divided and require frequent manual interventions, it is possible that some of the personnel working with product related information do not understand PIM to the fullest. Individuals might not be aware of, or care about the responsibilities in PIM, the importance of product information and its management for e-commerce, or the functionalities in the systems used for PIM. (Easton & Araujo, 2003; Kropsu-Vehkaperä et al., 2009.) They might start to create, store, and manage information in software and hardware – for example in personal Excel-sheets, flash drives, or even paper documents – not meant for those purposes. Consequently, the integrity and consistency of product information is hard to ensure as the ways of managing, handling, and distributing it differ from one person and department to another. (Liu & Xu, 2001; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.)

This can lead to a vicious circle: large entities of items and thus the arduous tasks related to the management of product information are challenges that feed on one another. Information on products is hard to find or non-existent and employees seeking shortcuts on the PIM tasks contribute to the deteriorating product information and scattered archives across many software and hardware, which further makes information search, retrieval, updating, and enriching even slower and more tedious than it was to begin with. (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.)

A foundation of knowledge on who is, for instance, creating, managing, enriching, and utilizing product related information – and how, when, and with what systems – could keep the unwanted information incoherence, non-existence, incorrectness, and duplicate items under control (Philpotts, 1996). Unfortunately, especially in large organizations where PIM has not been standardized, the foundation of knowledge is hard to establish, upkeep and distribute to all necessary parties. It is much more ordinary to not know who has done what, when it has been done and why (Kujansuu, 2016), which regrettably leads to overlapping work (Kropsu-Vehkaperä et al., 2009), emergence of duplicate items, and errors or conflicts in information content that feed the existence of the vicious circle (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002).

4.2.2 Shortage of standards

In more cases than not, PIM processes and tasks, in addition to the product information itself, tend not to be unified. In other words, organizations have a lack of standards regarding product information and its management. The controlling and standardization is, however, seen as a vital component of careful and systematic governing of product information. Thus having only few or no standards at all is a major challenge companies working with PIM face on an everyday basis. (Albrecht et al., 2005; Ding et al., 2004; Otto et al., 2013; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.) The objective of

striving towards high quality, rich, and accessible product information becomes a liability if ways of operating with product information are not regulated (Liu & Xu, 2001; Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002); the incoherent understanding of or the lack of respect for standardizing product information and the processes associated with it only advance the incompleteness and confusion (Kropsu-Vehkaperä et al., 2009; Kujansuu, 2016).

Managing and enriching product information are demanding tasks that cannot properly be systematized without a compact set of standards. (Fensel & Ding, 2001; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). The foundation of standardizing these is fixated on creating possibilities and boundaries for interpersonal and interdepartmental communication and information distribution. Companies need standardized operations and processes for PIM, just like they need unified data standards, if ensuring common understanding between different employees working with PIM and facilitating the ways of working are desirable objectives. (Abraham, 2014; Albrecht et al., 2005; Kropsu-Vehkaperä et al., 2009; Stark, 2005.)

For example, product descriptions need to be standardized so customers can find the products they need in the e-commerce website (Fensel & Ding, 2001). Additionally, the questionable ad hoc -solutions for PIM tasks need to be eliminated (Toews, 2012) and replaced with standardized processes, so challenges like being unable to determine what has been done by who in the past, who is responsible for doing what in the future, and what needs to be done and how, can be avoided (Kujansuu, 2016; Stark, 2005). Without standardizing the processes and the information itself, the personnel cannot efficiently access, enrich, and manage product information. As Stark (2005, p. 239) argues, “-- rather than searching and waiting for it, they may prefer to ignore it or re-create it --”, which adds to the issues and contributes to the already-mentioned vicious circle.

According to Fensel and Ding (2001), having too many standards for PIM is another possible challenge for companies exploiting e-commerce functions. Having numerous different standards for PIM is a cry for help amongst its varying bottlenecks, but instead of actually solving any, the many standards produce more complications; most of them do not take the whole plethora of PIM tasks, systems, and product information into account, and none of them is an actual main standard that everyone follows (Fensel & Ding, 2001).

4.2.3 Different people, different habits

On an individual level, one major influencer to the manifestation of challenges in PIM are the personal attitudes towards the importance of the tasks associated with PIM, its standards, e-commerce, and product information. In organizations, there are many different people in different positions, possibly from different countries, that all work with product information in some level: differing and even contradictory opinions are bound to exist about the actual necessity of some product information for the purposes of e-commerce (Abraham, 2014; Ding et al., 2004; Fensel & Ding, 2001; Kropsu-Vehkaperä et al., 2009;

Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002). For example, some individuals might not disclose pieces of product information to the systems in use, or to the individuals responsible for enriching the information, because they do not have the time or do not recognize the significance of not disclosing them (Abraham, 2014; Easton & Araujo, 2003). This lack of resources and understanding leads to inaccessibility of information, which in turn leads to poorer information quality.

Often the employees who are responsible for creating and understanding the product information are not the ones who manage, enrich, and publish the information for e-commerce purposes; therefore, a lack of common awareness of the necessity of the product information arises between the employees of different posts (Otto et al., 2013). If the whole personnel does not understand or care about the importance of the availability and accessibility of the information they possess, version control and product information enrichment among other functions face unnecessary challenges (Kropsu-Vehkaperä et al., 2009).

In a practical level, however, the most serious challenges emerge from differences in the procedures and the ways of working with PIM and the systems associated with it (Orr, 1998; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). Furthermore, the differences in how different people describe and categorize products are challenges many companies struggle with (Ding et al., 2004; Fensel & Ding, 2001; Omelayenko & Fensel, 2001), and because of this product description and catalog cohesion is hard to achieve. Many companies also exploit e-commerce globally, which challenges the companies to find proper translations for the mixed descriptions contributed by various individuals, in all the supported languages (Ding et al., 2004; Fensel & Ding, 2001; Stark, 2005).

Just like different people describe things differently and have differing ways of working, they also have distinctive learning curves, opinions, and attitudes when it comes to using the various systems for PIM activities. Specific systems might encounter resistance from employees required to use them, because they might be stuck in their own ways of working and simply do not like or trust the systems (Abraham, 2014; Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002). Additionally, for some individuals it might take a lot of time to learn how to use the systems properly, while some might not even want to learn (Liu & Xu, 2001) because the systems do not function as the employees would like them to function (Stark, 2005).

4.3 Product information -challenges

All the challenges described in the previous chapters can, in fact, contribute to the existence of product information -challenges. For example, the different opinions amongst employees, the differing ways of working and describing products, and the use of various systems for PIM purposes all partake to the lack of standards regarding product information, which leads to deteriorating overall quality of product information (Fensel & Ding, 2001; Philpotts, 1996). As all customer experiences and purchase decisions in e-commerce are highly de-

pendent on the available product information (Bilgihan & Bujisic, 2015), the importance of its quality has to be realized, and addressing the challenges it could face should be a priority (Otto et al., 2013) so high-quality experiences can be provided for the demanding B2B customers.

In accordance with prior literature and research, there are many origins for the challenges product information itself causes in its management. First, most of them manifest from the individual, but interdependent features product information has – such as its sheer amount and heterogeneity –, or should have – such as availability, reliability, and transparency. Second, some PIM challenges arise from the tasks the company personnel carry out, defined here as the act of information quality manipulation. Third, and last, some product information -challenges are related to the common lack of exploitation of the requirements customers might have for product information.

4.3.1 Vast amounts and heterogeneity

According to Abraham (2014, p. 1), “-- most online stores now offer tens if not hundreds of thousands of products --”, and if the amount of products is already immense, even more so is the amount of product information. In large companies the information amounts PIM activities and personnel must handle for e-commerce purposes are undoubtedly extensive (Forza & Salvador, 2006; Otto et al., 2013; Permalla, 2006), especially when it comes to the vast product portfolios many industrial manufacturers offer for their customers in after sales (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). Merely the amount of information itself (Stark, 2005) is, thus, a major challenge for PIM.

Tremendous data volumes are challenging to handle within reasonable timeframes (Cai & Zhu, 2015; Haug et al., 2011; Otto et al., 2013), as many of the PIM tasks – such as consolidating and enriching – are still performed manually within the information systems. The systems at use for PIM are also at the limits of their capability to execute the manually initiated tasks, as the diversity of the big masses of information in the type, format, and structure among others, specifically challenges the systems’ performance capability and capacity to provide comprehensive views of the products for the customers (Cai & Zhu, 2015; Otto et al., 2013; Stark, 2005; Toews, 2012; Walther, Schuster, & Schill, 2009).

However, Ding et al. (2004) alongside Fensel and Ding (2001) argue that even though the amount of information can be problematic, the real challenge of PIM lies in the heterogeneity and disorder of product information. The lack of standards in the vocabulary used to describe the vast amounts of product information causes different people to describe products heterogeneously, which leads to disorder and confusion. Inharmonious product descriptions are particularly problematic because of the possibilities for misinterpretations and misunderstandings by the employees working with product information, or by the customers buying the products (Ding et al., 2004; Fensel & Ding, 2001; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002.) When there are vast amounts of information available, without standards for high quality, co-

herence, and homogeneity, it is not possible to generate great customer experiences (Kujansuu, 2016).

4.3.2 Defining overall high quality

Altogether one of the most critical challenges many companies face with product information is the debatable issue of its overall quality, which is discussed from various aspects in many prior researches and other publications on product information management (see e.g. Abraham, 2014; Ballou & Pazer, 1985; Barnes & Vidgen, 2006; Cai & Zhu, 2015; DeLone & McLean, 2004; Fang & Salvendy, 2003; Kropsu-Vehkaperä et al., 2009; Kujansuu, 2016, 2017; Otto, 2012; Walther et al., 2009; Wand & Wang, 1996). For example, Kujansuu (2016, 2017) emphasizes that high-quality product information is rich and homogeneous across the product catalog. It is thus vital to pursue quality, if a company wants to deliver great experiences for its customers and ease the management product information. Without this, the personnel and the customers cannot properly find the information they need, nor rely on its fit for their purposes (Otto, 2012).

The prevalent, but false perception companies have, is that a good product will sell itself without rich and high-quality product information in place (Silvennoinen, 2016). This most certainly is not the case in the information-driven society of today where e-commerce is continuously gaining more popularity. As Wand and Wang (1996) state, severe impacts on overall effectiveness of a company can originate from poor data quality, if not enough attention is paid to its significance; Cai and Zhu (2015) further argue that poor data quality can lead to deteriorating competence of information, and cause decision-making problems for both employees and customers. Thus, the importance of information and data quality should not be underestimated (Abraham, 2014) but recognized as a priority a company should pursue (Kropsu-Vehkaperä et al., 2009; Rund, 2013) in its product information management functions.

The main manifestation of the challenges that information quality presents is the global lack of unified and approved standards that could define the meaning and essence of good quality (Cai & Zhu, 2015). Many different definitions and lists of data quality features do, however, exist with some similarities. Already in 1985, Ballou and Pazer attempted to divide information quality into four more easily defined dimensions: accuracy, timeliness, completeness, and consistency. Following their lead, many later researchers have also divided information quality into similar less abstract components. For instance, Wand and Wang (1996) define data quality by its intrinsic factors of completeness, unambiguousness, meaningfulness, and correctness. On the other hand, information quality can be seen as a composition of accurate, believable, timely, relevant, easy to understand, and correctly detailed data (Barnes & Vidgen, 2006). According to Walther et al. (2009), ideal high-quality information is complete, correct, fresh, neutral, relevant, comparable, and verifiable.

In their model for e-commerce success DeLone and McLean (2004) discuss the factors of system and information quality, that can be seen as parts of over-

all quality of product information. The challenge here lies in the usability, availability, reliability, and adaptability of the e-commerce system, because without these features customers cannot even access product information. Additionally, the information that must be made available, usable, reliable, and adaptable, should also be personalized, complete, up-to-date, and understandable, so e-commerce customers can make justifiable purchasing decisions and get positive experiences from using the e-commerce website. (DeLone & McLean, 2004.)

As can be deduced from the above-presented researches (Ballou & Pazer, 1985; Barnes & Vidgen, 2006; DeLone & McLean, 2004; Walther et al., 2009; Wand & Wang, 1996) and from other prior literature (e.g. Cai & Zhu, 2015; Fensel & Ding, 2001; Kropsu-Vehkaperä et al., 2009; Manenti, 2010; Permalla, 2006), the main building-blocks of overall information quality are its availability, accessibility, up-to-dateness, reliability, completeness, accuracy, transparency, and richness. Providing at least some of these highly interrelated features is a significant, if not the most important challenge in PIM for e-commerce: if the PIM activities in a company do not aim at improving and ensuring these features of product information, customers cannot with ease find and purchase the products they need and want (Abraham, 2014; Cai & Zhu, 2015; Fensel & Ding, 2001; Kropsu-Vehkaperä et al., 2009; Manenti, 2010; Otto, 2012; Philpotts, 1996; Sivapalan, Sadeghian, Rahnama, & Madni, 2014), and will consequently be dissatisfied with their e-commerce experience.

4.3.3 Ensuring the quality features

Availability, the degree of convenience for customers to obtain data and information (Cai & Zhu, 2015), is critical in e-commerce environments (Manenti, 2010), as customers have to base all their judgement on the product information made available on product pages in order to be able to decide whether a product is the correct one they need and want. As much as the availability of product information is important for the customers (Cox & Dale, 2001; Stark, 2005), it is also necessary that product information is available within the company that manages it for all people who need it whenever and wherever they need it (Kropsu-Vehkaperä et al., 2009; Permalla, 2006; Solteq, 2017; Stark, 2005). However, it is an ongoing challenge to enable and ensure the sufficient availability of all necessary product information, without causing information overflow or overload (Anders Innovations, 2015; Främling et al., 2006).

Availability also refers to the accessibility of product information (Cai & Zhu, 2015). Accessibility is the level of difficulty any kind of a user faces when trying to find or obtain product information (Cai & Zhu, 2015). Accessibility proves to be challenging, when product information is not in its specified place (for example within the designated system), not easily found on the e-commerce website, or the format of the information is of the wrong kind. Additionally, accessibility becomes an issue especially when the information is entirely absent from the PIM system(s): if product information does not exist in

the systems where it is managed, it cannot be available and thus will not exist in the e-commerce either. (Srinivasan, Anderson, & Ponnnavolu, 2002.)

Timeliness refers to the up-to-dateness of information, which is a feature also associated with availability (Cai & Zhu, 2015; Cox & Dale, 2001). What is challenging about product information up-to-dateness, is that it should be ensured from the initial creation onwards (Kropsu-Vehkaperä et al., 2009). It is crucial that timely product information is constantly available in e-commerce – around-the-clock and every day (Cox & Dale, 2001; Philpotts, 1996; Solteq, 2017; Walther et al., 2009; Wang & Strong, 1996). However, even when the importance of up-to-date information is realized, it is not easy to provide and ensure it. Data volumes in companies are usually immense and the change-cycles of data and are fast; much information can become obsolete rather quickly and it is an arduous task to keep up with the constant changes and manage the vast amounts of product information accordingly without high-performance systems and automation. (Cai & Zhu, 2015; Manenti, 2010.) Although product information can sometimes change quite fast, information related to a product can also be even decades old or imported from outside the company (Abraham, 2014), which further challenge the management as updating information takes time and might require tacit knowledge that is not available anymore.

The information system and e-commerce success models by DeLone and McLean (1992, 2003, 2004) list completeness as one of the main features of information quality. Completeness refers to the state of being complete, or conversely not being incomplete. One challenge with product information completeness is the same as with the overall quality: it is hard to determine what exactly makes information complete. Is product information complete when all and every available piece of information related to a specific product is attached to it (Walther et al., 2009)? Or is it complete when someone decides there is enough information attached to a product while there still are more unattached information available, even though this would, in theory, mean the product information is still incomplete? A prominent challenge of product information is, thus, the requirement of completeness (Wang & Strong, 1996), albeit information almost always is at least partially incomplete (Abraham, 2014; Petre, Minocha, & Roberts, 2006).

Accuracy refers to the state where all information included in, for example, an e-commerce product page is correct (Fang & Salvendy, 2003; Fensel & Ding, 2001; Walther et al., 2009). Inaccurate, wrong, or dirty information can manifest in many ways: for instance, erroneous information can exist, words can be misspelled, or updates forgotten (Bernstein & Haas, 2008). Ensuring that these manifestations do not occur is a significant challenge for PIM, as inaccurate product information could lead to inferior customer and user experiences and consequently to financial losses (Kropsu-Vehkaperä et al., 2009; Philpotts, 1996; Swerdlow et al., 2016). If product information is inaccurate, customers cannot properly understand product categorizations and descriptions, or make sure they are purchasing the right products. Hence, information might be misleading, which most likely causes poor decisions. (Petre et al., 2006; Toews, 2012;

Wang & Wang, 1996; Wang & Strong, 1996.) Thus, product information accuracy should be pursued and, if possible, maximized (Keeney, 1999) because at the end of the day e-commerce customers' tolerance for erroneous information is quite low (Cox & Dale, 2001).

Complete and accurate information can enhance its reliability among customers and other users alike (Cai & Zhu, 2015; Stark, 2005). Reliability refers to the trustworthiness of product information: can product information users of any kind trust the information available to them? The concept of reliability can also be seen to reflect the characteristics of usefulness – does information meet the needs of the users, ergo, is it fit-for-use and relevant –, and understandability – do users understand what the information means and entails. (Cai & Zhu, 2015; DeLone & McLean, 2004; Haug et al., 2011.) In other words, if information is not understood, useful, or relevant, it might not be relied on by the users.

The information quality features of transparency and richness are not often mentioned in literature per se, but instead insinuated to be important and challenging when read between the lines. Wang and Strong (1996) suggest, that transparent information is interpretable, understandable at a glance, and concise. Lack of product information transparency can relate to information asymmetry, where a company has information on products that has not been disclosed to customers (Wells, Valacich, & Hess, 2011). Product information transparency can thus be achieved, if information is made as available, as accessible, as up-to-date, as complete, as accurate, and as reliable as possible, for all necessary parties. In other words, to be as transparent as possible, product information needs to be as rich as possible (Keeney, 1999). This is, however, challenging to accomplish (Ding et al., 2004) because enriching massive data volumes to a maximum would be a preposterous task. Deciding how to enrich product information so that as much information is provided as possible, but not so much that customers and company employees will get overwhelmed by it, is a unique PIM challenge for companies to face.

4.3.4 Manipulation of information quality

Xiao and Benbasat (2011) make interesting and important remarks on the possibility of manipulating product information. Even though their research focuses on deliberate and maliciously intended modification of product information in e-commerce environments for the purposes of deceiving customers, some observations can be directed into possible challenges companies are faced with PIM, when their intentions are not malevolent, but sincere.

Manipulation is an act of directly altering the content of product information that a company provides for its customers in their e-commerce website, with malign ulterior motives to deceive the customers (Xiao & Benbasat, 2011). However, companies sometimes want to or must change product information that they display on product pages for various reasons: information changes constantly and sometimes it is too dated and needs to be updated accordingly for it to stay up-to-date. Therefore, some manipulation of information content

will take place, but the intentions are not malicious. Product information is made available, enriched or edited, making it different compared to the one previously on the product page. This can make some customers wonder if the product is the same they have gotten used to, and take the company back to the challenge of product information reliability. Companies can also manipulate the presentation of product information on their e-commerce, altering how and where customers can see it (Xiao & Benbasat, 2011). For example, companies might recategorize products, simultaneously affecting the way customers find and recognize them. In many cases, especially in spare parts business, a company might also refrain from providing some product information, thus decreasing the completeness and transparency: the aim is to protect the business by not providing information that customers could utilize for purchasing the same product elsewhere. Both examples also yield challenges of information availability, accessibility, and reliability.

Another way of manipulating product information is (usually unintentionally) attaching old or wrong pictures to the products, or using pictures of small size and low resolution. This type of misleading information can lead to poor decisions, because customers cannot recognize the product at hand when textual product information is not in sync with the visual. (Xiao & Benbasat, 2011.) For example spare part photographs are a part of product information displayed on a spare part product page, and their quality affects the customer experience through up-to-dateness, accuracy, and reliability. Companies might adversely manipulate product information by not presenting pictures at all (Xiao & Benbasat, 2011). In this case customers' recognition of the product is left to hinge solely on the textual descriptions, which might not be enough to create positive experiences and encourage purchasing. Here, product pictures can make a difference: in most cases, a picture is worth a thousand words.

4.3.5 Customer requirements

A considerable amount of prior research and literature (see e.g. Abraham, 2014; Cox & Dale, 2001; Fui et al., 2002; Kujansuu, 2016; Manenti, 2010; Parasuraman, Zeithaml, & Berry, 1985; Petre et al., 2006; Swerdlow et al., 2016; Wand & Wang, 1996) highlights the importance of customer experience and the factors affecting its formation in e-commerce. In many cases, when there is a mention of product information and the possible issues regarding its quality and management in e-commerce, there is also a mention of customer experiences. Thus, customer experiences and requirements cannot be dismissed from the examination of PIM challenges in the context of B2B e-commerce, as both are clearly connected to the challenges related to product information (Kujansuu, 2016).

Product information has a significant role in customer experiences and purchasing decisions; the issue is to determine what information is vital and what is not (Fui et al., 2002). Problematically, even though a company might think their product information is of high-quality, customers might not see it that way (Wand & Wang, 1996). This causes a gap between the company's per-

ceptions of customers' needs and product information quality, and the customers' actual requirements and needs for the same (Cox & Dale, 2001; Parasuraman et al., 1985).

The best way to fill in the gap is to ask customers what they value and need (Abraham, 2014; Keeney, 1999). Today, customers usually demand more and better information on products: the baseline requirement for customers is that all wanted product information needs to be accurate and accessible as quickly and effortlessly as possible. (Abraham, 2014; Fui et al., 2002; Manenti, 2010; Petre et al., 2006; Swerdlow et al., 2016) Having said that, customers are also prepared and motivated to extensively seek out relevant information on products so they can make comparisons and confirmations that they have found the best and right product to purchase (Abraham, 2014; Chua et al., 2010; Dahlén, Rasch, & Rosengren, 2003). This challenges companies to offer and ensure the information quality features, especially in the B2B environment where customers are more demanding than consumers in B2C environment (Anders Innovations, 2015).

Customer requirements are, however, unpredictable and questionable. It is challenging for customers to determine what information is vital or unnecessary without concrete incentive examples, as they generally do not exactly know what they want (Abraham, 2014; Fui et al., 2002; Swerdlow et al., 2016). Usually the case is, when customers are asked about their requirements, that they want as much information – such as basic and specific details, comprehensive attributes, and clear product pictures – available as possible (Kujansuu, 2016; Lightner & Eastman, 2002). This causes a unique challenge for PIM: how to provide high-quality product information within reasonable timeframes with the existing resources, if the customers cannot be specific about what they need and want?

4.4 Summary and framework for B2B e-commerce PIM challenges

Based on the examination of PIM and its challenges in interorganizational e-commerce in this chapter 4, a theoretical framework can be generated for the purposes of the empirical research seeking answers to the research question: *What product information management challenges can arise in B2B e-commerce?* The challenges emerging from the basis of prior literature and research are associated with PIM for B2B e-commerce purposes, and connected to either information systems, organizational aspects, or product information, which are consequently set up as the challenge viewpoints of the theoretical framework.

The main purpose of the framework is to summarize and unify the plethora of prior research and literature with various areas of focus, that examine the concepts of product information management and its challenges in relation to interorganizational e-commerce. Furthermore, the aim is to solidify the ways of identifying the different challenges, so they can be acknowledged, sought out, and possibly resolved more comprehensively, thus allowing the pursuit and

ensuring of better product information management practices, improved product information quality, and possibly enhanced customer experiences.

The challenges associated with the information systems at use for PIM purposes are summarized below (Table 2), with some examples of the manifestations presented in the sub-chapters of chapter 4.1. The categories for information system -challenges are the following: use of various systems, integration of various systems, data transfers, data formats, system features, and system updates.

TABLE 2 Information system -challenges for PIM

Information system -challenges	Example manifestation
Use of various systems	Product data decentralized into many systems
Integration of various systems	Legacy systems not integrable with other systems
Data transfers	Data transfer between systems is unsuccessful
Data formats	Data formats of one system not supported in others
System features	Missing functionalities prevent PIM actions
System updates	Added functionalities require new learning

Similarly, the PIM challenges arising from the organizational viewpoint are summarized in Table 3 along with examples of the potential manifestations introduced in the sub-chapters of chapter 4.2. The categories for organizational challenges are the processes, the standards, and the people of the company where PIM is needed for e-commerce purposes.

TABLE 3 Organizational challenges for PIM

Organizational challenges	Example manifestation
Processes	Many PIM tasks need to be executed manually
Standards	No standard processes for PIM
People	Different people describe products differently

Lastly, the PIM challenges that manifest from the product information itself are summarized in Table 4 below, with possible exemplary instances attached, derived from the narrative in chapters 4.3.1 through 4.3.5. The categories for product information related challenges are associated with the vast amount of information and its heterogeneity, its overall quality, the various quality features, the acts of quality manipulation, and customer requirements.

TABLE 4 Product information -challenges for PIM

Product information -challenges	Example manifestation
Vast amount and heterogeneity	Huge data volumes are challenging to manage
Overall quality	Defining what information quality entails is hard
Quality features	Ensuring e.g. information availability and accuracy
Quality manipulation	Modifying e.g. information content or presentation
Customer requirements	Customers cannot specify what they want

5 RESEARCH METHOD AND MATERIAL

This chapter discusses methods used to acquire and analyze the empirical research material of this thesis. First, the objective and the research problem of this thesis are redeclared. The company taking part to the empirical research is also anonymously introduced. Additionally, research methods, strategies, and data acquisition techniques used in the empirical study are presented and the selections are justified. Moreover, the process of collecting the research material is explained before moving on to presenting the analysis techniques for the research results and addressing the concepts of research reliability and validity.

5.1 Research objectives and research problem

The main objective of this study is to focus on uncovering the possible challenges companies can encounter in B2B e-commerce product information management, by the means of empirical qualitative case study research. The research problem in this thesis is to clarify the challenges companies can have in managing the product information for their B2B e-commerce purposes. The research question generated from the research problem is:

- *What product information management challenges can arise in B2B e-commerce?*

Additionally, for the purposes of the empirical study, one supporting research question is generated from the theoretical framework developed in the previous chapter to address the studied phenomenon in within the studied Company:

- *What information systems -, organizationally-, and product information -related product information management challenges exist regarding the Company's e-commerce?*

The empirical objective of the study is to seek answers to both research questions above. The research thus pursues to find out whether the Company faces any PIM challenges in their activities regarding the Store. Specifically, the aim is

to also discover whether the possible emerging challenges are related to information systems at use for PIM, to organizational aspects of PIM, or to the product information itself needed in the e-commerce.

5.2 Research case company

The subject of this thesis' empirical research is the product information management for e-commerce purposes within the case company (Company). The Company is an industrial manufacturing company specialized in cranes and crane parts, serving a broad range of different industries and specific customers. The global and international company is a world-leader in original equipment manufacturing (OEM) as well as in providing various lifting solutions, equipment, and different services for distinct lifting needs, and has over 15 000 employees in 50 countries.

The Company has three business areas out of which Service is one. Service focuses on providing maintenance and spare parts for the company's customers, specifically for any type and all makes of industrial cranes, hoists, and port equipment. One of the business units within Service is after sales and spare parts. The Company is known-for and successful in providing various kinds of spare parts and maintenance for all kinds of cranes and hoists regardless where and by whom the original product is made, thus rightfully earning the leading overhead crane maintenance supplier status. Customers can procure the spare parts through traditional call orders or inquiries still common in the industry, but also through the Company's e-commerce (further on referred to as Store).

The Store is used by both internal customers, such as service technicians, and end-customers, while being internationally available for a selection of countries in Americas, Europe, Middle East, Africa, and Asia. Featured in the Store are spare parts and accessories for various cranes and hoists, as well as for selected pre-configured lifting equipment. For each product, at least the following information is made available in the Store: a product identifier (ID) and a brief product description or a specification. Availability information is also provided; the detailed inventory information is dependent on the geographical Store area and shown for registered customers along with prices.

In the Company, management and enrichment of product information for the purposes of the Store are handled within several information systems. For instance, *Teamcenter* is used for PLM and PIM purposes alike. *Aton* is a legacy system that continues to store pieces of product information needed in the Store, in addition to being the master system for some of the spare part product items. *SAP* is utilized for ERP activities, but it also serves PIM purposes. Many important PIM tasks are carried out in *IBM Management Center* (further referred to as IBM MC), the foundation and the user interface for the Store: hence the customer interface and usability features are managed there. *Alfresco* is used for storing certain product information and documentation, and for performing the related management tasks. Furthermore, some older systems, such as some versions of *ILM(ari)*, are still used for storing and searching for data.

The company has around 335 000 items in their Store database, which are the digital representations of their physical products. The number of items for sale in the Store is over 309 000. These items that digitally represent the physical products, are identified by item IDs, which in the case of the Company are unique numeric identifiers. Multiple identifiers have been created for the same physical product during the past decades in various information systems and companies, that all appear as individual products within the Store. So, when a physical product has only one digital representation (the item that has its own unique ID), items can have many different occurrences in the Store, called products, all of which have their own identifiers. Thus, the number of products that are in the Store's database is about 600 000. As can be seen, the number of items and products, and hence the amount of product information is high, which only adds to the complexity of the management and enrichment tasks.

Markets and competition force the Company to strive for comprehensive product information in the Store, to positively stand out from competition. This would enable customers to uniquely identify the product they need. However, providing "too much" information should be avoided to minimize inconveniences for various stakeholders. This should help customers to recognize and buy the products from the Store, but also restrain them from buying the products elsewhere. All this requires and encourages the Company to discover their PIM challenges, so they can be resolved.

5.3 Research method

Within the academic field of information systems (IS), the research has usually focused on utilizing quantitative methods (Kaplan & Duchon, 1988). However, studies within the IS field have started to shift towards qualitative research methods (Benbasat, Goldstein, & Mead, 1987), as investigating context-dependent and fast-changing phenomena related to people and information requires more flexible methods than the standardized quantitative methods can offer (Kaplan & Duchon, 1988; Sarker, Xiao, & Beaulieu, 2013). For the empirical study of this thesis, qualitative research method is selected.

Qualitative research can take a positivist, an interpretive, or a critical stand (Crowe et al., 2011; Myers, 1997; Orlikowski & Baroudi, 1990). In positivist qualitative studies, the main attempt is to test a theory for increasing the predictability of a phenomenon. Interpretive qualitative studies pursue to increase understanding on a certain phenomenon through people's opinions and assigned meanings. Lastly, critical qualitative research assumes that social reality is produced by people and brings attention to the existing state of affairs – status quo – through restrictive conditions. (Crowe et al., 2011; Myers, 1997; Orlikowski & Baroudi, 1990.) Eskola and Suoranta (2014) argue, that qualitative research can also be naturalistic, where absolute non-manipulation of the studied phenomenon is pursued. This thesis is a combination of interpretive and critical qualitative research, with hints of naturalistic objectives involved. The purpose is to understand the studied phenomenon of PIM challenges through the assigned

meanings and opinions of the personnel within the Company without manipulating the study, but also to include a restrictive condition for the existing state of the studied phenomena. The restrictive conditions are the ones already mentioned in prior chapters: the discussion focuses on only the B2B type of e-commerce, specifically within the Company's spare part unit, and on PIM challenges from the viewpoints of information systems, organizational aspects, and product information.

Qualitative study is usually selected as the research method, if the studied phenomenon or the field of study is completely new, as qualitative research fits best for shedding light on the unknown (Hirsjärvi, Remes, & Sajavaara, 1997). Other reasons why qualitative research methods are utilized, are usually justified followingly in methodology literature and scientific articles (see e.g. Eskola & Suoranta, 2014; Gillham, 2000; Hirsjärvi et al., 1997; Kananen, 2010; Kiviniemi, 2007; Myers, 1997; Vilkkka, 2017): there is only little information available on the studied phenomenon; the purpose is to gain understanding on the studied phenomenon; the aim is to give a good description of the studied phenomenon; there is a need to gain knowledge on individual opinions and assessments about specific issues; the objective is not to uncover ultimate truths; the study of the phenomenon is not based on hypotheses.

In order to appropriately present the understanding gained through qualitative study, one needs to compose not only a verbally comprehensive description of the studied phenomenon (Kananen, 2010), but also a sustainable standpoint backed up with empirical results (Eskola & Suoranta, 2014) without pursuing statistical generalizations (Eskola & Suoranta, 2014; Hirsjärvi et al., 1997). Additionally, according to Vilkkka (2017), qualitative research aims at emancipatory evolution: increasing the understanding of the individuals involved in the research about the phenomenon being studied, thus improving their ways of acting and thinking.

The purposes of this study match most of the descriptions of qualitative research. For instance, the objective is not to uncover ultimate truths about PIM challenges in B2B e-commerce, but to gain information and personal insights on the issues, formed by the people within the Company. Additionally, even though B2B, e-commerce, and PDM and its challenges are individually highly studied topics in many academic fields, none too many studies have been conducted on PIM with the connection to challenges and B2B e-commerce, especially within the niche of industrial manufacturing and spare parts business. Thus, the qualifying feature of little information available is partially fulfilled. Moreover, this thesis not only aims at understanding the studied phenomenon without hypothesizing beforehand, but also strives for emancipatory evolution and giving thorough descriptions without forming statistical generalizations.

5.3.1 Research strategy

The most used research strategies in studies conducted with qualitative methods are action research, case study research, ethnography, and grounded theory

(Myers, 1997). For the purposes of this thesis, the case study research strategy (further referred to as case study) is selected because of its best fit, and will hence be the only strategy introduced here. Case studies are the most common research strategy within qualitative methodology (Orlikowski & Baroudi, 1990). A study following the said strategy investigates contemporary phenomena within natural and real-life contexts (Yin, 2003), where a researcher does not participate in the procedures and operation of the research subject during the time of research (Benbasat et al., 1987; Kananen, 2010). In this thesis, the empirical research is conducted within the natural context of the studied phenomenon, and the researcher does not take part in the Company's operations during the research. Consequently, the selection of case study strategy is justified.

A case study is empirically conducted by gathering in-depth knowledge on a phenomenon without manipulating or isolating it from its natural settings (Aaltio & Heilmann, 2010; Benbasat et al., 1987; Crowe et al., 2011; Hirsjärvi et al., 1997; Laine, Bamberg, & Jokinen, 2007; Yin, 1994, 2003). Hence, the primary purpose is to produce and express information on circumstances, processes, and the associated meanings of a phenomenon that are tied to a specific time and a place (Peltola, 2007). A case study additionally has theoretical frameworks or concepts guiding the data acquisition and analysis (Yin, 1994). As in qualitative studies in general, in case studies the objective is to thoroughly understand the studied subject and make appropriate interpretations from the gained information, all the while taking the circumstances within which the study was conducted into account (Aaltio & Heilmann, 2010; Eskelinen & Karsikas, 2014; Laine et al., 2007; Leino, 2007). Additionally, according to Benbasat et al. (1987), case study is well suited for studying and documenting the experiences of practice and individual knowledge within contexts where few prior studies have been conducted. These arguments are viable also in this thesis; hence, using case study as a research strategy is further justified.

Case studies can be conducted on either single or multiple cases (Vilkka, 2017). Multiple case studies are reasonable when the researcher desires to make comparisons between different instances, and when the goal is to build or describe a theory (Benbasat et al., 1987; Crowe et al., 2011). However, it is much more common for a case study to focus on a single case (Eskola & Suoranta, 2014; Laine et al., 2007; Vilkka, 2017), as is also done in this thesis.

There are several reasons to select a single case as a subject of a case study. The selected case can be a very typical one that represents the phenomenon and other possible case-alternatives well (Eskola & Suoranta, 2014). The case can also be very unique, or an exceptionally revealing one (Benbasat et al., 1987; Crowe et al., 2011; Eskola & Suoranta, 2014). The selected case could also be of no particular importance by itself, but is selected because it simply allows a researcher to study a specified phenomenon (Crowe et al., 2011). Whatever the reason for selecting a singular case may be, it is the nature of those studies to be exploratory without theorizing (Aaltio & Heilmann, 2010; Otto, 2012; Yue, 2010). This thesis focuses on a single case because of its representative essence and

revelatory state; the selected case also aptly enables the explorative research of the theoretical phenomenon of B2B e-commerce and PIM challenges.

5.3.2 Data acquisition techniques

In academic studies, it is important to understand the concept of samples. There are various possible units of analysis that could be studied, such as expert individuals, groups, companies, events, and systems (Benbasat et al., 1987; Laine et al., 2007; Vilkkä, 2017). That being said, it is fairly impossible to investigate all available instances of the selected units of analysis; this is where sampling steps in (Walliman, 2017). In qualitative studies the sampling is not random as in quantitative studies (Walliman, 2017), but done purposefully by selecting a small group of specified and theoretically appropriate instances to be researched: this is called purposive sampling (Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Vilkkä, 2017). Purposive sampling is guided by research objectives and it aims at obtaining a comprehensive set of research material (Vilkkä, 2017) along with enabling the formation of deeper understanding on the studied phenomenon (Hirsjärvi & Hurme, 2011). In this research, the unit of analysis is set on individuals, and the study participants are then purposefully sampled amongst the Company's employees and customers while considering the research objectives and the solving of the research problem.

In qualitative case studies, the techniques of acquiring information from the purposive sample are several but the following are most often used: observations, participating fieldwork, and interviews, as well as documents, archives, books, and other previously published material (Eskelinen & Karsikas, 2014; Eskola & Suoranta, 2014; Gillham, 2000; Kananen, 2010; Myers, 1997; Vilkkä, 2017; Yin, 1994). However, generally in qualitative research people are the popular choice as sources of information because of their adaptability in different situations, which is why researchers tend to lean towards trusting their own observations or conversations with the researched individuals, rather than utilizing secondary, previously documented information (Hirsjärvi et al., 1997).

When qualitative methods are chosen, data are generally over any other means collected through interviews, which are the main techniques of data acquisition especially in case studies (Aaltio & Heilmann, 2010; Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997; Myers, 1997; Rantala, 2007; Sarker et al., 2013). Hirsjärvi et al. (1997) offer several reasons for utilizing qualitative interviews. Their reasoning is further supported by other authors and researchers (Barlow, 2010; Eskola & Suoranta, 2014; Gillham, 2000; Hirsjärvi & Hurme, 2011; Kananen, 2010; Vilkkä, 2017; Walliman, 2017), thus making the justifications for why and when qualitative interviews should be used quite validated:

- Individuals, through their opinions, experience, and knowledge, are the key in generating meaning for the studied issues (Gillham, 2000; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997; Vilkkä, 2017);

- The selected interviewees are relatively similar-minded and interested in the studied subject (Eskola & Suoranta, 2014; Hirsjärvi et al., 1997; Kananen, 2010; Vilkkka, 2017);
- The researcher might want to ask follow-up questions or motivate the interviewees (Gillham, 2000; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997; Walliman, 2017);
- The data collected from the conversations will be incorporated into a larger context (Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997).

In this research, individuals are in a key position to provide beneficial information for the purposes of resolving the research problem. Additionally, the interview results will be mainly unpredictable, as the questions focus on opinions and experiences; thus, the possibility to ask follow-up questions is essential. Moreover, the data from the interviews will be compared with prior literature and research, and not only addressed as is. As these justifications are backed up by literature, the data collection technique in this thesis is set on interviews.

Qualitative interviews can be conducted in several ways, such as face-to-face, online, via e-mail or by telephone (Barlow, 2010) – nowadays, it is also very common to combine face-to-face and telephone interviews by making video-calls via, for instance, Skype (Walliman, 2017). However, it is more typical to distinguish different interviewing styles from one another by separating them into three types: structured interviews, unstructured interviews, and semi-structured interviews (Barlow, 2010; Hirsjärvi et al., 1997; Vilkkka, 2017).

Structured interviews, also known as form interviews, are highly standardized when it comes to the order of questions and the possible ways to answer them (Barlow, 2010; Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997; Hyysalo, 2006; Vilkkka, 2017; Walliman, 2017). Conversely, unstructured interviews are very much open and similar to an ordinary conversation, where certain subjects are discussed usually without any predefined questions (Barlow, 2010; Eskelinen & Karsikas, 2014; Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997; Vilkkka, 2017; Walliman, 2017). Semi-structured interviews are described to be a crossover between structured and unstructured interviews (Barlow, 2010; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997) with a convenient combination of standardization and openness.

In this thesis, for the purposes of the empirical research, semi-structured interviews are selected as the data acquisition technique because of their best fit: using structured interviews would be too restrictive in relation to the interview content and execution, whereas unstructured interviews would be too informal and open for eliciting information needed for solving the research problem.

Usually in semi-structured interviews the central topic of the study is divided into themes, all of which will be discussed in the interviews through predefined questions, whose order is, however, not strictly locked in (Eskelinen & Karsikas, 2014; Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Hirsjärvi et al., 1997; Hyysalo, 2006; Vilkkka, 2017). All the themed questions are, nonetheless, presented for every interviewee, who can answer them with their own words

(Eskola & Suoranta, 2014; Hyysalo, 2006; Vilkkä, 2017; Walliman, 2017). Having said that, asking follow-up questions or giving simple tasks for the participants is also relevant in semi-structured interviews: this way researchers can seek further details, and the research problem can be solved more thoroughly (Eskelinen & Karsikas, 2014; Hyysalo, 2006; Vilkkä, 2017).

Within the semi-structured type of interviews, there is a possibility to conduct them as individual interviews or group interviews (Kananen, 2010; Vilkkä, 2017). Most commonly the interviews are executed individually, where only one person at a time is being interviewed (Hirsjärvi et al., 1997; Kananen, 2010; Vilkkä, 2017). Individual interviews fit exceptionally well for studying personal experiences on a subject (Vilkkä, 2017), and usually yield a large amount of information (Kananen, 2010) that can be highly remarkable and precise (Hirsjärvi & Hurme, 2011). Group interviews are, naturally, settings where more than one individual is interviewed at the same time on the same subject, in a rather brainstorming -like situation (Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Kananen, 2010). Group interviews can generate a lot of information from many people in a short amount of time (Hirsjärvi & Hurme, 2011): these also enable the researcher to observe how interviewees form mutual and shared opinions on specified subjects (Vilkkä, 2017) while they recall past experiences together and confirm or object the opinions of one another (Eskelinen & Karsikas, 2014; Eskola & Suoranta, 2014). Group interviews can also be executed in pairs, where only two people are interviewed simultaneously (Hirsjärvi & Hurme, 2011; Vilkkä, 2017). This thesis will leverage both individual interviews and group, more precisely, pair interviews.

5.4 Research material collection

The research material collection for the purposes of this thesis' empirical study was conducted with semi-structured interviews in the spring of 2018. As already mentioned, in this study there was one unit of analysis, individuals, who were purposefully sampled amongst the employees and the customers of the Company. The research material collection for this thesis consisted of three phases, that are introduced in the following sub-chapters: purposive sample selection, interview form preparation, and interview execution.

5.4.1 Purposive sample selection

The purposive sample of the employees was selected from the basis of suggestions and personal experience. Having worked at the Company prior to this study provided knowledge on the possible persons who could have information on or opinions about the studied subject. Additionally, a contact-person within the Company provided names on a similar basis: who could contribute to this research? Eight employees in total were selected to take part in the interviews. They were divided into pairs sharing similar mindsets and understand-

ing on the studied subject. This resulted into four interviewee-pairs: data-team, product manager -team, e-commerce -team, and IT -team.

The customers were purposively sampled with the help of three subject matter experts. One of the three experts, already an employee-participant, was also selected to represent customers due to his substantial knowledge on customer aspects of product information and its challenges in the Store. Additionally, three more customers were selected and contacted to take part in the study. Two were internal customers and one was an external end-customer. A basis for the selection of these customers was their prior use of the Company's Store. Both external and internal customers were interviewed along the employees to get a more thorough picture on the customers' outlook on the studied subject.

5.4.2 Interview form preparation

Two separate semi-structured interview forms were designed – one for the employees and one for the customers. The forms were based on the PIM challenges in B2B e-commerce -framework presented in chapter 4.4. The purpose of basing the interview forms to the theoretical framework was to clearly address and solve the research problem through interview results.

The employees' interview form included all three viewpoints from the framework as main themes: information system -challenges, organizational challenges, and product information challenges. The purpose was to acquire subjective opinions and experiences from the employees regarding the possible extant PIM challenges in the Company, that could all in a way have an effect on the Store, on the customers, or on the other employees working with product information needed in the Store. The theme in the customer interviews was set on only product information -challenges, as it was the only viewpoint the customers could be interviewed on regarding the product information (management) challenges associated with the Company's Store. The reason why customers were selected to be interviewed at all, was that they could provide valuable insights into the possible challenges the Company has with the Store's product information. Also, as explained in chapter 2.5, customer aspects strongly relate to the existence of issues with product data and its management.

Within the interview themes, main questions to be asked from all participants were generated. Further questions were listed below each main question, that could be asked if not enough information would be yielded by solely asking the main questions. The employee interview form consisted of 14 main questions, each with one to seven possible further questions (see Appendix 1). Respectively, the customer interview form consisted of nine main questions with one to seven possible further questions (see Appendix 2) The to-be-asked background questions are also visible for both forms in Appendixes 1 and 2. Most of the interviews were conducted in Finnish, so Finnish versions of the forms were generated based strictly on the English ones. The Finnish versions are not presented in the appendixes, as the English versions were determined to be sufficient.

Moreover, example e-commerce product pages were created to be shown with question 13 for employee interviews and with question seven for customer interviews. The creation of these examples was limited; the Company offers so many distinct spare part products that covering the different product information types for all would not have been feasible in this study. The selected examples focused on three specific products and their information that were all representatives of certain product types: an electrical product, a mechanical product, and a product set. In the interviews, the examples included the actual product information, but for the purposes of requested Company anonymity and product information confidentiality the example product pages included in this thesis (see Appendix 3) were anonymized into generic product pages.

5.4.3 Interview execution

Group interviews are an excellent fit for semi-structured interviews: the aim of the interviews is to be relatively informal, but at the same time the focus should be on a specified issue (Eskola & Suoranta, 2014). Also, group interviews suit well for gathering large amounts of information simultaneously from multiple individuals (Hirsjärvi & Hurme, 2011). For these reasons, the employees of the Company were interviewed in pairs. If the group size was any larger, it would have been hard to select participants with similar mindsets on the studied subject, which is a notable issue in group interviews (Eskola & Suoranta, 2014). Furthermore, limiting the group size to two participants was a feasible way to allow all participants to be heard and to keep the discussion focus on the subject.

The background information for the eight employees who took part in the pair interviews is presented below (Table 5). The table does not include the number of used systems in where product information is handled daily: this number varied from two to seven for the participating employees.

TABLE 5 Employee -interviewee statistics

Interviewee	Job description	Time in the company	Time in current position
1	Item data analyst	7 years	3 years
2	Item data analyst	4 years	4 months
3	Product manager	28 years	28 years
4	Product manager	7 years	7 years
5	E-commerce configuration owner	4,5 years	4,5 years
6	IT service head	17 years	8 months
7	E-commerce manager	3 years	3 years
8	Digital service manager	5 years	1 year

The customers were interviewed individually. Their firsthand experiences and opinions regarding the studied phenomenon needed to be discovered for the purposes of solving the research problem properly: individual interviews are a suitable choice for investigating these issues (Vilkkka, 2017). Another major reason for interviewing the customers individually was the arduousness of organizing group interviews for them, mainly because all the participants either resided in different cities or countries, or were not employed by the Company.

The background information on the interviewed three internal customers and one external customer are introduced below (Table 6). Information not included in the table is associated with the Store use: the customers had used the Store from two to four years, and they used it either every day or only up to twice a month.

TABLE 6 Customer -interviewee statistics

Interviewee	Customer type	Country	Job description	Time in current position
8	Internal	Finland	Digital service manager	1 year
9	Internal	Sweden	Inside spare part sales representative	1 year
10	Internal	United Kingdom	Inside sales representative	4 years
11	External	Finland	Mechanic	9 years

In this thesis' research, the actual interview execution consisted of two parts: the pre-interviews and the further interviews. According to methodology literature, arranging a few pre-interviews is more than preferred (Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011). As Hirsjärvi and Hurme (2011) state, the purpose of pre-interviews is to test the interview form to assess the length of the interview situation and to see if the questions are clear and understood. Because of this, two separate pre-interviews were arranged, one for each group of interviewees, the employees and the customers. The pair participating to the pre-interview of the employees was the data-team (interviewees 1 and 2), and the individual pre-interviewed for the customer's side was the expert individual (interviewee 8). Before the pre-interviews, the participants were given the opportunity to familiarize themselves with the interview form and the example pictures.

After the pre-interviews, nothing needed to be changed regarding the interview forms or example pictures according to the interviewees, so the remaining interviews were arranged and conducted for the product manager -team (interviewees 3 and 4), for the IT-team (interviewees 5 and 6), and for the e-commerce -team (interviewees 7 and 8). The interviews were also carried out for the external customer (interviewee 11) and for the two remaining internal

customers (interviewees 9 and 10). Just like the pre-interviewed employees, all the other interviewees had the opportunity to familiarize themselves with the interview forms and the utilized example pictures. In total, as per the purposive sampling, 11 individuals participated the interviews.

The interviews took place during eight separate occasions. The information about the interviews regarding the participants, the interviewing type, the interviewing means, interview durations and the interview recording methods are described in the table below (Table 7). Additionally, it should be noted that all but two interviews were arranged in Finnish; interviewees 9 and 10 were interviewed in English.

TABLE 7 Interview statistics

Interview type	Interviewees	Means	Duration	Recording method
Group, Pre	I1 and I2	Face-to-face	1 h 40 min	Phone, computer
Group	I3 and I4	Face-to-face	1 h 27 min	Phone, computer
Group	I5 and I6	Face-to-face	1 h 36 min	Phone, computer
Group	I7 and I8	Skype	2 h 1 min	Phone, computer, Skype
Individual, Pre	I8	Face-to-face	59 min	Phone, computer
Individual	I9	Skype	30 min	Phone, computer, Skype
Individual	I10	Skype	34 min	Phone, computer, Skype
Individual	I11	Phone	32 min	Written notes

In the employee interviews, the pair dynamics were great and the mood of the discussions was light. However, in every pair interview, one interviewee appeared to be more vocal than the other, even though the researcher took both participants equally into account while asking the interview questions by encouraging both into answering. This might simply be explained by the interviewees' personalities and ways of speaking. That said, the interview questions engendered open and flowing conversation-like discussions: when one interviewee stated something, the other usually agreed or provided examples of such situations, or disagreed and justified their opinion out of which further opinions and comments originated. Also, what can be deduced from the interviewees responses and comments after the interviews, is that their understanding on the big picture of the PIM challenges was improved, when they had the chance to discuss their own experiences and opinions about those challenges from three different viewpoints.

What comes to the individual customer interviews, the situations were positive and the customers were eager to share their opinions and experiences. Noteworthy is, that all customers felt that the interview situation made them understand some of the questions more clearly: some questions they initially

thought they had no comments on, they were in the end able to remember something to explain or describe about when encouraged. It could thus be stated, that the interview induced contemplation amongst the customers over their own experiences on the challenges they have had with the Store and the product information, which yielded valuable data for this thesis.

The purposefully sampled interviewees can cause bias on research results. For example, most of the interviewed employees work in the same department with highly connected tasks: as such, their opinions and experiences could have been highly similar. To avoid biased results and to get a broad picture of the research subject from different viewpoints, the selected interviewee (employee) pairs were all different from one another by at least their job descriptions or work experience. The similar possibility of bias in the research material acquired from the customers was handled by selecting the interviewed internal customers from different countries. Also, to treat internality bias, one external customer was interviewed. All in all, even though no research is ever completely bias-free, in this thesis the possible threats of bias regarding research results and interviewees were dealt with diversification.

5.5 Research material analysis

The analysis phase in academic studies includes the whole process of handling, examining, and interpreting the collected research material for the purposes of producing viable research results and deductions (Hirsjärvi & Hurme, 2011). Especially in qualitative studies, the purpose of analyzing the research material is to organize and clarify the collected data in order to summarize it without losing the informative value within, so that new information on the studied subject can be introduced (Eskola & Suoranta, 2014).

Specifically in qualitative case studies, the analytic strategy that is usually leveraged is the theoretically based analysis (Eskola, 2007), which is also utilized in this thesis. Here, the purpose is – classically – to start from a theory and return to it after the empirical research, so that comparisons between the research data and prior literature can be made (Eskola, 2007.) Eskola (2007) also clarifies, that the theoretically based analysis does not have to be based on a sole grandeur-theory, as there can be multiple pieces of literature and prior research that are utilized together in forming the theory basis for the research and the analysis of the material to come.

Usually in qualitative case studies, especially when interviews are utilized as the data acquisition technique, some form of recording, such as audio recording, is used for rigorously collecting the research material (Eskola, 2007; Hyysalo, 2006; Rantala, 2007; Sarker et al., 2013). This way the researcher does not have to rely solely on their memory when analyzing and discussing the results. The first step in the analysis phase is to somehow transform the collected material from the recordings into usable, usually textual, forms (Eskola, 2007; Hirsjärvi & Hurme, 2011; Vilkkä, 2017): this phase is called transcribing.

After transcribing the recorded research material, the analysis technique is selected. With the selected analysis technique, the research material is examined through the transcribed data by systematically organizing it into different groups, classes, types, or themes (Eskola, 2007; Vilkkä, 2017). These techniques of organizing the research material are called typification, classification, and thematization (Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Walliman, 2017). Out of these, the typical way to approach qualitative research material analysis is through classification and thematization (Eskola & Suoranta, 2014).

Classification can be understood as a preceding step to thematization, where the research material is divided into distinct categories and groups. (Hyysalo, 2006; Jyväskylän yliopisto, 2010). Classifications, which are usually determined with the help of existing theories, especially in the theoretically based analysis strategy (Kananen, 2010), are the building blocks of analysis with which the research material can be sorted out into coherent segments – classes – that determine what shared features the individual pieces of research data have in common (Hirsjärvi & Hurme, 2011). After classification, it is common to also thematize the research material further: thematization is done by collecting, for instance, the interview quotations that address similar matters into sub-classes, themes (Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Jyväskylän yliopisto, 2010). Thematization is always done according to the interpretations of the researcher, who searches for similarities amongst the research data in order to divide the material into understandable entities (Eskola & Suoranta, 2014).

In this thesis, the empirical research is based on the theoretical framework created in chapter 4.4, which will also consistently guide the upcoming introduction and analysis of research data and results. The analysis of the collected research material was always initiated as soon as possible after the interviews by transcribing them manually into text documents. After full transcriptions, the interviews held in Finnish were translated into English. Following the transcriptions and translations, the analysis techniques of classification and thematization were used for organizing the research material for the purposes of facilitating the introduction and further analysis of the research material. The classification and thematization of the research material were also conducted according to the theoretical framework: the transcribed quotations from the interviewees that had anything to do with research problem were first categorized into three main classes, represented by the three PIM challenge viewpoints of the theoretical framework. Then, the quotations were thematized by assigning them into sub-classes, so the material could be sorted out into understandable divisions of repeating themes represented by the challenge categories within the framework viewpoints. Lastly, the thematized data was organized to form a coherent whole that follows the principals of the theoretical framework.

The purpose of these analysis steps are realized after the introduction of research results: the objective is to make abductive deductions by creating “discussion” between the current research material, prior research on the topic, and the theory derived from the literature (Eskola, 2007; Hirsjärvi & Hurme, 2011). This way the analysis will not be just a collection of quotations presented as re-

search results (Eskola, 2007), but a thrust towards understanding the studied phenomenon more comprehensively (Hirsjärvi & Hurme, 2011).

It should be noted, that the three PIM challenge -viewpoints emergent in prior literature, also discussed in the interviews, are connected to one another. Hence, the interviewees' remarks might resonate with more than one viewpoint (class) or challenge category (theme). The researcher decided to, however, give each recorded challenge only one class, either information systems, organizational aspects, or product information. Moreover, such a sorting was also carried out for the challenge themes within those classes. So, even though all the interviewee quotes about the challenges have been classified into one viewpoint and thematized into one category, one quote might address multiple different themes within its class because of the connectedness of the challenges. Consequently, even though a challenge is introduced and exemplified through quotations under one viewpoint in relation to a specific challenge category, it might relate to other viewpoints and categories as well. Also, noteworthy is that all the case study results could not be included in the introduction and discussion of the results, as the amount of diverse data gained from the interviews proved to be massive. That said, to get a comprehensive understanding about the studied phenomenon, the researcher used her best judgement to introduce as much of the interview data as possible through the classified and thematized results.

5.6 Research reliability and validity

Traditionally, research reliability refers to the repeatability of the measurements and results, ergo, to the ability to produce results and conclusions that are not random (Hirsjärvi et al., 1997; Ward & Street, 2010). However Miles, Huberman and Saldaña (2013, p. 312) argue, that reliability in qualitative case research should be seen as a combination of dependability and auditability, and be evaluated through statements such as the following: the research questions are clear and the study is compatible with them; the researcher's role has been explicitly described; and the analytic constructs are clearly specified. Additionally, objectivity and freedom from biases are listed as requisites for reliability. These can be ensured, if the research methods are explicitly described, the sequence of data collection, transformation and conclusion drawing can be followed, the study methods are explained, and limitations are considered. (Miles et al., 2013.)

In qualitative case studies, reliability however is mostly centered on the evaluation of process dependability and the meticulousity of process introduction (Benbasat et al., 1987; Eskola & Suoranta, 2014; Sarker et al., 2013; Vilkkä, 2017). In this sense, reliability can be achieved with detailed descriptions of the studied case and all the research phases, the selected research and analysis methods, and the data collection process; moreover, being clear about the possible influences the researcher(s) and the utilized literature have inflicted on the data collection and interpretation is important (Crowe et al., 2011; Hirsjärvi et al., 1997; Kananen, 2010; Kiviniemi, 2007; Ward & Street, 2010). Kiviniemi (2007) further states that the research report itself is the

backbone of reliability – if the research is reported, then reliability is established. However, being explicit about how conclusions were reached and acknowledging the subjectivity of the research are the ultimate criteria for research reliability, because the matters under scrutiny when evaluating reliability are the choices and decisions made by the researcher (Crowe et al., 2011; Eskola & Suoranta, 2014; Vilkka, 2017).

Reliability is an imperative condition for validity, but on its own does not guarantee it (Ward & Street, 2010). Validity usually focuses on figuring out whether the research focuses on the issue what it is supposed to study (Hirsjärvi et al., 1997). Another way to inspect a research for validity is to check whether the researcher(s) have declared their subjective opinions and observations that might have affected the conclusions, just like it is important to check are the study limitations clearly discussed (Hirsjärvi & Hurme, 2011; Yue, 2010).

In methodology literature, qualitative research validity is quite often split into internal and external validity. Internal validity refers to the credibility and authenticity of research, where narrative should seem plausible, presented data should be linked to prior theory, findings should be stated clearly, and limitations to the study should be addressed (Miles et al., 2013; Vilkka, 2017). Internal validity can be improved through face validity, which refers to the state of saturation, where research material is collected until new instances do not produce any new information regarding the research problem (Eskelinen & Karsikas, 2014; Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Vilkka, 2017). However, in case studies saturation is hard to reach, when examining the opinions and experiences of individuals (Vilkka, 2017); thus, to reach face validity for improving internal validity, stating the number of interviews, as well as recording and transcribing them is enough (Sarker et al., 2013). Additionally, research questions should be clearly stated and enriching research results introduction with quotations from case study interviewees is preferable (Eskola, 2007; Eskola & Suoranta, 2014; Hirsjärvi et al., 1997; Sarker et al., 2013; Vilkka, 2017).

External validity can be established, if the research findings can be linked or compared to existing theory or literature (Eskola & Suoranta, 2014; Hirsjärvi & Hurme, 2011; Yue, 2010). External validity is also connected to the generalizability of the research: are the findings applicable in other contexts or among other purposeful samples (Hirsjärvi & Hurme, 2011; Yue, 2010)? However, according to Kananen (2010) and Miles et al. (2013), in qualitative research it would be more fitting to talk about the transferability of research, especially regarding case studies. The prerequisites for transferability are that the characteristics of research participants are described, any limits to purposive sample selection are listed and the possible impacts are acknowledged, the findings are connected to prior theory, and the research report suggests settings where the results could be tested further. (Kananen, 2010; Miles et al., 2013.) That said, the easiest way to improve external validity is stating that the research results are dependent on the time, the place, the researcher, and the participants of the study (Hirsjärvi & Hurme, 2011).

6 CASE STUDY RESULTS

In this chapter, the case study results from the empirical research interviews are presented. As the interviews and the research material analysis followed the foundation laid out by the theoretical framework developed in chapter 4.4, the presentation of the research results follows the same tactics guided by the established classifications and themes. First, the product information management challenges related to the information systems at use in the Company's PIM and e-commerce operations, as reported by the employees, are introduced. Next the opinions and experiences of the Company's employees on the extant organizational challenges related to PIM and Store are discussed. Third, the product information -related challenges are addressed, as described by both the employees and the customers of the Company. The introduction of the existing challenges is reinforced with a selection of quotes extracted from the interviews; for the purposes of requested interviewee anonymity, the used quotations will be introduced without declaring the associated interviewee. Some quotes are also shortened for readability and clarity. Lastly, a summary of the discovered challenges is provided before moving on to discussions and conclusions, where the case study results are analyzed further.

6.1 Information system -challenges for PIM in B2B e-commerce

The first analysis classification of this research addresses the information system -viewpoint of the theoretical framework that covers the subject of product information management challenges in B2B e-commerce. One purpose of the interviews was to investigate, whether any information system -challenges exist in the Company's operation in connection to its e-commerce, the Store.

The interviewed employees of the Company reported existing challenges related to all themes under the information system -challenges class. Next, these case study results on the information system -challenges are introduced theme by theme in the following order as set by the theoretical framework: use and integration of various systems, data transfers and diverse data formats, and system features and updates.

6.1.1 Challenges with the use and integration of various systems

Many of the interviewees reported their concerns or exasperation to the PIM situation in relation to the Store by commenting on the amount of information systems at use for PIM purposes, all of which are used separately and together to get products and their information visible in the Store. The use of these various different systems for PIM tasks seemed to cause challenging situations and issues for the employees that complicate their daily work, in addition to having an impact on Store and the data that is presented there.

“At the moment, we have so many information systems where product information is stored and used. So, the searching process for the information in these systems is different for each one. We need to know, learn and remember all the shenanigans and tricks for every system differently and separately. In my opinion, this is absolutely unnecessary, that we have to remember various specific rules for many systems.”

“Strictly from the Store development viewpoint, the fact that we have so many information systems at use for product information and its management is a challenge. We have to combine data from various systems into one place so we can get our products for sale in a way that they'll all be available, and will have at least prices visible. This is a big challenge even on its own. -- And only now are we starting to notice that the Store really is a display window for all this data from various systems, that could actually be inaccurate or bad.”

Almost all employees argued that it would be much better, if the activities and tasks related to product information and its management and enrichment were all centralized into one main system. One of the reported improvements was the facilitation of information searches. The combined use of various systems was also argued to cause access rights issues and integration challenges between the used systems. It was also pointed out that all the systems have different functionalities for managing and processing product information, which can be a cause of multiple further issues.

“Personally, I don't see any benefits in the use of various systems at all. Our colleagues in German have everything in SAP, and they probably have their own challenges and issues too, but the ways to search and dig for information within the sole system is, I suppose, more uniform. The information searches follow the same pattern, instead of having to remember, first of all, where to search for certain information, and then how to search and find it in that system.”

“Of course the use of many systems is an issue for the product information management. Different systems manage and process information in different ways. Then there's the visibility- and access right problems. All the systems have distinct logic. And naturally there are integration issues too.”

“Well there's definitely more issues than advantages in that our product information is mastered in various different systems, because the same data has to be maintained and managed in many places, and hence the data is always wrong or old somewhere.”

Then again, some employees also pointed out, that using only one centralized system for PIM would most likely not work in practice, even though it looks good on paper and the current situation of various systems irritates them: it would not be possible to get all needed features from all the distinct systems conjoined together into one flexible system, that would not cause any side effects.

“One centralized system would of course be better and easier than having many different systems at use for product information management like we now have. Then again, we might not get all needed features combined in this one system. If we think about Teamcenter and SAP, for example, those are systems that communicate with each other. But then to get all the features from both and unite them in one system in a way that everything, including product information searches would work... that could be quite challenging.”

As there was no centralized system for PIM, but instead various distinct systems that were used for PIM purposes, the need for integration between these systems was a powerful issue according to the employees of the Company. For example, should something go wrong within the integrations, the challenges and issues would emerge in plentiful proportions. Moreover, it was reported to not be easy to find out what the actual problem with the integration might be, which was seen to cause even further issues.

“When it comes to system integrations, challenges are all that there is to them. Half of my daily tasks relate to sorting these integration issues out, like for example, where has this information gone, why is it missing. Or regarding the Store, why do we have this information like this in SAP and like that in the Store? We have these integration challenges almost daily, actually. We have also had situations, where some migrations or updates are executed and then something goes wrong somewhere along the SAP - BW - EDW - Staging environment - Data mart - Store -path the data takes. When these issues emerge, they usually come in ungodly amounts at once.

-- We combine data from two or three different places, so even finding out what has gone wrong and where in the first place is quite a challenge. If we can figure it out that something has truly gone wrong because of this system integration path, it's still not always easy to determine in which part of this integration path the issue has emerged. Added to that, the different systems usually have different persons in charge, which complicates things further when you start solving the issue.”

The combination of system integration and the data quality within those systems was also mentioned to be an existing issue. Additionally, the lack of integrations was reported as an existing problem that hinders and complicates the Company's PIM activities regarding Store even further.

“One challenge clearly is the quality of data within all these different systems. The data quality is distinctly different from one system to another, and then having to integrate these systems and use the product data from those systems together... the result is not always good.”

“These integration issues also mean that there might be some product information in the systems that we could upload to the Store, but can't, because the integration just isn't there or the integration development is so hard to get started.”

“Well, for example between Store and Teamcenter there are challenges such as most of the information that passes between those systems doesn't go through integration. We don't have the integration, which is why most of the information has to be transferred manually. -- There are no ways to carry certain things out in Teamcenter, these product categorizations and attribute or facet uploads, which is why challenges are connected to those tasks. They have not been modeled in Teamcenter, so that's why there are no integrations for these actions between Store and Teamcenter.”

Furthermore, the issues regarding the use and integration of various distinct systems emerged from the existence of legacy systems, that are still in use in PIM related activities performed for Store purposes. The main challenging issues most of the interviewed employees were faced with because of the legacy systems, were situations and implications caused by the product data still maintained or stored within those systems. Additionally, the legacy data was reported to usually be of inadequate quality, plain bad, or expensive to transfer into newer systems. All these challenges together could be seen to introduce further challenges for both PIM and Store.

“I'll answer this legacy system issue question through an example. We have these older ILMari ERP-systems, and as we have now noted, some inaccurate information exists there. Because there is inaccurate product information within those legacy systems, Store also shows wrong information, such as wrong spare part numbers.”

“We are currently repairing and correcting the legacy data. In the end, at least for me, this has seemed to cause more issues rather than fixed anything. The Store sort of sets some requirements for those legacy systems. The systems should be updated to match the current level of requirements regarding product information, instead of executing some hilarious mappings during migrations, with which the repairs are now performed. In these cases, the original information is still wrong in the source system, even though the mappings will correct the data for the receiving systems.”

“We have these issues, that the enrichment of legacy data into the newer systems is quite expensive. The legacy data is usually left as is, and only then dealt with if more time and budget is found.”

“The problem is that there still exists product information that is maintained within Aton. If the information changes there and sometimes it even ends up in Teamcenter, the problem still is that the product information never ends up from Teamcenter to Store. And, if some new information is created in Aton, it does transfer from Aton to SAP, but it might never end up in Teamcenter, unless someone notices it's missing.”

6.1.2 Challenges with data transfers and diverse data formats

As argued by the interviewed employees of the Company in this empirical research, transferring and migrating the product information from one system to

another either manually or via integration has caused and will probably continue causing issues in performing PIM tasks related to Store. For example, in manual data transfers, the challenge has sometimes been related to the unnoticed issues that might emerge.

“The product information that isn't updated and transferred automatically from one system to another when it changes, that's the main challenge.”

“In the "skin" integrations there are the copy-paste issues. So, when you copy-paste product information, and there occurs something like, well, an information type or form in an Excel-file can change from one to another and go totally unnoticed, and this causes data loss or something else goes wrong because of it.”

Additionally, the occasional slowness of data transfers stirred up discussion on past experiences: some interviewees focused on the performance issues that slowed down product information transfers between systems. Others paid more attention to the quality issues that manifested from transferring legacy data into newer systems.

“Well, an example of a performance issue is that, for instance, if we have something like a massive price list update going on, then the whole product information integration- and transfer channel is all blocked up. New and critical smaller updates won't bypass the bigger price list update. They'll just end up at the back of the queue.”

“Transferring product information between different systems... Well, if we start to transfer legacy data from one place to another, that brings about many challenges. Those are starting to get noticed, because the quality checkpoints for that data are insufficient and defective. If we transfer old data, especially from legacy-systems, then that's what causes most of the challenges, the data quality. All data transfers are risky, but they are especially risky if a legacy-system is shut down. The data that comes from those legacy-data transfers, that's problematic.”

Many challenges in the Company's PIM activities were reported to be the result of unsuccessful product information transfers. In some cases, the product information needed in the Store had not appeared there at all, whereas in other cases the failed transfer had destroyed important data altogether. Additionally, the reasons why data transfers had been unsuccessful varied from insufficient testing and mass-transfers to the structuredness of product data.

“If information is not transferred, either a needed product will not become visible in the Store, or the Store shows inaccurate information. Furthermore, because of this a customer will either not find the product they are searching for and will thus get a poor service experience, or a customer finds the product and sees that inaccurate and plain wrong information is shown for it and will, maybe, get an even worse customer experience.”

“We had that one thing with data transfers, when we transferred to using SAP, that some part manuals and catalogues were overwritten with older revisions. We had these cases because the data was run in masses and no one knew what had been

done before the information was checked. -- This is the curse of mass transfers, if something fails or some mistakes are made, it might even go totally unnoticed."

"Oh yeah, we have had transfer fails. Once, the integration for the data transfer was reported to be tested, and it "was tested", but the data that was used in the tests was modified to fit the test parameters. So, the tested data did not represent the actual data that exists in the source system, which sends the data that has to be transferred."

"One challenge that we have is this structuredness of product documentation. Product information management is, per se, about structured data. In a sense, there are these different structures, like father-child -relationships etc. And now, when we're transferring information that have these relationships from one system to many others, it's challenging to maintain and manage those structures in the receiving systems. We can transfer the "father" and all his "kids" and the associated product documents from one system to another, but God forbid if any of those "kids" ends up getting deleted from one of those systems for one reason or another, because it isn't automatically deleted in the other systems too. You'll have to perform a few tricks to get that done, and this is the ongoing challenge with data transfers."

Not many of the interviewees could come up with existing challenges or issues in PIM caused by data formats the different systems accept. However, it was discussed in one employee interview, that the viewing format of documents has been a problem, when TIF-files (tagged image format files) have been used over PDF-files (portable document format files).

"We have had these TIF-file issues sometimes. For example, we bought this one crane company in 2007 or 2008, and the personnel there used a lot of TIF-files as the viewing format of documents. We on the other hand have usually used PDFs. So, there was this difference. Actually, even now some units still use TIFs as viewing formats, and we pursue moving towards using these PDFs. -- PDFs are easy to share and upload to Store, while TIFs are not supported by many browsers and thus those files cannot usually be opened and viewed."

6.1.3 Challenges with system features and updates

Most of the information system -related PIM challenges regarding the Company's e-commerce operation were reported in the employee interviews to be about system features and updates. Much of the addressed challenges and issues with the systems had to do with the cognitive strain caused from having to learn and remember how to use the systems and their features.

"SAP is hard to use. And learning how to use it is hard. Some features in Teamcenter are complicated too."

"Everything about IBM Management Center is difficult. Everything. It takes about, if you use it like once a week, then it takes about half a year to understand how the system works. It is an unbelievably challenging system to understand as a whole. But even if you do know how to use it, it's still really hard. The flexibility within the system is bad, when you consider it not being either a PLM- or an ERP-system, where

you should be able to control, manage and monitor that processes are followed. The IBM MC should be far more flexible and easier to use so that we could have our marketing personnel using it without having them go through more than a day's training for it."

"The way information is saved and stored within different systems is so mixed and disorderly, so it's hard to remember what has to be done where."

Additionally, many of the interviewees recalled past issues with system performance and system usability. Some challenges manifested from bugs or glitches that complicated the use of the systems where product information is managed and enriched, while some were associated with certain features that caused the system usage to be extremely slow. Others addressed and even strongly questioned the usefulness of some bad system features that are used in the management tasks of product related data needed in the company Store.

"Well, there are bugs, performance issues and usability problems."

"The Store's IBM MC as a user interface is so painfully slow. Additionally, when you upload manually enriched data over there and the upload goes through, you can never see what you actually uploaded because there's no possibility to export a report or draw the uploaded data out."

"For example, there's some strange fields within SAP and nobody knows what they mean and what they're for. -- And now that we're talking about SAP and its problems, don't even let me get started. Just the fact that it's an ancient product information system, so the fillable fields there are only about the length of a finger. So just go and try to type, for example, to the material entered -field something that is longer than 18 characters, it's just not possible. There's also a material name -field that has been implemented for some reason, it's like this mix of item description and specification. What a totally incomprehensible idea to go and mix that sort of data and corrupt it in the process. Then the feature, where someone thought it would be a clever idea to give similar codes for sales organizations plants, and companies. Not only do the codes overlap but at the same time they refer to totally different things. That's makes no sense."

It was noted as well, that the systems in use and their features might not have been modified after the company's needs, which is why using those systems has been extremely challenging. However, one interviewee also noted, that when there are multiple systems in use for PIM purposes, it is usually desired that the systems should work as similarly as possible so remembering how to separately use each of them would not be such a pain. Thus, the pursuit of replicating system features has caused its own issues for PIM.

"Then we also have, of course, systems to which apply either that, A. the systems have not been developed or regenerated for our activities, or B. the systems have been developed and regenerated, but those projects have not been finalized and are still unfinished, or C. some out-of-the-box solution has been introduced and put to use without modifying it to fit to our purposes and needs."

"SAP has never been tailored for our needs, in my opinion, at all. It has just been taken into use as is, out-of-the-box. Then it has been filled up with information and we have just gotten a notice that "use this, take care, try to live with it."

"I would say the challenge with our system features is that we try to replicate the features and functionalities of one system into another. That is a big issue, which is also related to the business logic and processes, because the demand for these replications come from the people who'd like to see the systems function similarly. The issue isn't about some systems being harder to learn how to use or actually use than others, like PowerPoint versus Excel. -- The issue is that we try to make PowerPoint to work like Excel or Excel to work like PowerPoint. We try to customize these systems to a maximum by transferring Excel data to PowerPoint and then by trying to get PowerPoint to perform the calculations from that data, even though the systems don't function similarly. The point of this metaphor is that we should pursue simplifying our information systems more, instead trying to make all of them as similar as possible."

During some of the interviews, specific problematic functionalities of certain systems were highlighted in the discussion. Many interviewees mentioned the tediousness of search functionalities within systems, such as SAP and IBM MC, while almost as many if not more emphasized the challenges in PIM tasks that have emerged from or because of the user- and access rights within the systems.

"The main problem is that searching for and finding information is complicated, at least in SAP. That is the biggest issue for us. -- There are no coherent systems or transactions that would be tailored for after sales needs, where you could search for information with various kinds of references."

"Well, the IBM Management Center's user interface is, as mentioned, one that has its difficulties. It's difficult to use, it's challenging to find information within the system, no big exports can be extracted so you could see what the system actually contains."

"Well depending on the system, there's all sorts of user rights that you need for each system, and you of course have to ask for all of them separately. For example, when it comes to Teamcenter, you have to repeatedly ask for new user or access rights and also for SAP you have to repeatedly ask for new user rights, when the ones you have don't cover something you need to do or see. It's always a hassle. But all the user and access rights that have been asked, have always been granted, but it's not standardized or defined anywhere that what user or access rights are needed for this and that task."

"To my understanding, in Teamcenter we might have these issues, that if you want to change or fix some product information so it would be corrected in the Store, it's not possible to do that online without exiting the Store, as it should be. Instead, we must contact a specific person who can use Teamcenter, and then the issue might be that when the person goes to Teamcenter, they'll find out that they don't have access or editing rights for that item whose information should be edited. So, there are a couple of glitches here. First, the editing does not take place in real-time, and the person who's the most interested about making these changes and improvements on product information cannot do anything about it. Second is, that there is only a small number of individuals who can carry those modifications out for the item. Third is, that those who have the skills to carry the modifications out, don't have the rights to

do so. -- In my opinion, this user rights -issue might be the most challenging feature in our systems. In some cases, the limitations are a bit too strict."

The challenges caused by the user- and access rights were, however, seen to be somewhat justified: the possibility of an employee taking all product information related data with them when changing his or her place of work to another company needs to be withheld, so that the Company will not lose competence or their business altogether. Also, strict user- and access rights were seen to be a feasible way to improve product information quality, which has been an issue in legacy systems, where the rights management had not been as strict. However, it was still pointed out that even though certain rules were in place so no serious issues for business could emerge, asking for and getting the needed rights should be somehow facilitated.

"Well, it needs to be noted that we are a company that designs and manufactures cranes. And thus, we naturally don't want that one day some individual X somewhere, for instance, makes a "jump folder" for themselves and then changes companies and during that sells all our product information, designs and 3D models amongst other data. So, when considered this way, it's all the way justified that getting different user and access rights to the systems is so complicated, difficult and challenging."

"According to the old model, that we followed with the legacy systems, everyone could make changes to everything, because everyone had access to everything. And the data was then formed accordingly too, if you know what I mean. It was messy and the quality was not so good. So, nowadays there are good and bad sides to this everyone not having access and editing rights to the item data. -- This process is a bad influence when it comes to speed of doing things, but it also is a factor that plays into the data quality, it maybe ensures it a bit."

"The process of acquiring user-, access-, and editing rights should maybe be a bit easier. Now you must know exactly what role you need. -- The knowledge on the user rights needs to be way in too deep, you would have to know the systems through and through to be able to even ask for a role you need to get the rights you need."

Many diverse challenges for the Company's product information and its management for B2B e-commerce purposes existed also due to system updates or changes. For example, updates might sometimes have been unsuccessful, thus causing delays in PIM tasks because some data went missing or was destroyed. Added to that, some interviewees reported that sometimes the updates that took place so something could be fixed, ended up breaking something else.

"We have these examples of unsuccessful system updates from the early days of Store. For example, all the products have disappeared from the Store after an update was carried out. A flag had gone up for every row in an EDW-board, which meant that when we read the product data from the EDW, we ended up deleting all data during the implementation. The system doesn't recognize this flag as an issue."

“I don't think we have had any major catastrophes with system updates. Well, actually there is one famous and legendary situation from near history. We had this older system in use at one of our factories, and it was time to transfer systems from the older one to the first version of ILMari. So, in the process of transferring our data from the old system into ILMari, all material-rows disappeared. So, we had only the main rows left, which caused a situation where we didn't know anything about the materials that were used in our older cranes. So, that system update went "well". “

“We have an example out of this, where a system update has caused more harm than it has fixed things. We had this case, where a functionality of a search function within a system had been ignored, and then we had to do a roll-back for that update. This is the only roll-back case that I can think of, and this one was about IBM Management Center and its search function. That search function crashed when it was being evaluated, and because of this a big portion of our products were not findable anymore.”

From the interviews held for the employees of the Company, it was possible to infer that the causes of system updates being unsuccessful, ending up in failures, or actually breaking something – and thus causing challenges and problems for PIM and the Store – varied from poor testing and little to no debugging taking place. Also, earlier lack of quality assurance for system updates seemed to be a major factor in the formation of issues and challenges.

“Poorly tested systems naturally tend to break something. It could be that the updates are tested with only happy-cases and then it's decided that this can be put into production without even testing any sorts of problem cases or non-happy cases. -- There's too little debugging going on. Or then it could be that a new functionality of some widget has been tested, but the old functionalities have been ignored. And the initially unnoticed result is that these older functionalities have broken down because of the new functionality. These kinds of challenges manifest from time to time. The updates should just be tested more thoroughly.”

“Everything between the earth and sky has happened with those system updates. But now Store is starting to, after 4 years, be a rather stable system. We haven't had any bigger system update issues in a while actually. Now that we have the Staging QA (quality assurance) environment for the Store, that has taken care of many of these problems. If we detect something big or fishy happening, we can intervene.”

Added to the unsuccessful or failed system updates, one specific and major issue pointed out by many of the employees was that it takes too long to even get the system updates or needed system fixes started. According to the research results, the time it takes then to reach update implementation and finalization after the update initiation also seemed to cause a lot of irritation amongst the employees.

“Generally speaking, the updates follow this update cycle which is from 2 to 4 times a year during weekends. -- If something breaks down, getting it fixed will be pushed back to the next release, the next update cycle. For example, if some function has been specced out incorrectly, fixing it will be pushed back to the next release. But if an integration between systems crashes entirely, then it might take from 2 to 5 work-days, or something similar, to get it up and running again, which is too long. -- Addi-

tionally, if something is left out of the update or if some issues still exist despite of the fixes the update was supposed to carry out, then it can take up to 100 days to get those fixed.”

“In our Store's case, these update issues depend so much on the system. In many cases we might have an update in the making, that might seem like a simple update for the end-user even though there's usually more under the surface, which could cause the update to take months to complete. -- First, to even get it figured out that what is wrong with some system might take forever. I know and understand that many of our end-users are probably a bit pissed off at the IT department, especially with the action pace, but it's not always up to one IT person. It takes time to solve the issues.”

“Every time a functionality breaks down, it takes a month or two or three before the repair even begins. Then, when it's underway, if it takes a month, then that's really good. Usually these things take about six months. -- And during this the work that was done with the thing that broke down must be done manually, if possible. And if some data was created with the broken functionality, it has to be cleaned if it's dirty.”

6.2 Organizational challenges for PIM in B2B e-commerce

In the second class of the empirical study results, the focus was on the organizational challenges that were reported by the Company's employees to have manifested in the PIM and Store related tasks of the Company. The purpose here was to gain insight on said organizational challenges through the firsthand experiences and opinions of the interviewed employees.

According to the research results, organizational challenges manifested in several ways in the Company's operation through all the organizational themes. Next, the case study results on these organizational challenges are introduced by following the theoretical framework structure, first focusing on the theme of processes, next on the theme of standards, and last on the theme of people.

6.2.1 Challenges related to processes

In relation to the process challenges in the Company regarding PIM and Store, the dependency on manual work was reported to be a notable issue during the interviews: it was stated, that the need for manual interventions might be one of the biggest challenges the Company has regarding the management of product information for the Store, and automatizing some tasks within the PIM processes would be a good idea, provided that data would be of high-quality.

“Maybe the biggest challenge for product information management for us is the data that we transfer manually by copying it from one system to another.”

“Of course it would be better if processes were more automatic, at least it would facilitate things. Especially if data quality has been verified to be good and high, then after that automation is a good thing, a great thing actually.”

However, many employees also pointed out, that even though the dependency on manual work is an issue, the product information could not properly be managed without it: automatizing the manual tasks taken care of by humans would not necessarily solve any issues, but bring about more new ones.

“Human interventions in are not that bad, because a human can sense and see things that cannot be detected or noticed with different kinds of algorithms. For example, with product items and their creation or if there's item duplicates, we need a human there in the mix, even though the manual work is taking up a lot of time and energy.”

“This might be a bit of a philosophical answer, but it's not self-evident that automatization with the processes would be better than the current situation with a lot of manual dependency. If we would carry our stupid processes out automatically and build more system integrations, then we would have our foolish process and foolish data-models automatized. It wouldn't just make much sense. This is one reason why we are not there yet, because the processes are not ready for automatization.”

Findability of information was also argued to be one issue caused by the processes that are either poorly standardized or missing, or by the information system situation, which was earlier already noted to be a problem on its own. And, because of the tediousness of searching for product information, some PIM tasks were reported not to be carried out at all.

“Is product information hard to find in Store or other systems? Yes, it is. And it's because the product items are more enriched in PLM- or ERP-systems than they are in Store. And the enriched data from those other systems hasn't been transferred to Store, because it has to be done manually. And this is because we don't have the regulated processes in place, according to which data would be enriched in one place in one specific way following a specific set of rules.”

“One other reason for why product information findability is an issue, is that the information is scattered across many places. The individuals who upload the data into the Store could carry those uploads out more easily and in bigger masses, if they would get this product information from one or two places. But now there's always this huge investigation task ahead so the information can be found because the information is scattered. This is why those big enrichments won't be carried out.”

In addition, the interviewees pointed out some process-related issues with the arduousness of managing product information for Store purposes. These challenges were mainly seen to be the cause of insufficient resources within the Company: most specifically and often mentioned deficiency was time, because of which the improvements for the Store through product information enrichment were carried out too slowly or sometimes left unfulfilled.

“I would say that from the point of view of Store product information, product information management and product information enrichment, something in this set-up of ours causes our activities to not be as agile and fast as they should be. The tasks are not completed fast enough. -- Within the digital and e-commerce reality that we live in, our "clock speed" is too slow. So, these things take too much time, like want-

ing to build a new e-store page for introducing a product, or wanting to update this introduction page a little by changing its picture or video for the better, or wanting to group some products under the introduction page in order to tell that these products belong in this category. And then these cases, that “hey we have somewhat of a wrong description for those products, we would like to fix those”, and then “let's add some documents and PDFs to those product pages”. We can't do anything like this, because our clock speed is so slow.”

“Maybe the thing in this enrichment of product information is, that we don't have enough time -- to properly put our minds into it. We don't have time to think about how to get the information into a better form or format. Also, to think about things like what information you really can show for a product in the Store on anywhere else without showing too much information, which might in fact even lead someone astray. We have a lack of resources with this, at least with time.”

Another major process -related challenge for the Company's PIM activities, also in a sense associated with the lack of resources, was broadly reported by the interviewed employees: only a small group of people was solely and primarily responsible for the actual daily management, enrichment, and publication of product information. It was pointed out that, in fact, only two individuals worked with the daily tasks of global support and upkeep of item data and product information needed in Store, and one of them was working part-time. Most interviewees added that more people should be working with PIM, because currently the time it took to complete PIM related tasks was not ideal.

“Of course there should be more people working with product data management and enrichment. In a similar e-commerce where things are properly taken care of and everything's good, there's significantly more people working with and creating commercial data per product than we have. For example, if we have 300 000 items and then we have, actually I don't even know how many individuals we have in the USA, but we have two individuals in Germany and two people along with the product managers here working with product information management. Let's just say it's not a lot, when considering what's required from us regarding tasks and speed.”

“If the company saw Store as an actual important matter, then of course there would be more people involved in this. But it's apparently not that important. But hey, three years ago there was just one person doing all the work with product information upkeep and such, now there's almost two, one and a half!”

“Most of our processes with product information are entirely manual or Store-specific, and the processes and tasks are personified really easily. We have about two individuals who can perform these product information management things regarding Store, and that's a continuity risk. -- Given the situation with our current processes and the current productivity, we should definitely have more people working on the management, enrichment and publication of product information for Store purposes. And the long lead time justification for that already on its own.”

As much as the small amount of people working with the PIM related daily tasks was seen as a problem, during the interviews the focus was also on the availability of product information that can sometimes be achieved only though

specific individuals, such as product managers. However, even though most interviewees thought this as a notable gap in the processes related to PIM and Store, a few did not recognize this as a real issue or even as a challenge. So, maybe the fact that some employees did not realize the availability of information through certain individuals as an issue, or realize the challenging and problematic impact knowledge personification can have on the big picture of PIM processes, is a process-related issue on its own.

“One issue is that as the product managers are in charge of their designated products and their information, we have to ask for their permission on everything regarding the product and its information and clarify what we can or can't publish in Store.”

“Yes, this information availability only through certain individuals causes issues. For example, if you want to create a category for a specific product, then if the products of that category are not enriched within the ERP- or PLM-systems, then you can't search for all the products that would belong into this category by yourself. Then you'd have to go and ask this information from the product manager.”

“I have personally not had big issues with this, that some information is only available through certain people. It naturally comes down to socializing and networking, all those networks and social bonds that have been created through the years. -- And it doesn't hurt if you have built personal relationships with the people here at work, especially with those whose help you sometimes need with some product information. -- Of course, this might be an issue for newbies. They might not know who should be asked about what.”

“I would imagine others having trouble with product information, if it's available only through certain people. For example, if someone gets sick or is on a vacation or something like that, then of course it's a problem. -- The reality is that the information, knowledge and the know-how becomes personified really easily, even though our company is large and we have a lot of personnel. But for me personally, this availability of product information through certain individuals doesn't cause challenges.”

Ad hoc -solutions that are occasionally used by some individuals handling product information were also pointed out as an issue by few of the employees. In addition, these solutions - when used - caused challenges for product information quality. Furthermore, the process -related challenge these solutions created was the issue with product information's existence outside of the systems, which makes the management of said information harder than it should be.

“Well, we are probably focusing more on the product information and its amount that exist in the systems, but in reality, we also have product information that's outside of those systems we use. For example, for commercial items the data might be in data sheets or PDF-documents, if we're lucky. -- So, the data we need can exist in a PDF-document which is on the computer of the designer. But the information might not be in a textual form in a text field, so it's not possible to send it automatically into other systems and exploit it there because the text cannot be detected by other systems. Or then we have sales representatives who collect information about, for instance, most sold stickers and they list all the product information for those stickers,

such as the text in those stickers and their colors. Then the listed information is not centralized into the PIM systems, so when others will go and look for one of those stickers, they can't see any information without opening a separate PDF-document."

Further issues with PIM processes were pointed out to be the results of the insufficiency of mutual understanding on PIM, its importance and the reach of product information related tasks. The interviewees stated, that not only individuals, but even entire units and departments have differing grasps on the essence of PIM and the processes through which PIM is carried out, which is why PIM facilitation and ensuring data consistency is challenging.

"Well, at least that the different processes are not described anywhere. Different departments execute and understand the processes differently."

"At the moment the situation is, as far as I have understood, that even the simplest pieces of product information, such as purchasing category or purchasing group that sound like pieces of information that could be useful in Store for categorization and grouping purposes, the fields for this information are filled with completely absurd data by the individuals who open the items."

"We have personnel on many different skill levels, others might be internal resources while others might be external resources. Others might also be very unexperienced and have no understanding on the operations of the company as a whole, the least of all on the after sales or e-commerce. They might not even know they exist, and thus the customer experience factor for the after sales is not the first thing on their mind. Then a system forces them to enter some information into this field X, before an item can be created. To what all this entered information then has an effect on, that's not the first thing on their mind - nor are all the places where the information is going to be visible. And then they'll just key in the first thing that pops into their head."

Lastly related to the problematic processes of maintaining product information for Store purposes, were the challenges that manifested through shortcuts being taken by the employees who in any way handle product information. Some interviewed employees referred to others taking shortcuts and thus complicating the work of others, while other interviewees admitted taking shortcuts in their own tasks with product information. Whoever the individual taking shortcuts in PIM activities is, what is certain are the issues emerging from those.

"-- everyone tries to get off these things in the easiest way possible. They try to do things and enter or upload information so that it's as easy as it gets for them. Minimal effort."

"Yes, shortcuts are most certainly taken. I don't have any straight examples for you here, but the previously mentioned lack of time and other resources are huge influencers on these shortcuts being taken. This leads to that, metaphorically "we'll go over where the fences are the lowest". At least this sort of behavior makes our own job easier. -- If you don't have to fill some fields up in a system, then you might not fill them up. There's this enormous difference between mandatory and voluntary. People don't have time for the voluntary."

“I would say that we ourselves have to take quite many shortcuts rather often actually. When there's a need for some product information in the Store, we usually have to get it up there really fast. Corners have to be cut to achieve this.”

“Most certainly shortcuts are taken with the product information management tasks. Metaphorically stated, “we go over where the fence is the lowest”. Sometimes “we even go where the fence has already fallen down”. So, corners are being cut here and there, even demolished occasionally. It makes you wonder with the product information management tasks, that are the errors or missing data just honest mistakes, or has someone just been extremely lazy? You can, for example, encounter items in the systems or Store, that have no product information at all. Then -- we have also had cases, where an implemented integration hadn't been tested at all. It had just been implemented into the live systems and thus a lot of data was overwritten with some completely useless crap.”

6.2.2 Challenges related to standards

The second theme in the organizational challenges focused on the challenges that might emerge for the Company from the basis of standards. The interviewed employees pointed out that there are many standards that are missing for their processes and for the product information handled within those processes. What was inferred from this, was that the shortage of these standards caused much unnecessary strain and confusion amongst the employees regarding, for example product information findability and enrichment.

“There are no common guides or procedures for how the information should be stored and saved. -- If there were some standards for product information and its input into systems, then searching for that information in the future would most likely be less of a pain.”

“The processes and requirements for the items and what information is needed for them should be standardized and harmonized, so that the enrichment tasks would be carried out similarly everywhere when an item is opened and created. We should know what information should be enriched, where it should be enriched and how it should be enriched. But we're not there yet, which is why we cannot operate as agile as we should.”

“We have so much shortage on standards regarding, for example, what product attributes should be in place for the products in the Store, what is a retail number, do products have categories and should they have categories... all these standards are pretty much up in the air.”

“If we had any standards for the products or product types, then we wouldn't have to bother the product managers with every little question about the products when enriching their information.”

What was inferred from the research results as told by the interviewees, the nonexistence of standards ensued mainly because of the shortages in resources, especially time, or the obscurity of responsibilities in creating the standards.

"In my subjective opinion, the reason why we don't have as many standards in place as we would like to have for our product information management is related to scarcity and prioritization. So personally, I have not had the time for determining and creating standards. We have a shortage of resources."

"One concern with these standards might be the issue with the responsibilities? It's not that clear who should be creating these standards."

The fact that there were no unified standards in place that would be followed by all, was seen to cause challenging situations where PIM processes and tasks were not unified across teams and departments. This, according to the interviewees, resulted in different departments, teams, and even individuals coming up with their own guidelines for managing, storing, and enriching data.

"We have to make our own guidelines and instructions for these systems and searches, so that we'll be able to remember afterwards how some sort of information can be found and where. There are no common and unified instructions for those tasks, or rather if there are, then they are so generic and of no use at all."

"But with the creation of product information it's just the data created in Parts unit that is created in a centralized way. Others then will create their data to the same systems after their own rules and guidelines."

"It's the responsibility of each unit to create their own guidelines and standards for the system use and ensure those are followed. This, of course leads to the situation, where every business unit might have their own standards that could differ significantly from one another. When this happens, the team that uses, manages and enriches the product information for items encounters many issues, because data quality is different in every unit because of their own standards."

That said, the employees did explain that a few standards do exist for their processes and for some product information as well, because some standards need to be in place so the products would even end up in the Store for sale. However, the issue with these standards was the same as with the guidelines: they were not followed by everyone who should follow them, so that product information quality could be ensured and processes facilitated. Additionally, it was pointed out that some of the standards did not apply for every distinct product or comprehensively take everything required into account.

"From a strictly technical viewpoint we do have certain standards that need to be followed and fulfilled to get products into Store. Certain attributes need to be in place, this is the minimum requirement for products that need be available in the Store."

"I suppose there both is and isn't any standards when thinking about the enrichment of product data. I think there are some guidelines for two products about what should be enriched for them to the Store. But there are no wide enough or good enough standards."

"For spare part photos, we have a great standard. But in my opinion the standards represent only one side of the coin, while implementation is the other. Together they

form an issue for us. It doesn't matter how great the standard itself is, if it hasn't been implemented properly or if it isn't followed everywhere. For instance, the spare part picture standard is ready, but we should now make sure that it is followed in every warehouse unit."

6.2.3 Challenges related to people

In addition to the small team of individuals who are responsible for the daily management, support, and enrichment associated with product information needed in Store, there are multiple different people who work with product information. So, naturally differing attitudes people have toward PIM importance exist. This issue, regarding the organizational challenges related to people, was pointed out by the interviewed Company employees, who further noted that some individuals did not even disclose needed product information into systems or to other individuals. The reasons behind this were that they did not have the time to do so, or they expressed a lack of enthusiasm and interest towards the Store.

"There's no Store-oriented thinking or attitude yet in our company. Our product managers are not that interested in the Store, what it is or how to sell through it. Maybe one product manager in ten is a little interested, or one is highly interested and one is a bit, the rest not so much, if at all."

"I would say that the mentality here is pretty much, so that nothing else is interesting or will get any attention but the territory each person has for their own. The process as a whole, regarding product information management for Store purposes, might not be thought about at all, neither the upstream or downstream. The mentality is, that "I'll take care of my own plot and that's it"."

"The designated individuals from whom much of the product information has to be asked -- are weighed down by their amount of work and unmotivated. This results in certain challenges when you try to work with them and ask for some information, which to them might seem totally unnecessary. For example, they might not want to deactivate duplicate items, because it would be too arduous. Sometimes even the simplest of questions are also left unanswered. -- It's either that they don't have the time or don't remember to answer. Or don't care enough about answering."

All large and global companies naturally have various people from diverse backgrounds, cultures, and nationalities working for them. Thus, it is no surprise, that the different individuals also have diverse ways of working and distinct habits. The research results also showed, that the interviewed employees felt the various different ways of working to be an issue for product information management.

"Different departments and units create data of highly differing quality levels, and usually the data is understood in completely different ways. -- Different people also work in different ways. And then there always is the resource issue. No one has the time or the energy."

“Then there are those issues and challenges, that people might use specific system functionalities or fields in a way that they have gotten used to using those. Everyone uses them differently, which makes finding information even harder. -- If there's a possibility that some things can be done in two different ways, then it's almost certain that two different people will choose different ways of doing it. We should guide people into doing things in a certain specified way within the systems, or at least we should instruct them to enrich the information within these systems in a certain specified way, which would be followed by all. This is the one of our biggest problems. If there is too much freedom to do things as one wishes, then most likely everyone will do it in their own special way. And then because of this the information is scattered and can be found a bit all over the place, if it is found at all.”

Some interviewees also argued that issues for PIM stemmed from language barriers or just simply from the unregulated and incoherent ways of describing things. These issues were also seen as causes of further challenges for PIM, such as different information existing in different places, and individuals working with product information not understanding each other.

“One issue we have is the discrepancy between our units, the equipment-, service- and parts units and the different vocabularies used for item descriptions in different systems. Because of these, different information exists in different places.”

“-- if we think about the diverse ways different people describe products, there's this one case for example, that our alpha brands won't agree on using the sales text that would be transferred for their branded products from Teamcenter. We had to come up with a workaround for this, and now the alpha branded products receive their sales texts from SAP.”

“Well of course some aspects of us, the people, create challenges for product data management. For example, language questions and barriers are such aspects. This traces all the way back to the nationality of a person, which is going to affect their language skills. And then there are these dialect differences or the differences between British and American English, like do you say tyre or tire, and do you recognize electric cubicle as an actual word. Americans don't, and they'll laugh at the use of that word. So maybe this has something to do with the issues we have with product information and the associated management and enrichment tasks, as well as the standards. These are challenging matters if the individuals included don't understand each other.”

In addition to the different ways of working and describing things, which could be understood as habitual influencers for the individuals who are working with PIM, the case study shed some light on the existing opinions and requirements of different individuals. These were recognized to be problematic as is, but also as matters causing further challenges. The differing and sometimes even contradictory opinions challenging the smooth flow of information and the effectiveness of PIM were about product categorizations and product attributes that are important in the Store, among others.

“Of course people have differing opinions on product information, like what are the best ways to categorize or describe products. Some want things this way and others

want things that way. For example, someone might want product categorizations done this way, but there are no people creating data that would fit for the purposes of that requirement. That's a clear challenge. And then if we create and produce data in a certain way and form that would be ready and easy to utilize, but then it isn't good in someone's opinion. That's another clear challenge."

"When it comes to product attributes, there are many different opinions about those: into which system should they be entered, where within the system should they be entered. And even if we would reach a consensus about a standard like "this is the place where the attributes must be entered from now on", -- reaching consensus in the order things should be done is sometimes hard. Should we first build an intersystem integration for getting these attributes to Store, or should we first implement the standard? This would be the disagreement we sometimes have with the product information management people."

"We try to do things in a way that's possible, but those ways and the results will never please everyone anyway. Something is accomplished, but then general disappointments emerge, because it isn't exactly so, like some certain individuals would have wanted."

Interesting is, however, that even though some interviewees also recognized the existence of different opinions and requirements about, for example, best ways of categorizing products, they did not see them as actual challenges for product information management.

"Well, naturally in every company there are differing opinions amongst the personnel about different things as there are various distinct individuals involved, but these differences produce discussion. Per se, here in our company and department we might not always directly agree on everything, but I don't know if this is an issue or a challenge as is."

"Of course there are different opinions about best ways to categorize and describe products in the Store, it's normal when there are many different people. But personally, I don't see this as an issue."

Maybe the existence of these opinions is also a people-related issue on its own: the disagreements on whether the different opinions and requirements about product data and other matters connected to both PIM and Store are challenges or not, is a manifestation of the existence of different opinions that hinder the effectiveness of PIM. If the issues are not realized as issues, they cannot be addressed and solved.

The employees participating in this study additionally pointed out the lack of skills in using various systems that are needed for PIM and Store purposes as a major issue among the individuals who work with product information. Many of the interviewed employees stated that some individuals are unable to use certain systems, which naturally cause issues for PIM, if certain tasks cannot be carried out on one's own. This also increases the workload for the individuals who know how use the systems.

“No, everyone that should know how to, can’t use all the systems needed in product data management. For example, personally, I still can't use SAP very well.”

“Skills in using systems are naturally relative and subjective. Some individuals might learn how to "swim" amongst these systems rather quickly and others are like fish is on dry land. Some people gasp for more air every time they open Teamcenter and some people feel right at home with it.”

“There’s this issue of know-how personification. When the skills of using systems are personified, it's easy to just go ask the person who knows how to do things and use the systems to help and sort of give up yourself.”

Lastly, as much as the lack of skills in system use was reported to be an ongoing challenge the Company had encountered, just as much was the resistance of system use pointed out as an existing issue. According to the interviewees, some of this was due to the systems simply being hard to use. Additionally, change resistance was seen as one of the reasons behind not agreeing to use some systems.

“Yep, SAP would be the one that causes most of our issues. Sometimes, people don't even want to use it. It's a pain in the you-know-what. Mostly it's the information search that causes people to get irritated with SAP, it's just so difficult to use.”

“Naturally there always is going to be this normal change resistance but I don't know if there are any other issues with the willingness to use the systems.”

“If you have two different systems, then of course you are going to use the one you have been using for the last 10 years because you know how to use it, where everything is in the system and how everything works, because, well, it's familiar. And you don't want to change to the newer system as the older one still seems to work.”

6.3 Product information -challenges for PIM in B2B e-commerce

The third and final analysis classification of this research addresses the product information -viewpoint of the theoretical framework for PIM in B2B e-commerce. One purpose of the interviews was to investigate, whether any product information -challenges manifested in the Company’s operation regarding its Store. The reason why customers were also included in the research as interviewees regarding the product information -challenges, was based on the theoretical assumption that product information and its quality are notable influencers on customer experiences, while at the same time customer experiences impact the existence of issues with product information.

All the interviewed Company employees as well as the customers – both internal and external – had a chance to express their opinions and experiences on the state of existing challenges related to product information. Based on the interviews, it was evident that challenges related to all themes under the product information -challenges class existed in the Store and PIM operations of the Company. Next, the case study results on these challenges are introduced

theme by theme, first focusing on the challenges related to the vast amounts and heterogeneity of product information. Second, the challenges in defining overall product information quality are introduced, followed by the introduction of challenges associated with ensuring the quality features of product information for both employees and customers. Last, the challenges related to manipulation of information quality and customer requirements are discussed.

6.3.1 Challenges with the vast amounts and heterogeneity

When asked about the amount of product information the company deals with and handles for the purposes of the Store through different PIM tasks, almost all interviewed employees stated that there exists a lot of product information. Some also described issues that were caused because of the vast amount: the management tasks of those vast amounts of information were indirectly stated to be challenging and highly time-consuming, because there was only a few people to perform the actual management tasks. Also, the poor product data quality was figured to be partially caused by the information amounts. Additionally, the amount of information itself was defined to be an issue in many different occasions regarding various tasks the company performs for Store purposes within their internal systems.

“You know, we have way too much of product information, so to get the relevant information from there is... Well not really, that was a joke. The amounts of product information that exist for our products is minimal, and that's all scattered around. -- That said, we have 300 000 plus items in Store. Even though we have minimal amounts of product information, having it for 300 000 items is a huge amount.”

“Yes, the number of products and the amount of product information in Store and in other systems does create issues for their management. -- For example, we have 400 000 items in the USA Store and one and a half people here to manage all of them. One full time and one part time.”

“Apparently the amount of product information needed for the management and enrichment tasks is too much. As long as I have been employed here, the topic of discussion has been that data quality is bad and poor. So, maybe we have too much of that product information, if we cannot get its poor condition fixed.”

Then again, customers did not see the amount of information to be a hindrance for their customer experience in the Company Store: all stated, that the more information there is the better, which naturally is normal. Customers usually want as much information available as possible.

“I don't think there can be too much product information available. I cannot imagine a situation, where there could be too much product information. The more information there is, the better. Information provides certainty and reliability.”

Noteworthy however is, that the amount of information the Company would have to handle to get as much product information available to the Store as possible would be immense. The Company already handles vast amounts of data within the various systems, so much so that some interviewed employees reported the management tasks had sometimes taken too long to get done.

“We have about a couple of hundred thousand commercial items in our selection. So naturally some tasks can be hard to get done in reasonable timeframes.”

“In my opinion, it might be even more pleasant to handle large masses of products or product information at the same time, than to handle smaller masses. By handling big masses, you get more done at once. But, if you have to handle large amounts of items one at a time, it's going to be royally slow. And this is where the timeframes are passed.”

In addition to the amount of product information causing PIM issues, the product information heterogeneity was reported to be a cause of certain challenges for the management of product information by the interviewed employees. According to some of the interviewees, this information divergence was particularly problematic because of the possibility for misunderstandings by the employees working with product information, or by the customers buying the products. Moreover, the product information heterogeneity was reported to be mainly associated with brand-related product information.

“If we look at the brand specific product information, then yes, the heterogeneity and divergence of product information does cause issues and challenges for the management. Our systems have been made to specifically fit for the needs of the products of our own brand. All our other brands that we own, those are more like "stepbrothers" of sorts. -- This can be seen, for example, when inputting a product sales description of "one size fits all", and the same description becomes visible for all products of this type. But this "one size fits all" isn't true for our alpha brands.”

“One issue we have with the product information heterogeneity is that our brand information sometimes leaks in the Store. So, if I'll open up a product page for a branded product ID and then look at the picture, I'd see that the picture has been named with the ID that applies to our own brand and not the one I'm looking at. So the product ID on top of the page won't match with the product ID shown on the picture description.”

Some of the manifested information heterogeneity related challenges were reported by both customers and employees to be associated with product groups: products within specific product groups might have issues with information heterogeneity. What can additionally be observed from the research results is, that comparisons over different product groups regarding product information heterogeneity were not reasonable to even make, as the spectrum of products the Company offers is so diverse.

“Yes, product information within product groups sometimes is too divergent, but comparisons between different product groups cannot really be done. -- the field of

product information within these product groups is, today, maybe too heterogeneous in the Store, but heterogeneity in our whole spectrum of products is mandatory.”

“In the Store, there are certain product categories that need to be dealt with as product groups. Within these product groups there are information heterogeneity issues, with for example electrical components. For all electrical components, the one thing that should be shown is voltage information, but for some components that information is not available in the Store.”

“In practice, product information unification isn't that doable, isn't it? Well, certain information can be standardized for every product for Store purposes, like weight or size --. But otherwise the information is just too divergent to be unified when comparing various products. If we compare, for example, some fastener-chunk to some fancy electrical part, the products are going to have totally different required specifications and information that are needed for them in the Store. Within product groups or types however, unifying and standardizing the product information should be pursued to reduce the heterogeneity that exists.”

What was, however, surprising, was the fact that many of the interviewed customers and employees did not consider product information heterogeneity to be an issue that would cause challenges for the Company's management tasks of product information or for the Store, or for the customers themselves in identifying products. Even the challenge of product group heterogeneity was not seen to be an issue by everyone.

“Heterogeneous information is bound to exist because we have so many different products. However, even within product groups, the heterogeneity is surprisingly slim.”

“It's naturally clear that the products and their information bare a resemblance to their maker, the product managers, but we have not had problems with this heterogeneity.”

“I wouldn't say the information for products is too heterogeneous in the Store. I think that they must be. Otherwise people would get mixed up. Within product types even, like contactors, I wouldn't say so, the information just has to be a bit heterogeneous.”

6.3.2 Challenges with defining overall high quality

One clearly evident manifestation of product information -related challenges was, that it is difficult to define what high quality of product information entails. There are no unified standards with which it could be defined, and thus different people naturally describe high quality differently.

“This is a bit abstract of a question, isn't it? High quality of information is not an easy concept to define.”

This challenge was also obvious in the research results. Both the employees' and the customers' definitions of high quality varied when they were asked to define high quality of product information. The variation is, however, to some extent evident, as high quality is largely dependent on the subjective opinions and experiences an individual has had with product information.

"I would say that high quality product information is unequivocal and unique. So, one item for one real life product that cannot be mixed up with other products. Every item has its physical counterpart and there are no "generic products"."

"Product information is of high quality, if customers feel it removes their uncertainty about selecting a correct product. If the product information can convince the customer, that they are selecting the right product, then product information is of high quality."

"High quality product information includes, in my opinion, the part pictures, part dimensions and measurements, weight, possibly the producer part markings like part number or other possible numbers and letters marked on the part. So, there should be enough information available for me in the Store, that provide the means for recognizing and identifying the product. The information should also be as complete and as accurate as possible."

Even grasping the essence of the concept of high quality of product information and defining it with one's own words proved also to be difficult, which is why some interviewees, mainly customers, resorted in utilizing the quality features listed in the interview form when describing the concept.

"I guess I would define high quality so, as you have here in the form, that information has to be available, accessible, up-to-date, complete, correct, and reliable and transparent. Oh, and rich too, but I think richness follows if all those other features are provided."

"High quality product information in my opinion is about these features you have listed here below, so availability, accessibility, timeliness and all that."

When asked, all interviewees - customers and employees alike - could state the most prominent features of high quality according to their own opinions: thus, further definitions and variety in the contents of concept ensued.

"Well the data that exists has to be reliable, otherwise it's of no use. Also, the data you search for has to be complete and accurate in a way that helps you to identify that the part you searched for and found is the one you really need."

"In addition to availability, in my opinion the important product information quality features are reliability and completeness. And to be reliable, product information would also have to be correct, so accuracy and up-to-dateness are important."

"Product information should be available and accessible. But it doesn't need to be enriched too much for nothing, it should be just enough for the customers' needs."

“There can be an endless amount of product information available, but the question remains is, it serving some purpose --? Because if not, it's useless, not relevant. And even though we try to provide as much information as possible, of course we at the same time try to provide as little information as possible, because the more information fields there are to be filled, the harder management is. Which is why the relevance of information is, maybe, one of the most important criteria of high quality.”

As per the study results, there is thus no common definition for the high quality of product information, which is why ensuring it for the Store is difficult and challenging.

6.3.3 Challenges with ensuring the quality features

What could be seen from the research results was, that all the interviewed employees determined that there has been challenges with all the product information quality features determined in the literature review: ensuring them is hard for both employees regarding the internal systems where product information is managed, and for customers who use the Store. The customers also reported having experienced challenges with the quality features in the Store, mainly with the features of availability, accessibility, timeliness, and accuracy.

The interviewed employees stated product information availability and accessibility to be challenging features to provide, because information did not exist centralized in a structured form in appropriate places, or it had not been enriched for items.

“The issues with availability are the same as with ad hoc -solutions in general, so the information is either in PDFs, or it isn't in a structured form in the systems so that it could be transferred to Store without manual intervention through integration. The information isn't accessible enough. If the product information of, for example a sticker documentation, is in an Excel-file or worse, as a print-out in a sales representative's office wall or in a map Z, it won't do any good for anyone. Or if the information is only in the mind of the product manager or the platform designer, or worse, in the minds of the designers. So yes, we have information availability and accessibility issues, very much so. We just don't know the scope of that.”

“As far as I can say, especially for older products the case usually is either A. the product and its information don't exist in any of our systems, or B. if the product exists in the systems, the information it has might only be an ID without any enrichments, any data, any pictures, datasheets, anything.”

“The issue is not that we wouldn't have the information at all, but that it isn't in the correct place where it should be if it's needed in the Store. -- The product information mostly always exists within some system, but is the availability and accessibility a given or easy? No.”

Similarly, all interviewed customers reported having had challenges or problems with information availability and accessibility, mainly because Store either

does not support some pieces of product information as search words, or some information was simply not provided.

"I have sometimes had problems with information availability. It depends on what I am searching for. But yeah, it happens nearly every day and that's because the Store rarely supports searching with specifications for some materials."

"I have sometimes been unable to get availability information, unable to get a price and other times having, you know, been given a quote for something but it was still not available in the Store because there's no number for it."

"Some of the features are not always provided. For example, some product information might be unavailable. Pictures are usually the ones missing."

The feature of timeliness, or up-to-dateness, was a bit twofold amongst the interviewed employees regarding the issues in ensuring it. Some stated that it is an issue, and some stated that it is not. What was, however, evident from the statements, was that ensuring up-to-date product information for both employees and customers was not that much of a challenge in relation to the OEM - products the Company manufactures and produces on its own; the challenges with product information timeliness were associated more with the commercial parts the Company also has in its spare part selection.

"In my opinion, the product information timeliness for individual products is actually on a rather good level, and this is mainly because we have so little product information available in the Store. But the information that is available in the Store is usually also up-to-date."

"I think these timeliness and up-to-date product information issue is more of a problem for commercial products, not so much for our own OEMs."

"A distinct challenge is that the lifecycles of our products are so long. Because of this, old data, on which we have very tenuous knowledge on, most certainly exists in our systems and this just doesn't go well with the requirements of today."

"The timeliness issue is a concern with those commercial products. For example, regarding electrical components, is the latest revision taken into account? And if we dive into the software side of those products, the pace in which changes might emerge could be so fast and then the actual product modifications on top of that. It's hard to stay up-to-date, at least when talking about electrical parts."

Customers mostly stated, that they had encountered outdated information in the Store and hence had been faced with the issues of product information timeliness. That being said, one customer also pointed out that he had never had issues with information up-to-dateness in the Store.

"Yes, every now and then I have found outdated information in Store. Usually it's the prices that cause the most harm."

"I don't remember ever finding outdated product information in the Store."

One of the challenges the employees reported the Company has with the high quality -feature of completeness in association with product information, was the difficulties in defining what completeness means. Completeness was stated to be a rather subjective concept, because the state of completeness depends largely on who is viewing the product information, and someone might always say that information is incomplete even if all others would think it is complete. Additionally, completeness was argued to be a challenging feature to ensure, partly due to information not being available in the internal systems.

"Completeness is a tricky feature. The question is, from whose point of view should the product information be complete? It's completely subjective. Is the person viewing the information a customer, or some employee of our company? And within our company, who is the employee viewing the information, in which unit does he or she work? Completeness depends entirely on the viewer."

"More often than not the case is, for example, that weight information is not going to be provided in the Store, so the information is not complete. Then problems are going to emerge if the information isn't anywhere else either on our systems, -- because the customer wants to know how much the products weigh so freights can be estimated."

"Achieving completeness for the relevant product information is challenging, because we don't have the standards for it and because the information isn't easily dug up, and then there are no tools to efficiently add the information that has been found."

Customers principally stated that they had not come across incomplete product information in the Store. However, certain customers also remarked inconsistently that incomplete product information had not been an issue, but still some needed information was occasionally not provided. That said, completeness might not be a big issue for the customers, because if some information is missing, they can always ask customer representatives to check it for them.

"I don't think I have had any problems with product information completeness, not many at least."

"I find incomplete information very rarely, if ever. The information that is provided is complete, but some information might still be lacking. But incomplete information as is, is not an issue, because we always have someone to ask if something is missing."

Accuracy, also referred to as correctness, was stated by the interviewed employees to be one of the most challenging features to ensure for product information. Some employees also noted that accuracy is an extremely important quality feature, because customers have to base all their opinions and decisions in the Store on the information that is made available for them. If information is not accurate, ergo it is incorrect, customers will not be able to determine whether the product they have found is the correct one they need to purchase. Inaccu-

rate information is, in other words misleading, and it can cause extra work for the employees of the Company when it has to be fixed.

“Inaccurate information is an issue, because the information is the main thing that customers use to make their decisions on the products. This will cause both tangible and intangible harm.”

“If there is inaccurate information, especially in the Store, it will be brought up as a claim and when claims come up, they will raise up a storm. -- Then the hassle begins, managers are startled, people lose their brains and start making stupid and rash decisions. We just create extra work for ourselves when we have to mend those quick fixes made in a hurry.”

“If someone has done something wrong in SAP, it might take 24 hours before the inaccurate information is visible in the Store. Besides, getting it fixed will also take 24 hours. So, the issue here is, that when inaccurate information appears in the Store, and people would like to get it fixed ASAP, it's just not that easy.”

With accuracy, the interviewed customers were tied in their opinions: half stated they had encountered inaccurate information in the Store, and the other half declared they had not.

“No, I haven't had issues with information accuracy, not on this newer Store.”

“Once I was searching for a hydraulic pressure sensor in the Store with its part number and when I found it, the name and description were correct and every other textual information too, but the picture was wrong. It was a picture of some entirely other part --. So, the picture was of a different part than the one I was searching for, which is why I was a bit confused.”

Reliability of product information was, as per the employee interviews, an extant challenge for the Company, and a combination of information accuracy and completeness. Additionally, usability was mentioned to be a part of reliability, as was relevance. Consequently, reliability was argued to be a challenging feature to ensure and create, because without correct and complete product information that is additionally both relevant and useful, reliability cannot simply exist. And if reliable information does not exist, customers might decide not to buy parts from the Company's Store, and the employees might end up making mistakes completely unwittingly.

“If information is wrong, it's unreliable, simple as that. -- The challenges with unreliable and inaccurate product information have mainly applied to these standard product descriptions, which might cause an active Store user to doubt whether they have found the right part, even though they have already gotten an offer for it.”

“We have had occasions where unreliable information has been up in Store. Sometimes product specific documents have gotten mixed up and the documents for serial number A have been found under serial number B, and vice versa.”

“If you don't know the product, it might not be possible for you to even realize if the information is unreliable or useless, which is what's so tricky about this reliability.”

Even though the interviewed employees described that product information reliability was sometimes difficult to ensure, the customers principally reported that product information in the Store has been reliable, and thus they had no challenges or issues with it.

“Yes, product information in Store is reliable.”

“I have almost always been sure about the parts I have searched for and found that they are the correct ones. So, Store's product information is very reliable.”

Transparency was, according to the research results, determined to be a particularly challenging feature, a two-headed sword of sorts. On one hand, product information transparency should be ensured for both employees and customers, so products can be unambiguously identified. On the other, holding some information back especially from the customers is a mandatory evil in spare parts business, if companies do not want to lose their competence.

“The transparency feature is also important for us, because if transparency is provided and ensured, customers can see that we can be trusted. That we don't hide product information. But this is also a feature we can question, because if our items in the Store have just an ID and a picture, nothing more... is transparency then provided?”

“We don't want to show all the information we have for customers. Not even for our internal colleagues even.”

“We have lots of product information that we don't put forward. Some are trade secrets and some information is not shown because we want to protect our business.”

“Yes, we do have some information that is not presented for customers or even internal employees. So, our product data might not be as transparent as it could be. For example, we sometimes hide IDs from certain users. Also, we can have many different prices for a product --. We naturally only want customers to see the price that is designated for them. We don't want customers to see information which could benefit them in a way that they could buy some of our products from other e-stores.”

Because all the other discussed quality features were determined to be hard to ensure, providing all employees and customers with rich product information was also stated by the interviewed employees to be a challenge for the Company. However, the interviewed customers felt that the information in the Store is rich, even though they described having issues with some other quality features of product information.

“This sort of collects together all the issues with the other quality features. If we have issues with any of those, we have issues with product information richness.”

“If product information is complete and reliable, there's no reason for it not to be rich too. So, I would say the product information in the Store could be defined to be rich.”

6.3.4 Challenges with the manipulation of information

The interviewed employees stated, that manipulation, modification, and anonymization of product information takes place in the company, even though the intention is not to deceive customers, but to protect the business and trade secrets. However, it was realized, that hiding or modifying product information to fit the company's needs, might not serve the customers as some important product information needed in product identification might not be available.

“We might have, maybe, sometimes, used Photoshop a bit to remove some part numbers from the product pictures. Or logos and such. We photoshop the pictures with a stamp-tool or then we retouch them.”

“Yes, we do modify and anonymize product information. At least with commercial products, we don't want our customers to know who has produced the products, because if we made this information available, we would lose this commercial part business almost entirely.”

“But basically, if some product information is sometimes deteriorated or hidden, it causes uncertainty with difficult cases, like a product could be hard to recognize.”

Even though the interviewed employees admitted that the Company does manipulate or hide information from their customers, the interviewed customers had not experienced any issues, where they would have discovered that some information that once was available was not anymore.

“Usually if I notice that something has changed in the Store after the last time I used it, it's usually something like the products have been updated with more information and more pictures have been added. So I would say these possible modifications or changes on product information I have encountered in the Store have always been positive, and nothing like something would have been hidden.”

One reason to hide or anonymize product information, as stated by the interviewed employees, was the prevention of customers being able to benefit from using the Store only as a database, and then moving on to different e-stores to actually make the purchases. This, as it happened, was deemed to be a possibility by all, both the interviewed employees and the interviewed customers.

“Of course it's possible that customers would use Store with rich product information as a source of information only, not buying anything. The customers could do this now too, without having the richest and highest quality of product information available. The main factor here is price.”

“Especially with the commercial parts there's always this possibility that we'll lose customers, particularly if there's enough information available in the Store. People

always tend to go for the cheapest one after all when buying something. And of course, the availability factor might influence this kind of behavior too. So, if a customer can get what they need from a neighboring store within five minutes, they'll probably go there instead of waiting three days to get it from us if they order it from our Store."

"This, that customers would only use our Store as an information source and then move on to buy the products from some other e-store, is something that is definitely an existing fear in our company. And this is probably one of the reasons why we don't want to, for example, publish our prices yet in the Store, they are only visible for registered customers. -- we want to prevent those actions of customers coming to our Store just to look at the product pages and not buying anything from us --."

It can thus be argued that this was an ongoing challenge for the Company, as they strive for as complete information available in the Store as possible, but at the same time they wish to restrict the customers from buying the products elsewhere. However, interestingly all the interviewed customers pointed out they would not engage in this kind of behavior themselves.

"-- at least personally, in a case where there is a rich product page available in the Store with high-quality product information in place, I wouldn't just use this information to my benefit and try to buy from some other e-store. -- There'd be no sense in this, because we know using Store will always ensure the quality of the products for us."

6.3.5 Challenges with customer requirements

The challenges with customer requirements regarding product information and its quality in the Store were, according to the case study results, principally associated with the requirement gaps between the Company's perceptions of what customers want, and the actual customer requirements. These requirement gaps were brought to light and deduced from the results of the product page example -related interview questions, asked from the employees and the customers participating to the interviews.

First, customers and employees defined what product information is essentially important for the specified product groups in the example pictures (mechanical product, electrical product, and a product set). For all three product examples, variation and divergence between the customer requirements and employee perceptions was evident, even though similarities emerged as well. Almost the same product information attributes were, in fact, defined to be vital; however, their level of importance was in most cases different, when comparing the combined requirements of customers, and the combined perceptions of the Company. The importance of these information was calculated from the number of mentions in all the interviews, separately for the customers and the employees. Excluded from the examination were the price and availability information, which were both equally defined to be the most vital for all products and must be provided, so the products can even be bought from the Store.

The customers' requirements about the essential product information and the Company employees' perceptions of the requirements are introduced for all three examples below (Table 8) in a descending order for the three most vital pieces of product information.

TABLE 8 Divergences in the requirements about product information importance per product example

Customers' requirements			Company's perceptions		
<i>Mechanical</i>	<i>Electrical</i>	<i>Product set</i>	<i>Mechanical</i>	<i>Electrical</i>	<i>Product set</i>
Picture	Specification	Dimensions	Type	Specification	ID
Serial number	Short sales text	Picture	Dimensions	Picture	Dimensions
Dimensions	Picture	Specification	Serial number	Short sales text	Picture

For example, customers listed picture and the serial number, specification and short sales text, and dimensions and picture, to be the most essential pieces of product information, respectively, for mechanical products, electrical products, and product sets.

"The picture shows you everything that you get. -- So, I think for this mechanical product we need the picture, and then the serial number area where this applies."

"The essential information in the case of this electrical product are specification, -- the electrical details so the short sales text, and the picture."

"Photograph and dimensions, yes, those would be the main thing I'd need to see for this product set."

Comparably, the employees defined the most important product information to be, the type and the dimensions for the mechanical product, specification and the picture for the electrical product, and ID and dimensions for the product set.

"For this kind of a mechanical product, the type is important, so customers will know to what kind of a hook this fits, and the dimensions are also important."

"The specification is the most important piece of product information this electrical product has. The other essential information are this short sales text and the picture."

"The most important information for this product set are the spare part number, the ID, and the rest depends on the customer. -- But most likely the other important things are the picture and the dimensions."

Second, there were some differences in the selections of employees and customers regarding what amount of product information – poor, moderate, or rich –

would be enough on a product page so that recognizing a product could be ensured. Interestingly though, while the customers were quite unanimous in their requirements for mechanical and electrical products with a hint of disparity in the requirements for the product set, the employees were rather divided in their opinions about what would be enough for the customers. This divergence between the customers' requirements and company's perceptions of them is exemplified in Table 9, by listing how many interviewees in both customer- and employee interviews stated each level of product information enrichment on a product page to be enough for recognizing said product.

TABLE 9 Divergences in the requirements for product information enrichment level per product example

Product type	Level of product information enrichment			Interviewees
	Poor	Moderate	Rich	
Mechanical	0	4	0	Customers
Electrical	0	3	1	
Product set	1	2	1	
Mechanical	0	4	4	Employees
Electrical	3	5	0	
Product set	2	2	4	

Regarding the mechanical product, the customers defined the moderate amount of product information enrichment to be enough for recognizing it, with disclaimers that some information provided in the richest enrichment version should still be added there. Hence it can be inferred, that only the richest version would have been enough for the customers if no changes on the example product pages were allowed. The employees were evenly tied between rich and moderate versions.

"If this moderate one would have measurements, it would be enough for me as a customer."

"I would say, in this case with these examples, all other versions would be traps for our customers except this fully enriched one. The moderate would work just fine, if it had the "from serial number" information. If I had to choose between these without changing anything, I would have to say only the richest one is enough for customers, because the serial number information is not provided anywhere else."

"In my opinion, this moderate version is the minimum requirement for our product pages, so customers could familiarize themselves with the products. I would say that this moderate version would be enough --."

On average, the customers defined the moderate version to have enough product information for identifying the electrical product. Employees were, again, divided in their selections: some stated that already the poorest version had enough product information available, while others insisted on the moderate one having enough product information available for an electrical product.

"I would say, the fully enriched is a bit overkill, actually. -- I think again, as a customer, probably the moderate one is enough for me."

"Here in the moderate version we have the specification and short sales text displays the electrical information. I would say, that customers would be well off with that moderate version."

"As a matter of fact, only the specification would be enough information with which the customer could recognize this and then go buy from some other e-store. So -- even this poorest version would be enough."

The customers, on average, again stated that the moderate level of enrichment would be enough for recognizing the product set. The employees, on the other hand, argued variedly in favor for all versions. However, the most selected version was the richest product page example with remarks, that even the richest enrichment level would not be enough, because most likely some uncertainty would still prevent customers from identifying the product set unequivocally without fail.

"So, in my case as a customer, this poorest version would probably -- cause some uncertainty because there is so little information that is provided, even though the part number is available. But the moderate version would most certainly be enough for me, because it has that picture that makes all the difference in the world."

"-- only the fully enriched product page would be enough for this product set. Added to that, the customer will most likely have to ask for extra information from our customer representatives before being able to make any purchasing decisions."

Lastly, in addition to requirement gaps, challenges were reported to have manifested from the evaluation and implementation of customer requirements. The interviewed employees stated, that it is possible for customers to ask for relatively anything in relation to the Store and the product information within, which is why evaluating and deciding what requirements are reasonable to follow and implement is a difficult task the Company has got no time for.

"There probably is an innumerable amount of issues that could emerge from studying and utilizing customer requirements. The requirements can conflict with one another, for example. Surely there are other issues too. Customers can naturally demand almost anything, and we then need to prioritize and decide which of those requirements are we going to utilize in some way."

"We don't have the time, the resources or the energy to be proactive and examine the requirements and experiences."

6.4 Summary

In this sixth chapter, the empirical results of the case study carried out as group and individual semi-structured interviews with the Company employees and

customers were introduced. The results on the manifested and existing PIM challenges for the Company's B2B e-commerce (the Store) were presented by following the theoretical framework created from the basis of prior literature and research in chapter 4.4. First, the PIM challenges related to information systems were discussed through the challenge themes of use and integration of various systems, data transfers and diverse data formats, and system features as well as system updates. Second, the organizational challenges were declared through the challenge themes of processes, standards, and people. Third and last, the product information -challenges were introduced through the themes of vast amount and heterogeneity of product information, overall quality, quality features, product information quality manipulation, and customer requirements. All the challenges were exemplified through the interviewees' statements by leveraging their classified and thematized quotes.

By following the theoretical framework structure, the empirical results of the case study on the existing PIM challenges within the Company are summarized in Table 10, with some exemplifying manifestations attached for each class and theme of challenges.

TABLE 10 Summary on existing PIM challenges in B2B e-commerce for the case company

Challenge class	Challenge theme	Example manifestation in the Company
Information systems	Use of various systems	Combining data from various different systems into Store
	Integration of various systems	Some needed integrations between systems do not exist
	Data transfers	Unsuccessful data transfers might cause the needed information not to end up visible in the Store
	Data formats	TIF-files are sometimes used even though web browsers do not support them
	System features	Learning and remembering how to use the various systems and their distinct features is hard
	System updates	System updates and fixes sometimes take too long to carry out
Organizational	Processes	Shortcuts are taken in PIM tasks because there is not enough time to properly carry them out
	Standards	PIM is not unified, because all departments and individuals have their own guidelines for managing and enriching product information
	People	Lack of skills in using the systems needed in PIM, or even resisting the use of some systems
Product information	Vast amounts and heterogeneity	The Company has a lot of products and thus a lot of information to manage, but only a few people to carry the daily management tasks out
	Overall quality	Defining what high quality entails is difficult, and thus providing high quality for product information is challenging

(continues)

(Table 10 continued)

Product information	Quality features	Issues in ensuring product information availability, accessibility, timeliness, completeness, accuracy, reliability, transparency, and richness for both employees and customers
	Quality manipulation	Hiding certain product information, such as prices or specifications, from customers in the Store causes uncertainty in identifying products
	Customer requirements	Requirement gaps between the company's perceptions of customers' requirements, and the actual customer requirements for product information

To conclude, PIM challenges related to all challenge classes were discovered to have manifested in the Company's Store operations. Similarly, numerous PIM challenges related to all the challenge themes within the challenge classes were seen to have manifested in relation to the Company's Store. Next, the case study results are analyzed further by comparing the empirical findings into existing literature and prior research on the studied subject.

7 DISCUSSION AND CONCLUSION

This chapter concludes the thesis. First, the research results are analyzed and discussed. Comparisons between the research results and prior literature and research are made to see whether reality matches theory; how many of the PIM challenges examined to exist in the operations of the Company have also been noted and discussed in prior literature, and vice versa. Second, the conclusions drawn from the research results are explained and the possible implications of the research are speculated. Third, the limitations valid in this study are presented, and the matter of research success is considered. Fourth, and last, this chapter and the entire thesis concludes with remarks on possible further lanes of research, and with a summary on the contents of thesis.

7.1 Research results analysis and discussion

According to the empirical qualitative case study results, the PIM challenges that can arise in B2B e-commerce are multiple and varying; however, all challenges are related to either information systems, organizational aspects, or product information, as the research was conducted with its basis on a theoretical framework addressing PIM challenges from these viewpoints.

The information systems -viewpoint was associated with challenges that directly addressed or manifested from 1. the use and integration of various information systems functioning in the background of PIM operations, 2. the data transfers between systems and the diverse data formats utilized and accepted in the many systems, and 3. the features of the multiple systems in use, and the updates performed for or within the systems. This was evident in both the literature review and the case study results.

In more detail, the case study results indicated that the daily work and PIM related tasks the employees perform have become more difficult because there are so many distinct systems at use that require integration in between. This was similarly stated to be an issue in multiple prior research and literature, where one of the main challenges of PIM was argued to be the product information stored in numerous different systems (Abraham, 2014; Saaksvuori &

Immonen, 2004; Sääksvuori & Immonen, 2002) that need to be integrated to achieve product information cohesion and unity (Ding et al., 2004; Fensel & Ding, 2001; Kropsu-Vehkapera et al., 2009) in e-commerce. In this study, especially the continuing use of legacy systems was also reported to cause nuisance and extra work because of the product information still stored within them; similarly, in the literature review the continuing usage or legacy systems was mentioned as an identified challenge for companies in their PIM activities for e-commerce purposes (Toews, 2012). Additionally, the research results of this thesis showed that because there are so many different systems in use, including legacy systems, the data quality was a prominent issue, especially when the systems containing data of differing levels had to be integrated to get the product information unified. These challenges can cause further issues and problems: for instance, the data shown in the Store can be poor or inaccurate, and thus customer experiences will suffer. In prior research, the same has been noted by Orr (1998) and Toews (2012).

In the literature review, it was discovered that also data transfers and data formats are existing causes of PIM challenges in B2B e-commerce. For example, inconvenient and problematic issues were stated to be caused for PIM, and thus for e-commerce, because of transfer slowness (Kropsu-Vehkapera et al., 2009) or technological demandingness of the transfers (Wenninger, 1999). Attention was also paid especially to manual transfers and to the problematicness of legacy data transfers: both are sensitive to inconvenient errors originated from technology and people alike, that could cause issues for the smooth flow of data required in the editing, enriching and management of product information for getting the products and their information visible in e-commerce (Kujansuu, 2017; Liu & Xu, 2001; Permalla, 2006; Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002). Added to that, issues for data transfers and general management of product information were argued to be caused by unconventional data formats that might not be accepted by all systems behind PIM and e-commerce (Bernstein & Haas, 2008; Kim et al., 2001; Philpotts, 1996).

According to this study and its empirical results, not that many issues in PIM emerged for the Company from diverse data formats: only challenge clearly stated to be about data formats was the issue with TIF-files being used as a document viewing format even though most systems and web-browsers, thus also Store, will not accept and process them properly. The scarcity of data related to these challenges might originate from the interviewees not being able to remember any examples during the interviews, or from the analysis of the interview data: some reported challenges and problems might truly address the diverse data formats, but are nonetheless thematized into other challenge categories. It is also possible, that truly not many challenges associated with data formats have manifested in the PIM activities of the Company. That said, the case study results showed that the data transfers caused multiple issues for the Company's PIM and Store because of their manual dependency, slowness, unsuccessfulness, or connection to legacy data, thus reflecting the results of the literature review.

In short, as deduced from the case study results, the challenges inflicted on the management of product information in connection to the Company's Store because of system features or updates were multiple. For example, the difficulties in learning and remembering how to use multiple systems was pointed out as an issue, as were the specific system functionalities and features like poor usability, difficult search functionalities, and user rights. Moreover, the problems caused by the systems not being modified to meet the company's after sales needs were an ongoing challenge. Added to the problematic system features, malfunction issues, such as bugs, and system updates were the cause of many issues too. As per the study results, updates had sometimes been unsuccessful and even broken something that used to work. The employees also felt that the updates take too long to even initiate and then to carry out.

These challenges, empirically proven to exist in the Company's PIM operation for the Store, can be seen to mirror the system feature and update challenges declared in the literature review. For example, Kujansuu (2017) and Stark (2005) defined the cognitive strain from learning and remembering how to use multiple systems and their features to be a particularly problematic challenge for PIM from the information system -viewpoint. Additionally, Stark (2005) had defined some problematic features, such as system search functionalities and user- and access rights in the systems to be notable challenges. Bugs and other system malfunctions were also described to be challenging issues that companies had encountered for their PIM activities carried out for PIM purposes. Moreover, system updates were noted to be challenging due to their possible unsuccessfulness, total failures and long lead times, which might end up in the updates even breaking something that used to work. (Saaksvuori & Immonen, 2004; Stark, 2005; Sääksvuori & Immonen, 2002.) Accordingly, it can be stated that the research results from the case study have, in a sense, strengthened the literature review and the theoretical framework by empirically demonstrating the theorized to hold true.

The organizational challenges found out in the case study manifested through or were associated with the 1. processes, 2. standards, and the 3. people of the studied Company. According to the research results, the circumstances that made the processes of managing, enriching, and publishing of product information in relation to the Company's Store especially problematic, mainly encompassed the matters of manual work, lack of resources like time, and findability of information, as well as the issues with the small amount of people working with PIM tasks, the availability of information only through certain individuals, and ad hoc -solutions used in handling product information. Additionally, the employees reported that there is not enough collective understanding about PIM or caring for its importance, which is why the issue of shortcuts being taken in the related activities and processes are common.

All these processual issues were also addressed in the existing literature reviewed prior to the empirical case study. Manual work was stated to be an issue and possible contributor to the inconsistency and inaccuracy of product information through, for example, human errors (Abraham, 2014; Främpling et

al., 2006; Lee et al., 2006). The PIM tasks were also stated to be time-consuming, partly due to the poor findability of product information (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). The immense workloads aggravated by the manual dependency of the PIM tasks and lack of time were seen to be an issue for the usually small group of people responsible for the daily management activities of product information, that as is was also defined to be a challenge for PIM (Abraham, 2014; Haug et al., 2011; Kropsu-Vehkaperä et al., 2009). On top of that, prior literature referred to the personification of product information and other knowledge to be an intricate existing issue for PIM in B2B e-commerce (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002). The common lack of unified understanding and appreciation for PIM was also mentioned in prior literature to cause challenges for PIM (Easton & Araujo, 2003; Kropsu-Vehkaperä et al., 2009), especially when people utilize ad hoc - solutions for storing and managing product information, thus endangering its consistency and quality as a result (Liu & Xu, 2001; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002).

The challenges that the Company appeared to have with standards regarding PIM related processes and tasks, as well as the product information itself, were, based on the case study results, due to the obvious non-existent standards as well as existing standards or guidelines. Mostly, standards did not exist because it was not clear who should make them. Additionally, the scarce resources were defined to be one reason why standards were not created and thus followed. Whatever the reason why standards were not created, the missing standards nonetheless caused issues for PIM by hindering the findability and quality of product information, as well as adding to its disjointedness and to the overall confusion about what should be done by whom and what information should be enriched for which product. This was also evident in prior literature, where it was stated that few to no standards in place for PIM practices and product information complicate the ensuring of product information quality and process unification, and further also hamper the improvement of customer experiences (Albrecht et al., 2005; Ding et al., 2004; Liu & Xu, 2001; Otto et al., 2013; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002).

The missing standards were discovered and determined in accordance with the case study results to have caused a lot of incoherence between different departments: because no common standards existed regarding almost anything, different teams and individuals had come up with their own guidelines and instructions for different processes, tasks, and information, so they could facilitate their own work even though it caused more issues to emerge for the big picture of PIM regarding Store. The need for creating unified and common standards to avoid the development of departmental or individual-specific instructions and standards that lead to multiple distinct ways of working with PIM, was also a clear challenge detected from the basis of the literature research (Abraham, 2014; Albrecht et al., 2005; Kropsu-Vehkaperä et al., 2009; Stark, 2005). Some common standards were, according to the empirical study, discovered to exist for product information enrichment in the Company, but they

were reported to be insufficiently followed or not wide enough to take everything needed into account; according to the literature review (Fensel & Ding, 2001), this is a clear challenge of PIM standards.

The last theme in organizational challenges both in the case study and literature review was associated with the issues and challenges that have emerged from the basis of various individuals who take part in the management and enrichment activities of product information for e-commerce purposes. In the case study, these people-related challenges were mainly seen to be caused by the individuals' different attitudes and interest-rates towards PIM and Store. Additionally, different individuals caused issues for PIM and Store because of their differing habits, that emerged as several distinct ways of working with product information and the systems at use, and distinct customs in describing products. Moreover, the differing opinions and requirement different people had about, for example product categorizations, were seen to cause problems in ensuring product information cohesiveness. Lastly, the lack of skills in using the different systems or actual resistance for system use were seen to cause issues for PIM and Store through different individuals.

These results on people-related challenges for PIM in B2B e-commerce can be seen, again, reflecting the results of the literature review conducted prior to the empirical case study. The diverse attitudes and interests different people have towards PIM tasks, standards, e-commerce, and product information itself were described as an existing challenge for companies (Abraham, 2014; Ding et al., 2004; Fensel & Ding, 2001; Kropsu-Vehkaperä et al., 2009; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002), as were the distinct ways of working with product information (Orr, 1998; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002) and the different ways of describing the products due to vocabulary differences and language barriers (Ding et al., 2004; Fensel & Ding, 2001; Omelayenko & Fensel, 2001; Stark, 2005). Respectively, also the lack of skills in the utilization (Liu & Xu, 2001), or even resistance for the use of the systems leveraged for PIM purposes in connection to e-commerce (Stark, 2005), were addressed and defined as challenges in prior research.

The product information-related challenges discovered in this thesis' empirical case study either addressed or emerged from 1. the vast amounts and heterogeneity of product information, 2. the issues with defining the meaning and elements associated with the high quality of product information, 3. providing and ensuring the many high-quality features for product information, 4. the possible manipulation and modification of product information, and 5. the customer requirements for product information and its quality. Similarly, all these challenges were introduced in the literature review.

The challenges caused by the vast amounts and heterogeneity of product information that were presented in the literature review from multiple viewpoints. The immense amount of information was seen to be a highly problematic issue for PIM and e-commerce as is (Stark, 2005), but also the managing and enriching tasks were deemed difficult to carry out and complete in reasonable timeframes (Cai & Zhu, 2015; Haug et al., 2011; Otto et al., 2013; Stark, 2005;

Walther et al., 2009). The heterogeneity of product information was defined to actually be one of the most problematic PIM challenges in B2B e-commerce, because its incoherence and anharmonicity prevent great customer experiences from developing (Ding et al., 2004; Fensel & Ding, 2001; Kujansuu, 2016; Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002).

The case study results showed, that same challenges that exist in theory regarding vast amounts of product information, exist in practice too. The results pointed out that the extensive amount of product information was an issue by itself, but was also seen to cause further issues for PIM as there were, in fact, only a few people managing the said information. Additionally, reasonable timeframes to carry the management tasks out were sometimes surpassed because of the amount of product information that was handled. The information heterogeneity was mainly seen as an issue regarding brand-related product information and product groups. Having said that, in many cases information heterogeneity was, in fact, not seen as a concerning challenge for neither the PIM, nor for the Store, even though it was pointed out to exist for some information: this shows a difference between the review conducted in prior literature and the empirical study conducted in this thesis. Whereas in existing literature, heterogeneity of product information was determined to be one of the most difficult PIM challenges, the empirical results showed otherwise: the research participants stated they had not had that many issues with it.

The main challenge with overall high quality of product information was, according to the case study results, its subjectivity and the various possible and distinct ways to define it. Almost all the participants defined high quality differently, although with slight similarities; no universal definition for product information high-quality exists, which is why ensuring it is harder than it should be. The nonexistence of common and universal definition of the meaning and the elements high quality comprises, was also pointed out through the literature review results to be a challenge for PIM and e-commerce (Cai & Zhu, 2015): prior literature also offers multiple varying descriptions of high-quality, all of which are slightly or clearly different from one another, which only adds to the confusion about what high quality of product information truly entails.

The high-quality features of availability, accessibility, timeliness, completeness, accuracy, reliability, transparency, and richness were concluded from the basis of multiple prior researches to be its most prominent features (Ballou & Pazer, 1985; Barnes & Vidgen, 2006; Cai & Zhu, 2015; DeLone & McLean, 2004; Fensel & Ding, 2001; Kropsu-Vehkapera et al., 2009; Manenti, 2010; Permalla, 2006; Walther et al., 2009; Wand & Wang, 1996). Ensuring all these was seen as a challenge for PIM regarding e-commerce operations, both in prior literature and in this research.

Product information availability and accessibility for both internal employees of a company (Kropsu-Vehkapera et al., 2009; Permalla, 2006; Stark, 2005) and for the company's e-commerce customers (Cox & Dale, 2001; Stark, 2005) were explained to be highly important, but at the same time usually challenging to achieve for all needed information. Sometimes information might not

exist in a PIM system, where it should exist, if it needs to be transferred to e-commerce too (Srinivasan et al., 2002). Same was reported to be true in practice, as per the case study results achieving availability and accessibility of product information has been difficult, because sometimes the information does not exist there where it should. Hence, finding it is hard within the internal systems of the Company, and consequently it is challenging to put it up in the Store.

Timeliness of product information was defined in the reviewed literature to be hard to ensure: the high volume of information makes it difficult or even impossible to provide up-to-dateness for it all. Information can sometimes change extremely fast, thus keeping up with what is old and what is current is highly demanding. (Cai & Zhu, 2015; Manenti, 2010.) Sometimes product information can also be decades old and making sure whether it is still valid and current could be hopeless (Abraham, 2014). Exactly similar issues were present in the Company, as according to the results of this study, product information of the Company's products might sometimes change extremely fast without the Company being able to keep up with it, while at the same time some product information might be old due to long product lifecycles. The issue of providing product information timeliness was also proved to exist, because the interviewed customers stated having had issues with it in the Store. However, the challenge with timeliness was determined to be more of an issue with commercial products than with the OEM -products of the Company.

It was found out from the basis of the literature review, that the main challenge with product information completeness is the nature of the feature itself: completeness depends highly on who is viewing the product information and determining its state of completeness (Walther et al., 2009). Hence, product information is most likely always going to be incomplete in someone's opinion, even though others would state it is complete (Petre et al., 2006). Respectively, in the case study, same issues as in literature review were found to be challenging about product information completeness. Additionally, ensuring product information completeness was determined to be challenging, because sometimes the information did not exist in the systems where it should be managed for Store purposes, and because there were no standards defined for products that would state what information should be enriched for them to be "complete". That said, these background influencers for the difficulties in providing completeness were not addressed in prior literature.

Accuracy was stated in prior literature to be an issue for PIM and for e-commerce, because if erroneous information is provided for customers and other users alike, it can lead to misguided decisions, problems in identifying products, and to poor customer experiences (Bernstein & Haas, 2008; Kropsu-Vehkapera et al., 2009; Petre et al., 2006; Philpotts, 1996; Swerdlow et al., 2016; Wand & Wang, 1996; Wang & Strong, 1996). The case study showed corresponding issues to exist in practice, as the Company's customers stated to have encountered inaccurate information in the Store. Similarly, the employees also clarified accuracy to be challenging to ensure, because mistakes could easily be made during the management tasks of the product information. The case study

also provided research results on the problems with guaranteeing product information accuracy that were not addressed in the literature review, but still important to mention: sometimes accuracy was difficult to achieve because fixing inaccurate information takes too long, and by taking shortcuts in the corrective actions to achieve the fixes faster, manifestation of possible new inaccuracies in the information can be caused.

In relation to product information reliability, it was clearly stated in the literature review results, that completeness and accuracy of product information have a clear effect on its reliability. Reliability cannot be achieved and ensured, if product information accuracy and completeness cannot be provided first (Cai & Zhu, 2015; Stark, 2005). Additionally, usefulness and relevance of product information were determined to be related to the concept of reliability (Cai & Zhu, 2015; DeLone & McLean, 2003; Haug et al., 2011). So altogether, providing reliability was, according to prior literature, difficult to even produce for product information, because to be reliable, product information must be complete, accurate, useful, and relevant. Interestingly however, as shown in the case study results, the Company's customers did not report having issues with product information reliability in the Store, even though the Company's employees reported the feature to be challenging to create for the same reasons as disclosed above in relation to prior literature.

According to the literature review, transparency can be achieved, if product information is made as available, accessible, up-to-date, complete, accurate, and reliable as possible. If these cannot be provided, information will not be transparent and information asymmetry will follow. (Keeney, 1999.) As per the case study results, because hiding some information and thus causing information asymmetry between the customers and the company is a mandatory evil in spare parts business, ensuring total transparency is not possible. Consequently, transparency is a challenging feature for the Company, as without hiding or withholding some information, it might lose customers to other e-stores or expose its trade secrets. Also noted was that without transparency of product information, customers might not identify the products properly in the Store.

The high-quality feature of richness, was determined in the case study results to be almost an epitome of all the issues related to the other high-quality features: providing and guaranteeing product information richness was a challenge, because it was challenging to ensure the availability, accessibility, timeliness, completeness, accuracy, reliability, and transparency of product information. This was also a straight reflection of what was discovered in the literature review (Keeney, 1999) about product information richness.

The manipulation of product information and its quality was determined to be an existing challenge, according to the case study, mainly because some anonymization, modification, and hiding of product information is imperative in spare parts business, if the Company wants to guard its business. The aim was not to deceive the customers by withholding essential pieces of information out of intentional malice: the purpose was to simply not provide information in the Store that customers could utilize in purchasing the same product else-

where, which in fact was also explained to be an existing concern. However, at the same time it was realized that this anonymizing and modifying of information could cause misunderstandings or misguided decisions among the customers, as they might not be able to identify products with ease, thus making product information manipulation a significant PIM challenge that relates closely to the transparency -feature of high-quality.

These case study results on challenges associated with the manipulation of product information and its quality are a clear reflection of the literature review results on the same. In the literature review it was also stated, that the manipulation is an act of hiding or anonymizing product information (Xiao & Benbasat, 2011) without malicious intents, carried out to protect the business and trade secrets. Noticed and defined were also the possible issues caused by the manipulative practices: customers might not be able to recognize products, whose product information has been altered (Xiao & Benbasat, 2011).

According to literature review, one issue with customer requirements was, that it is not easy for customers to define what product information is vital and what is not for various kinds of products (Fui et al., 2002). Having said that, this was not discovered to be an existing challenge for the Company according to the case study results, as the interviewed customers were clear with their specific demands for the three example products and their most vital information. However, requirement gaps between a company's perceptions about customers' requirements regarding product information were defined to be a PIM challenge according to both the literature review (Cox & Dale, 2001; Parasuraman et al., 1985) and the case study of this thesis. As per the case study results, the requirement gaps between the customers' needs and Company's perceptions of the same existed regarding the most important pieces of product information for distinct products. Though not conspicuous, the existence of this requirement gap was a challenge regarding the PIM activities performed for Store: situations where company might think product information is of high-quality and complete while the customers would not declare the same are possible, because the requirements differed. In addition, differences in defining what level of enrichment would be enough for Store product pages of different products both existed and did not exist. However, as all the employees were not on the same page as the customers on average were about the satisfactory level of enrichment, the requirement gap must be noted, even if it is not obtrusive.

In addition to the requirements gap, the research results showed challenges had emerged from utilizing the customer requirements because of their variety and the shortage of resources in being able to reasonably and systematically define which of them to utilize. The same was also noted in the literature review results: prioritizing certain requirements over others was a challenge for companies in association with PIM and e-commerce (Lightner & Eastman, 2002).

As a conclusion, it should be stated, that the empirical case study was carried through the theoretical framework created as a result of the literature review. It comes thus as no surprise, that similarities between the literature review and the empirical case study results existed in considerable amounts, even

though differences could have and did somewhat emerge. That said, it was important to analyze and declare the similarities, as it could have been possible that no such challenges discovered through the literature review would have existed in the PIM operations of the Company.

7.2 Research conclusions and implications

The purpose of this thesis' empirical research was to investigate solutions to the research problem of declaring the possible challenges companies can be faced with while managing their product information for the purposes of their B2B e-commerce. The main research question derived from the research problem was: *"What product information management challenges can arise in B2B e-commerce?"*.

Solving the research problem by answering the research question was carried out by first conducting a literature research on the topic. From the basis of the literature review, a theoretical framework was created for the purposes of the empirical research. From this framework, an additional research question was formed to be solved through the empirical research carried out as a qualitative case study with semi-structured interviews, also guided by the framework: *"What information systems -related, organizationally related, and product information -related product information management challenges exist for the Company regarding their B2B e-commerce?"*.

Based on the research results of the case study it can clearly be stated, that challenges presented in the theoretical framework also existed in practice for the Company. Thus, an answer to the additional research question is as follows. Challenges related to information systems were associated with the use and integration of various information systems functioning in the background of PIM operations, the data transfers between systems and the diverse data formats utilized and accepted in the many systems, and the features of the multiple systems in use, and the updates performed for or within the systems. Respectively, the challenges regarding organizational aspects were related to the processes, the standards, and the people that all in some way affiliated with the PIM activities of the Company for the purposes of its Store. Lastly, product information -related challenges extant in the Company were associated with the vast amounts and heterogeneity of product information, the issues with defining the meaning and elements related to the high quality of product information, providing and ensuring the many high-quality features, the possible manipulation and modification of product information, and the customer requirements for product information and its quality.

Referencing the empirical case study results and the literature review from the basis of the created theoretical framework, the main research question is also solved and answered to. In general, PIM challenges that can arise in B2B e-commerce are challenges related to or caused by information systems, organizational factors, and product information.

From the basis of the research results it can be concluded, that all the PIM challenges are highly interrelated and somewhat even dependent on one another.

er, consequently creating a vicious circle that spins with the power of the connected challenges: when some PIM challenges exist in one of the viewpoints of information systems, organizational factors, and product information, challenges in the other two start to emerge as well. The challenges in one viewpoint affect the challenges in the other viewpoints. It is a vicious circle, not only as described in the literature review regarding the organizational challenge -category of processes (Saaksvuori & Immonen, 2004; Sääksvuori & Immonen, 2002), but also in a larger scale in the unity of information systems, organizational aspects and product information itself. The challenges do not exist separately in a vacuum, but rather openly feed on one another. This is visualized into Figure 4.



FIGURE 4 Interconnectedness of PIM challenges

For example, if the product information is scattered around in many different systems and ad hoc -solutions are also utilized in handling it, the management of this information becomes quite troublesome (information system -challenge). That being said, if the information is managed in many different systems and handled by many different individuals – in addition to the small group of people responsible for the daily management – the ways of managing the information are possibly not that structured or standardized, but rather incoherent and diverse (organizational challenge). So, if there are no standards for product information processes or the product information itself, the quality of product information will decrease as availability and completeness issues, among others, start to emerge (product information -challenges) because the information is managed in various distinct ways according to multiple department- or individual -specific guidelines (organizational challenge) in various unconventional and not-agreed-upon solutions (information system -challenge). So, as seen, the issues depend on one another and consequently the vicious circle keeps on spinning, creating more momentum (challenges) along the ride.

To break free from the vicious circle, companies need to start investigating and realizing the challenges they have in their product information management. When they do, the issues and challenges can be faced and possibly treated and solved, thus leading to at least fewer challenges and slower spinning of the vicious circle, if not possibly totally halting it and breaking free from its harmful influence on e-commerce, PIM, customer experiences, and productivity.

This thesis and its empirical case study provide substantial new and beneficial information for academics. PIM is a relatively new concept to be studied

on its own: even though PDM and e-commerce are widely studied both individually and together, the conjunction of PIM and its challenges especially in the niche context of industrial manufacturing spare part sales through B2B e-commerce is not. This study was possibly one of the first of its kind to research the prominent challenges in the management of product information for inter-organizational sales and marketing purposes, especially in the context of after sales. Thus, the generated theoretical framework on PIM challenges in B2B e-commerce, that was empirically tested and proven to hold true and be functional in possibly identifying and clarifying potential PIM challenges in B2B e-commerce associated with the spare parts sales of an industrial manufacturer, summarizes a vast amount of prior knowledge and current research on PIM challenges. The framework is created and empirical research results based on it are studied in association with a niche environment, but nothing implicates it would not work in other e-commerce environments and industries for detecting possible challenges that stand in the way of high-quality product information, its effective management, and great customer experiences.

The implications for practice derived from this thesis apply in particular to the Company participating the empirical study. The empirical case study results backed up by the theoretical framework provide the Company with significant assets and means for realizing the interrelations of various PIM challenges it might have in relation to their e-commerce. This could significantly help the Company to prioritize the resolving of the challenges, if so is deemed necessary. As per the results of this case study, it would be highly beneficial to concentrate and guide some resources in solving these challenges, so efficient and coherent management of product information can be improved, consequently improving the quality of product information, through which the enhancement of customer experiences can follow. Noteworthy is, that focusing on even one challenge might improve the big picture significantly, as all the challenges discovered through the case study partake in the rotation of the mentioned vicious circle.

7.3 Research limitations and success

As any academic research, this study does not come without its limitations. A few limitations were observed and noted to be valid that could affect the results and the transferability of this study. These limitations were associated with the selected preconditions for the literature review and for the empirical study conducted as a commission. Additional limitations are related to the execution of the material collection and analysis, as well as to the researcher.

The preconditions for the literature review conducted as a basis for the empirical research were as follows. The only e-commerce environment considered was the B2B e-commerce, thus limiting all other e-commerce environments out of consideration and out of the study. Additionally, within the B2B e-commerce, the focus was prompted towards after sales, specifically spare parts. The concept for managing product related information in relation to the B2B e-commerce was set on PIM over PDM and PLM, as it was seen to be the most

fitting due to its connection to the sales and marketing world. Also, through the commissioning Company, the study was limited to focus only on the industrial manufacturing industry. Thus, the literature review and the empirical research following the lead of the literature review results – the theoretical framework – were limited within these boundaries. It could consequently be inferred, that the literature review and the empirical research results apply only within the said limitations. That said, the limitations were not seen to be too restrictive for the case study results' transferability over the lines set by the preconditions. The results could thus be applicable in other settings, but the limitations needed to be noted for declaring all possible influencing factors to the study results.

The collection of the empirical research material and its analysis could also be argued to be limitations to the study. The empirical material was collected from both the employees and the customers of the participating Company. The participants were selected as per the purposive sample process, deemed to be appropriate in qualitative case studies. However, the selected participants could cause the study and thus the results to be biased. The possible sources of bias were, however, tried to be avoided by selecting multiple employees of the Company with different job descriptions and work experiences to be interviewed in pairs. This way the emphasis of the study would not solely be on the experiences and opinions collected by interviewing few highly similar individuals. To get an even more comprehensive picture on the studied phenomenon, customers were also interviewed: moreover, to avoid internality bias of the results, not only internal but also external customers were interviewed.

Another limitation could be the geographical context of the study, and that only one case was selected to be studied. The study was conducted in Finland for a selected single case (the Company), and most of the interviewees participating to the empirical research were Finns. Thus, the research results could be geographically limited to only apply in Nordic or Finnish interorganizational e-commerce contexts. However, two interviewees were foreign; it could be argued, that the geographical bias is not fully applicable, but a factor that needs to be noted. Additionally, the limitation set by studying just one case was mended through differentiation in the purposive sampling of the interviewees.

Limitations to the study and the results can also be drawn from the semi-structured interview forms created for the purposes of the empirical case study. Even though the forms were created strictly based on the theoretical framework that is based on the literature review, the translations from English to Finnish done for the purposes of carrying out most of the interviews could be a source of bias. Additionally, the same bias could originate from the interviews carried out in Finnish, the results of which needed to be translated to English to allow their proper analysis. Moreover, the example product pages utilized in the interviews could be possible limitations to the study and the transferability of some of its results, as they encompassed only three specific product types.

Lastly, some limitations to the study could be due to the researcher: her experience as a researcher and her subjective opinions can be contributing factors for the direction of the research results. These limitations were handled

through consulting the research supervisors and by reading methodology literature. The objectivity of the researcher could additionally be questioned, as she had been working for the Company prior to the study. The researcher however strived for maximum subjectivity, and this was established by not participating in the procedures and operation of the company during the study, as well as by not methodically steering the interviewees into any clear directions in their answers, apart from the possible additional questions visible in the interview forms, or the ones that intuitively emerged during the interviews.

Considering all the possible limitations to this research, the study in this thesis was successful when contemplating the practical execution. The study was planned as an empirical, qualitative case study to be conducted through semi-structured interviews by interviewing the employees and customers of the commissioning Company. All the interviews were carried out successfully, allowing full transcription and analysis of research results. Referencing the research results, the main and the additional research questions were answered to, thus solving the research problem of clarifying the challenges companies can have in managing the product information for their B2B e-commerce purposes.

Besides the practical viewpoint, the success of the study needs to be evaluated through reliability and validity (Hirsjärvi & Hurme, 2011). As declared in chapter 5.6, reliability in qualitative studies can be established through ensuring the following: The research questions are clear and the study is compatible with them; The researcher's role has been explicitly described and the analytic constructs are clearly specified; The research methods are explicitly described; The sequence of data collection, transformation and conclusion drawing can be followed; The study methods are explained, and study limitations are considered; Detailed descriptions of the studied case and all the research phases, the selected research and analysis methods, and the data collection process are provided; The possible influences the researcher and the utilized literature have inflicted on the data collection and interpretation are declared; How conclusions were reached is stated; And the subjectivity of the research is acknowledged. Referencing these statements, this research can be stated to be reliable, as all the requirements for reliability are fulfilled in the research report.

Research validity, then, can be established through confirming the internal and external validity of the research process and results. The requirements for both internal and external validity, as presented in chapter 5.6., are combined as follows: The researcher(s) have declared their subjective opinions and observations that might have affected the conclusions: Presented data is linked to prior theory; Findings are stated clearly, and limitations to the study are addressed; The number of interviews is stated as well as the recording and transcribing them is described; The research results introduction is enriched with quotations from case study interviewees; The findings are applicable in other contexts or among other purposeful samples; The characteristics of research participants are described; Any limits to purposive sample selection are listed and the possible impacts are acknowledged; And the research report suggests settings where the results could be tested further. All but one of these statements can be

seen to apply for this thesis' research, and thus research validity can be stated to have been established. The statement not yet applicable in this research report is the last one. This part of validity is, however, provided in the next chapter 7.4.

Added to research validity and reliability, it is the aim of semi-structured interviews to induce emancipatory realization among the research participants. This can be achieved, if a study provides the possibility for enhanced understanding on the studied subject, and by allowing the participants to realize they have truly been heard, not just listened to (Vilkkä, 2017). This was pursued and likely established through the interviews, and by asking whether the participants had anything to ask or comment further in the end of each interview.

7.4 Future research and research summary

Even though being a thorough research on PIM challenges in B2B e-commerce, this thesis leaves much room for further studies. The framework created and proven to be valid here, could be studied in other concepts to see whether it truly is transferable and applicable. For example, studies within the same industry including other companies and other business areas than after sales and spare parts business could be researched to see, whether their PIM challenges could be declared and identified with the framework. The framework, though created for studying the challenges in a niche field, could be furthered to other industries and other B2X e-commerce environments, to see whether similar challenges also manifest there. Furthermore, it could also be studied how the PIM challenges identified in this research could be solved. The framework could also be reinforced by studying what other possible challenge viewpoints and challenge categories within those viewpoints could exist in addition to the ones identified in this study, as the framework and the empirical results are in no condition completely all-encompassing. Lastly, the topic of PIM challenges in B2B e-commerce could be studied in other geographical and cultural contexts, to see if there are any differences in the challenges and issues individuals have experienced when compared to the results of this study.

This research was carried out by the means of literature review (see the full overview on the literature in Appendix 4) and empirical research conducted as a qualitative single case study through semi-structured pair- and individual interviews, based on the theoretical framework created from the basis of the literature review. First, an introduction to the study was presented in chapter one. The literature review was presented in chapters two through four, where the theoretical framework was also created. The methods utilized in the empirical research and the research material collection were described in chapter five. In chapter six, the empirical research results were introduced. In the last and seventh chapter, analysis and discussion on the research results were presented, in addition to the research conclusions, implications for academics and practice, and the research limitations and success evaluation. The last chapter concluded the whole thesis by declaring potential future lanes of research and by presenting a summary of the entire research report.

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APPENDIX 1 INTERVIEW FORM FOR EMPLOYEES

BACKGROUND QUESTIONS

1. How long have you been working for the Company?
2. What is your current position and how long have you been working in it?
3. Have you ever not found a product in the Company branded Store while knowing it should be there?
4. How many information systems that are related to product information management do you use daily at work?

INFORMATION SYSTEM -CHALLENGES

1. Are there any issues with the systems and software used for product information management? What issues?
 - a. Is the use of various systems in managing product information an issue or an advantage? Why?
 - b. Is it an issue or an advantage that different pieces of product information a product has are not managed centrally within one system? Why?
 - c. Does the integration of the various systems needed in product information management tasks ever cause any issues? What issues?
 - d. Do any legacy systems ever cause issues for product information management because they still contain pieces of product information? What issues?
2. Do data transfers between different systems or the file formats supported within the systems used for product information management ever cause any issues? What issues?
 - a. Do the data transfers ever fail? How does this affect the management processes?
 - b. Do all systems accept and support similar file formats or are some formats problematic? How does this affect the management processes?
3. Are the features within the systems used for product information management tasks problematic in any way?
 - a. Are they hard to use? Why?
 - b. Is it challenging to learn how to use them? Why?
 - c. Does everyone have user rights to all the systems and their features? What issues does this cause for product information management?
4. Do system updates ever cause any issues for product information management? What issues?
 - a. Do the updates sometimes fail? What issues does this cause?
 - b. Do the updates sometimes take too long? What issues does this cause?
 - c. Do the updates sometimes bring about more problems rather than fixes? What issues does this cause?

ORGANIZATIONAL CHALLENGES

5. Are the processes and tasks related to product information management and enrichment problematic in any way? What issues exist in the processes?
 - a. Do the management processes rely on manual work in any way? What issues does this cause?
 - b. Would it be better if the processes were more automated or standardized than they are now? Why?
 - c. Should there be more people working on the management, enrichment and publishing of product information for the purposes of the Store? Why?
 - d. Is product information ever hard to find or access because of the systems in use for product information management, or because of the people working with product information? Why?
 - e. Are issues inflicted on product information management because some information is accessible only through specific individuals? What issues and why?
 - f. Do people search for shortcuts in product information management or enrichment tasks? How and why? What issues can this cause?
6. Are there any standards for product information and its management?
 - a. Are the pieces of product information published in the Store standardized in any way? How?
 - b. Are the processes or tasks for product information management and enrichment standardized in any way? How?
 - c. How do these standards affect the management and enrichment?
 - d. If there are no standards, why? What issues does this cause?
7. Do the various people working with product information and its management and enrichment cause any issues? What issues?
 - a. Do people describe products differently? What issues does this cause for product information management?
 - b. Do people have differing opinions on the best ways to e.g. categorize and describe the products? What issues does this cause for product information management?
 - c. Do people have contradictory opinions on e.g. the availability and necessity of some product information? What issues does this cause for product information management?
 - d. Do people have different paces and ways of working with product information and its management? What issues does this cause?
 - e. Are some people unwilling or unable to utilize the systems used for product information management? Why? What issues does this cause?

PRODUCT INFORMATION -CHALLENGES

8. Is the amount of product information a product has on the Store and in other systems an issue for the management of said information? Why?
 - a. Is there too much information to work with during management or enrichment tasks? What issues does this cause?

- b. Are the management and enrichment tasks hard to fulfill within reasonable timeframes because of the amount of product information? What issues does this cause?
9. Does product information heterogeneity (divergence) cause any issues for the management of said information? What issues?
 - a. Should the management of product information aim at unifying the field product information? Why?
10. How would you define high quality of product information?
 - a. Are availability, accessibility, timeliness, completeness, accuracy, reliability, transparency, and richness suitable features to describe high quality? Which of these are the key features in your opinion? Why?
11. Are the mentioned quality features challenging to ensure? Why?
 - a. Have there ever been any issues in product information availability or accessibility either in the Store or in the systems used for managing and enriching product information? What issues? Why?
 - b. What challenges are there in ensuring product information timeliness?
 - c. What issues are there in ensuring product information completeness?
 - d. Has inaccurate product information ever caused any trouble or extra work? What issues emerged from this?
 - e. Have you ever encountered unreliable or useless product information within the Store or in the systems used for managing the product information? What issues did this cause?
 - f. Does information asymmetry exist between customers and the company regarding the product information available in the Store? Why?
 - g. Is rich product information hard to provide for both internal employees and customers? Why?
12. Are different pieces of product information, such as product pictures or descriptions, on a product page in the Store ever modified, edited, or anonymized in any way? How?
 - a. Why must product information sometimes be manipulated?
 - b. Have the modifications ever caused issues for customers or internal employees? What issues and why?
13. Out of these three product pages, which is has enough product information available so that customers can recognize a product and purchase it? Why?
 - a. What kind of product information is most useful for the Store customers? Why?
 - b. How much product information is too much information for a product page in the Store? Why?
 - c. Is it a possibility, that customers would visit the Store to only browse for information and then go buy the product from somewhere else, if overall high-quality product information was provided? Why?
14. Have customer requirements on product information and its quality been researched and leveraged before? If not, why?
 - a. Should customer requirements be leveraged more than they are leveraged now? Why? What issues could emerge from leveraging them?

APPENDIX 2 INTERVIEW FORM FOR CUSTOMERS

BACKGROUND QUESTIONS

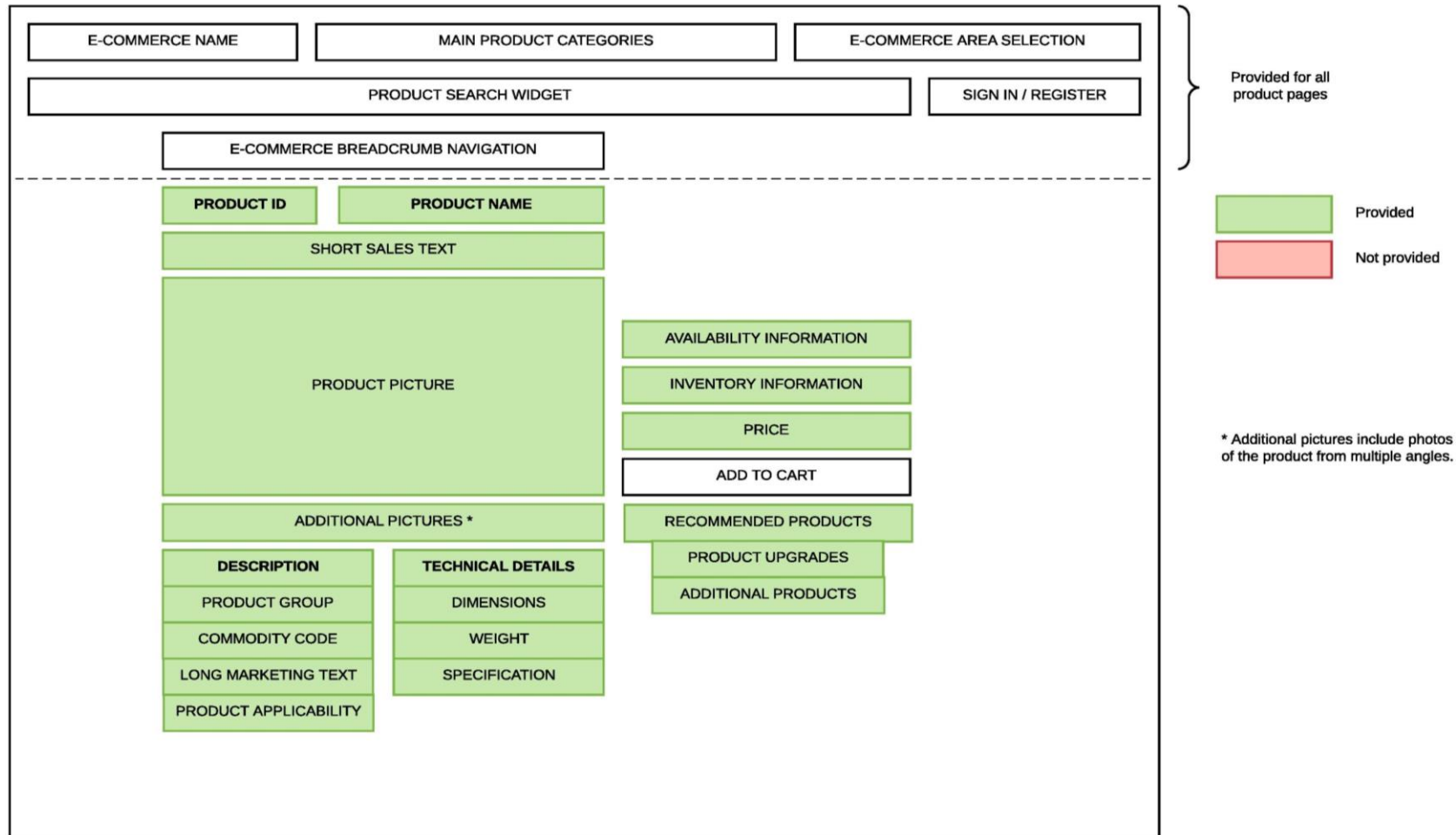
1. What company do you work for? How long have you been working there?
2. In what country are you situated?
3. What is your current job description? How long have you been working in that position?
4. How long have you been using the Company's Store?
5. For what purposes do you use the Store? Please list all purposes.
6. How often do you use the Store?

PRODUCT INFORMATION -CHALLENGES

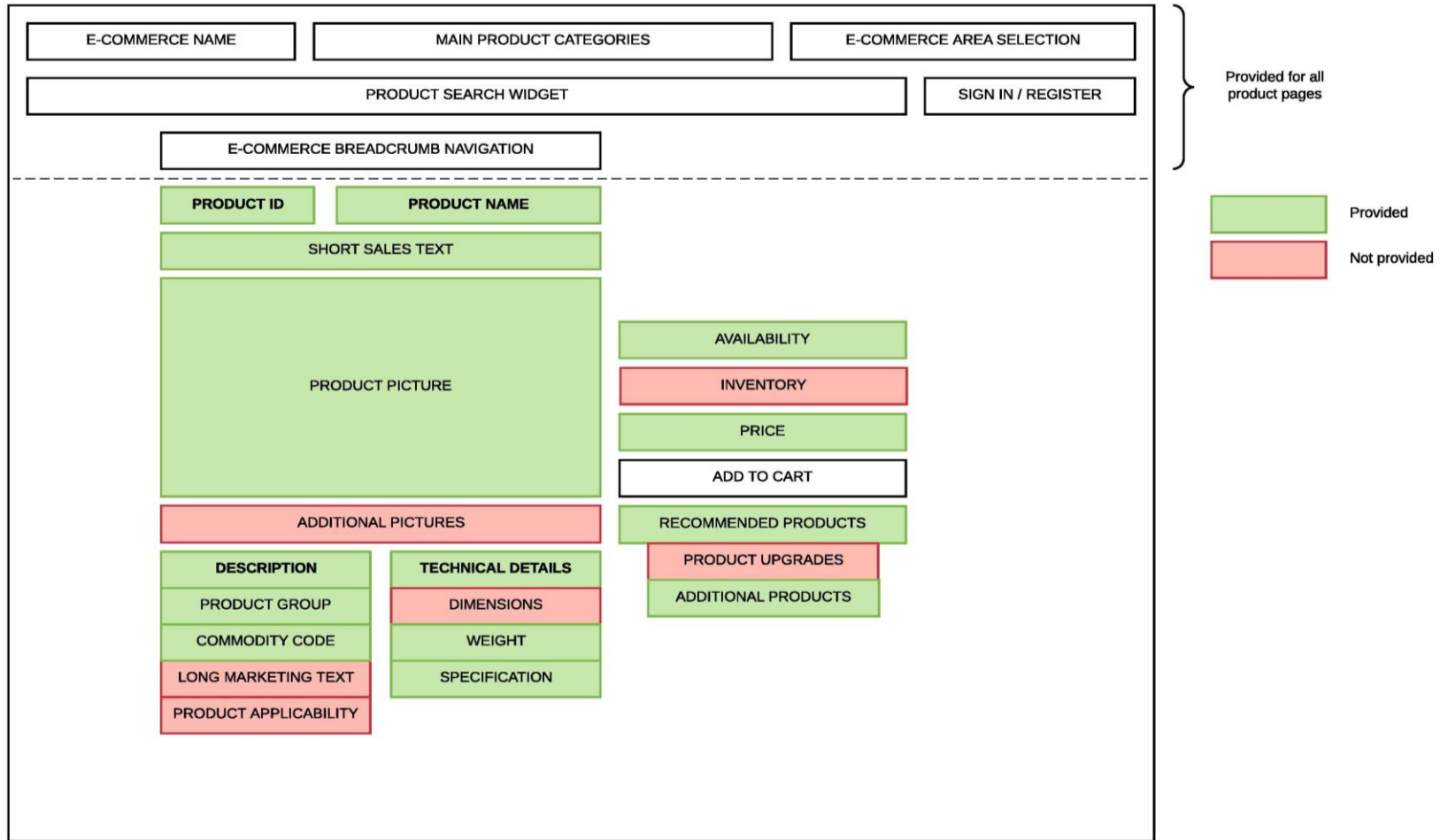
1. Have you ever had challenges in finding the product you were searching for in the Store? Always, mostly, seldom, or never? Why?
2. Is the amount of product information ever too much when browsing for products in the Store?
 - a. Should all the products in the Store have similar amounts of information available about them? Why?
 - b. How much information is too much to go through on a product page when browsing for needed products? Why?
3. Is the information available in the Store for different products too divergent (heterogeneous) from one another? How?
 - a. What should be done to improve information uniformity? Why?
4. How would you define the high quality of product information?
 - a. Are availability, accessibility, timeliness, completeness, accuracy, reliability, transparency, and richness suitable features to describe high quality? Which of these are the key features in your opinion? Why?
5. Have you ever had any issues with product information in the Store because some of the mentioned quality features were not provided?
 - a. How did this affect your customer experience?
 - b. Have you ever encountered issues with product information availability or accessibility? What kind of issues?
 - c. Have you ever found outdated product information on the Store? What issues did it cause and how?
 - d. Has incomplete product information ever been an issue in the Store? Why and how?
 - e. Have you ever encountered product information in the Store, that you knew was inaccurate? What was your reaction to it?
 - f. How would you define reliable product information? Do you feel the product information available in the Store is reliable? Why?
 - g. How do you understand the concept of rich product information? Is the product information available in the Store rich?
6. Have you ever found out that e.g. product categorizations or product information have changed from the last time you visited the Store?

- a. Did it cause any issues? What issues?
 - b. How is your customer experience affected, if some product information is edited or its quality features are for some reason decreased (i.e. accessibility is restricted or accuracy degenerated)?
7. Out of these three product pages, which has enough product information for the purposes of recognizing and purchasing the product? Why?
 - a. What product information is the most critical or vital for the purposes of recognizing and purchasing a product? Why?
 - b. What product information is beneficial, but not vital for the purposes of recognizing and purchasing a product? Why?
 - c. Is any product information useless regarding the purposes of recognizing and purchasing a product? What information and why?
8. If there was a rich product page available in the Store with overall high-quality product information and you needed this product, would you buy it from this Store that has the rich product page, or would you browse the net with the gained information and buy elsewhere? Why?
9. Can focusing on high-quality product information lead to better customer experiences? How and why?
 - a. Should customer requirements on product information and its quality be leveraged more than they are now? Why?

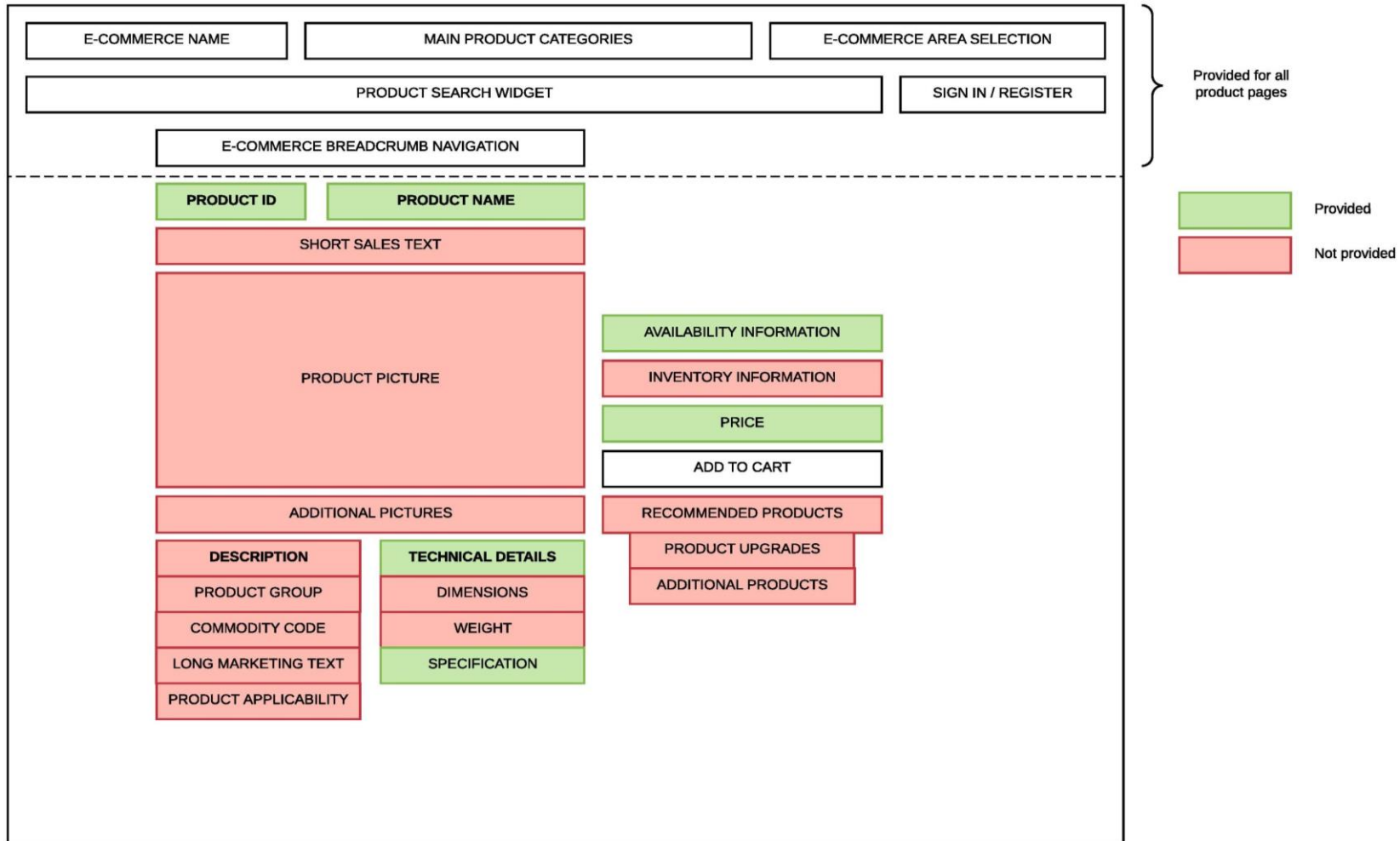
APPENDIX 3 ANONYMIZED PRODUCT PAGE EXAMPLES



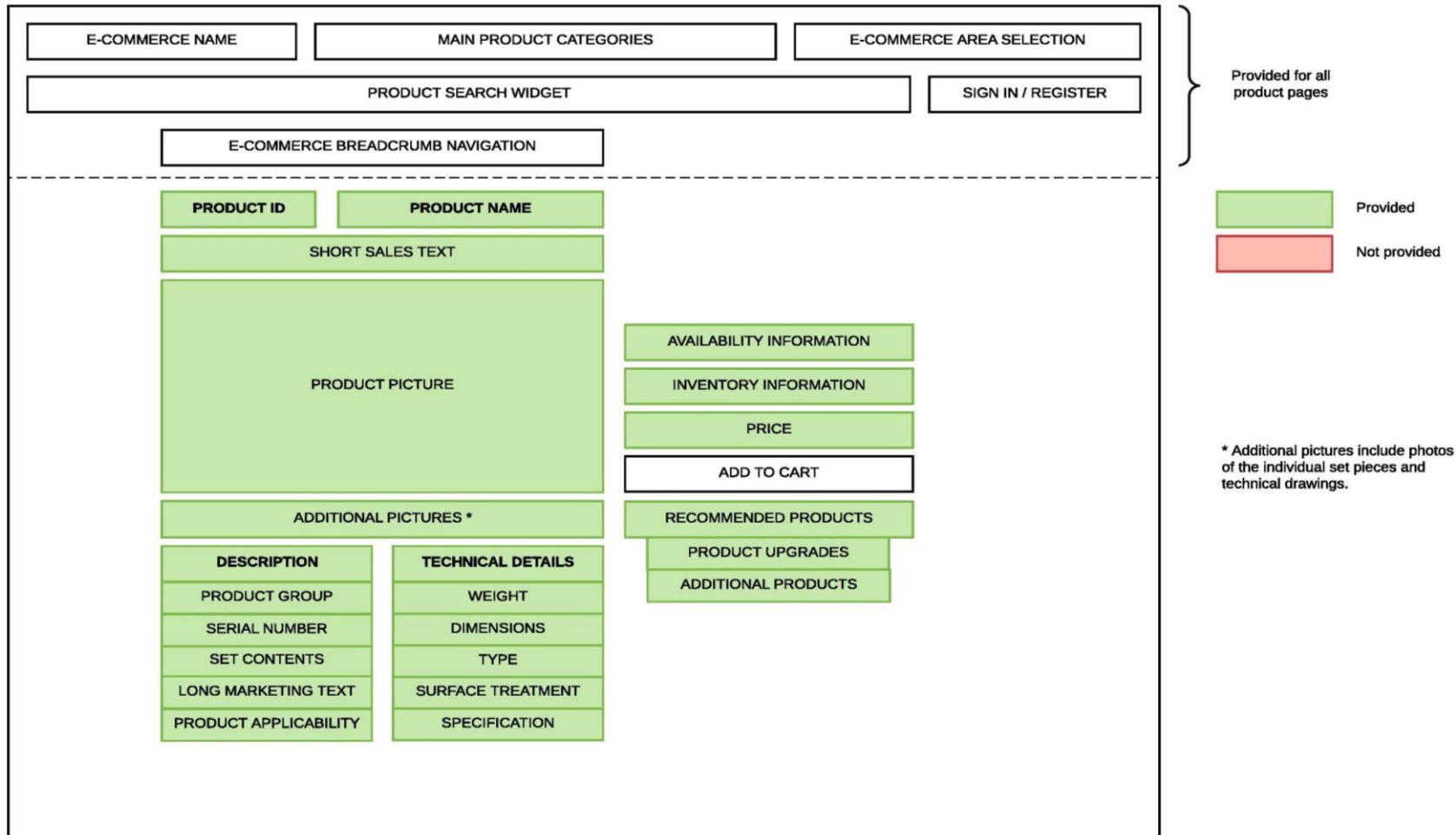
Rich product page example for an electrical product



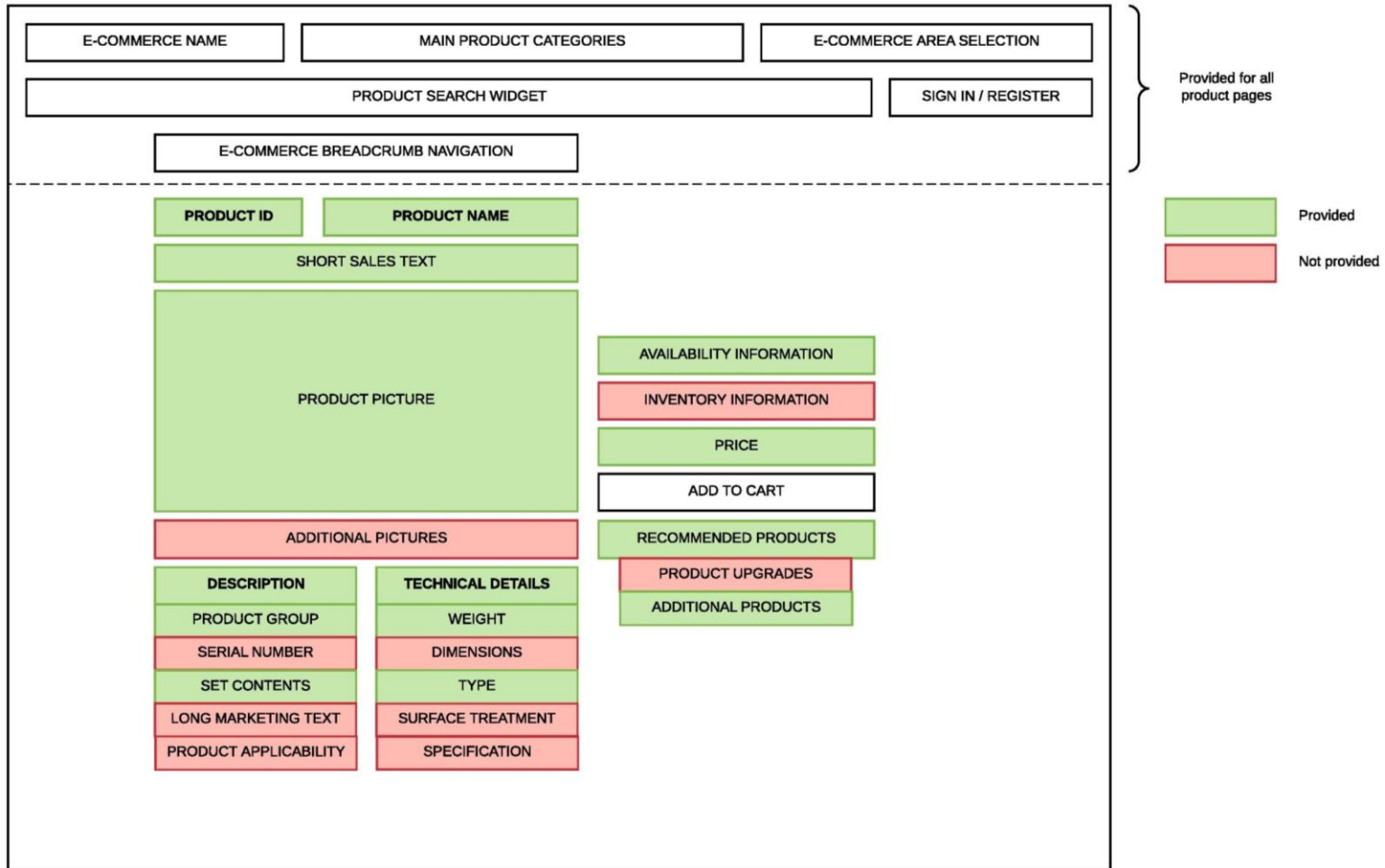
Moderate product page example for an electrical product



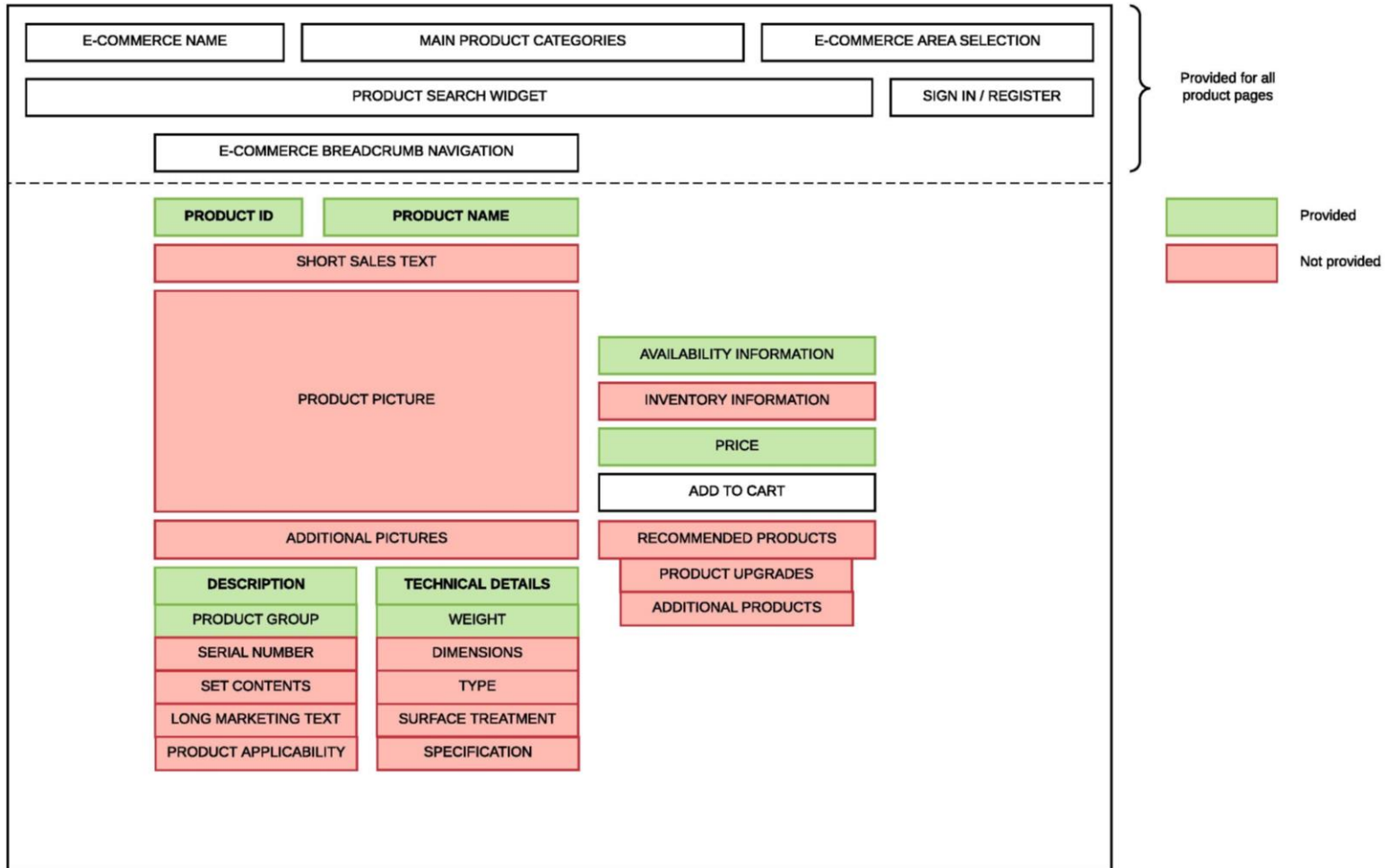
Poor product page example for an electrical product



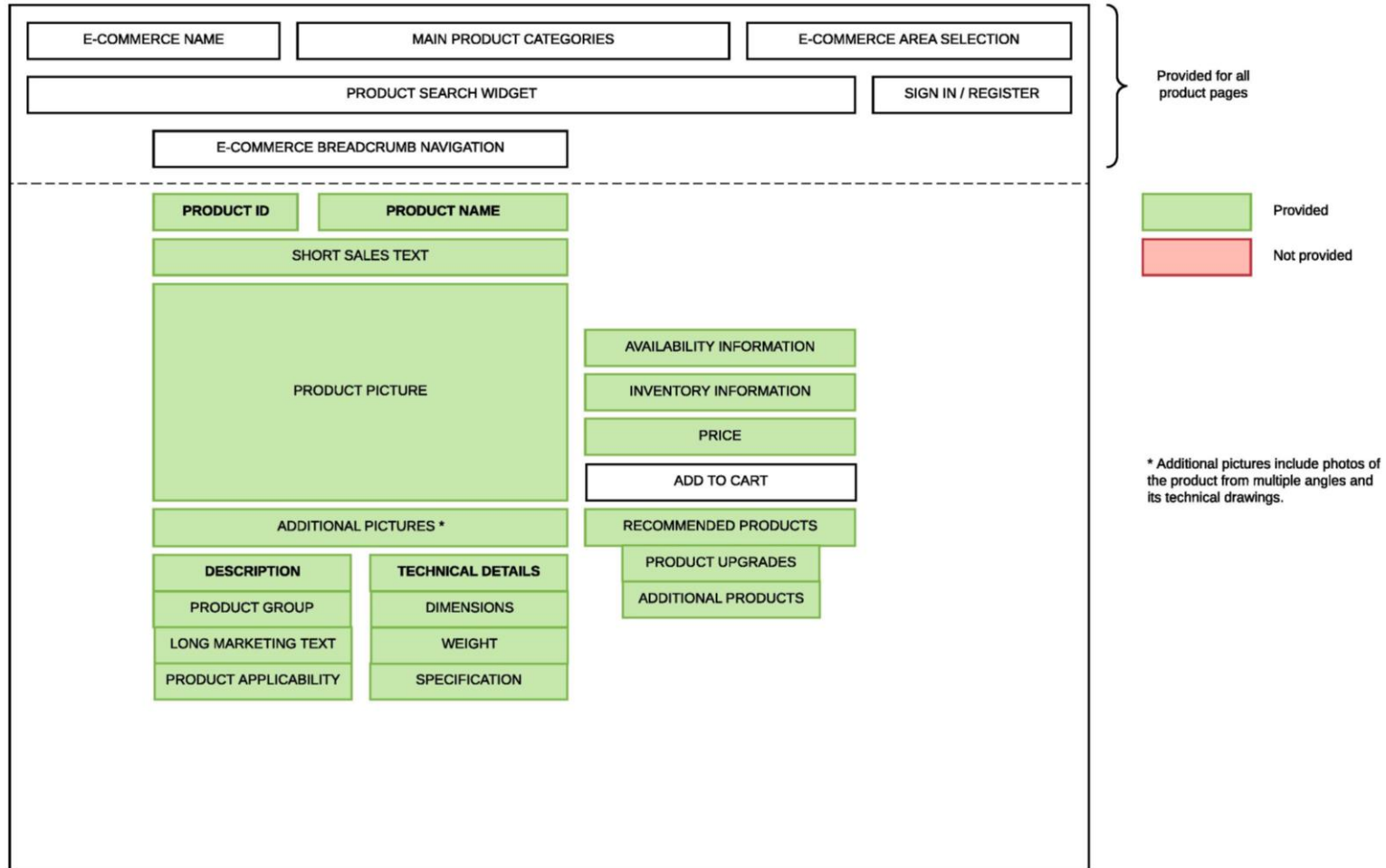
Rich product page example for a mechanical product



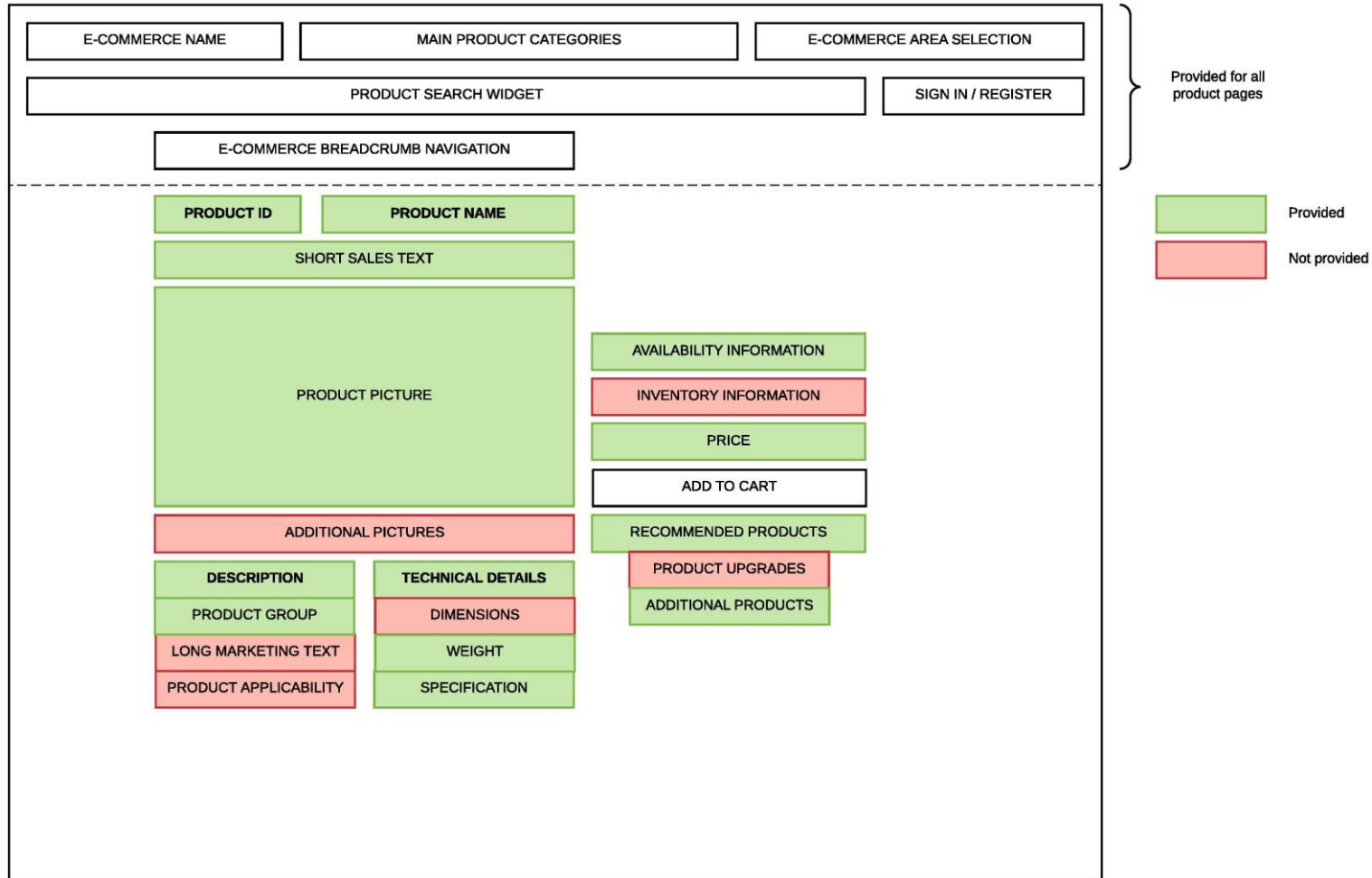
Moderate product page example for a mechanical product



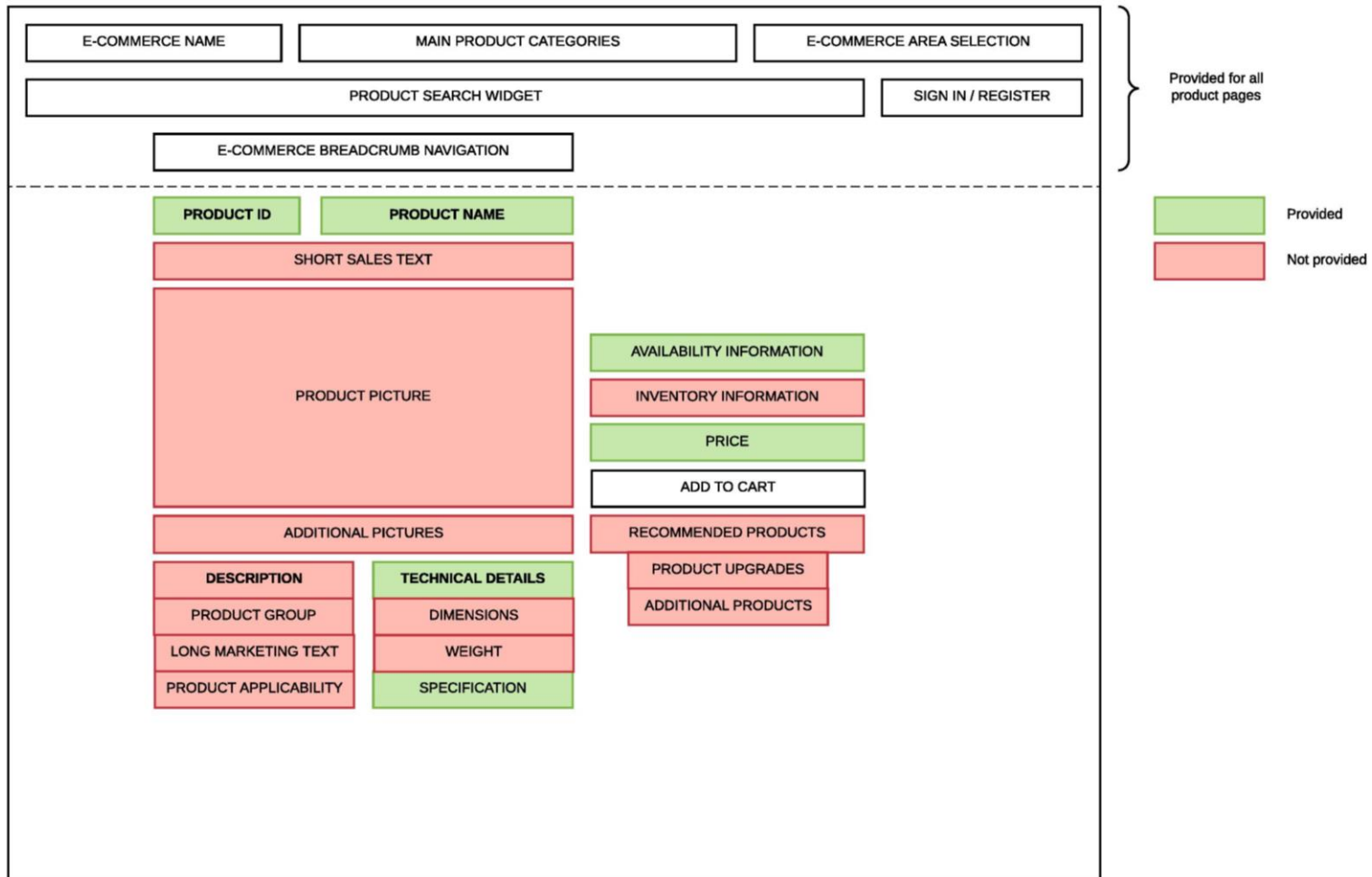
Poor product page example for a mechanical product



Rich product page example for a product set



Moderate product page example for a product set



Poor product page example for a product set

APPENDIX 4 OVERVIEW OF THE THEORY LITERATURE

Year	Author(s)	Topic	Keywords	Key findings
2010	Abdeldayem, M. M.	A study of customer satisfaction with online shopping: evidence from the UAE	Customer satisfaction; Online shopping; Internet shopping; Customer-based electronic commerce; UAE	Online shopping attitudes and the intention to shop online are affected by ease of use, usefulness, and enjoyment, in addition to e.g. perceived Web-store traits
2014	Abraham, J.	Product Information Management: Theory and Practice	Product information; PIM; PIM systems; PDM; PLM	Explanations on and examples of the PIM concept, constructs, challenges, and benefits
1989	Ackoff, R.	From Data to Wisdom	Data; Information; Knowledge; Understanding; Intelligence; Wisdom	The meanings for the discussed concepts and the main differences between them
2005	Albrecht, C. C. Dean, D. L. Hansen, J. V.	Marketplace and technology standards for B2B e-commerce: Progress, challenges, and the state of the art	B2B E-commerce; Standards; Procurement; Web services; Electronic markets; B2B hubs	Evidence for the need of common/shared technology standards for e-commerce in B2B sector
2001	Amit, R. Zott, C.	Value creation in e-business	E-commerce; Value creation	A firm's business model is an important and a crucial source of value creation
2015	Anders Innovations	B2B e-commerce is a big challenge with huge potential	E-commerce; B2B	A description of the challenges and possibilities of B2B e-commerce
2002	Archer, N. Gebauer, J.	B2B Applications to Support Business Transactions: Overview and Management Considerations	B2B applications; Business transactions; Management considerations; Challenges	B2B e-commerce application challenges: liquidity generation, participant motivation, ownership decisions, defense crafting, and value generation
1994	Babin, B. J. Darden, W. R. Griffin, M.	Work and/or Fun: Measuring Hedonic and Utilitarian Shopping Value	Shopping; Values; Utilitarian values; Hedonic values; Consumption experience	Distinct hedonic and utilitarian values exist; The values relate to various consumption variables

(continues)

(Appendix 4 continued)

1985	Ballou, D. P. Pazer, H. L.	Modeling Data and Process Quality in Multi-Input, Multi-Output Information Systems	Information systems; Management; Reliability; Quality control; Computers; System design	Selected error output expressions and their possible magnitudes, which are usable in analyzing alternative quality control procedure impacts
2006	Barnes, S. J. Vidgen, R. T.	Data triangulation and web quality metrics: A case study in e-government	Online tax submission; Website; Evaluation; Quality; eQual; Data triangulation; Comment analysis	Usability of the self-assessment facility and difficulty in communicating with the company are key problems influencing the users' perceptions
2012	Becker, A. Mladenow, A. Kryvinska, N. Strauss, C.	Aggregated survey of sustainable business models for agile mobile service delivery platforms	Mobile Service Delivery; Platform Models; Classification; Comparative Analysis; Business Models	Closed technology approach remains relevant; Open technology approach is prospering; Mobile phones will become the most common method of accessing the Internet
2016	Bell, C.	E-Commerce Models - Business to Consumer - B2B B2C C2B C2C B2G	E-commerce; B2B; B2C; C2B; C2C; B2G	The definitions and examples of the mentioned e-commerce types
2004	Bellinger, G. Castro, D. Mills, A.	Data, Information, Knowledge, and Wisdom	Data; Information; Knowledge; Understanding; Wisdom	The meanings and differences of the discussed concepts
2008	Bernstein, P. A. Haas, L. M	Information integration in the enterprise	Information integration; Disparate sources; Data; Software	A guide for using the tools and core technologies in merging information from various sources
2015	Bilgihan, A. Bujisic, M.	The effect of website features in online relationship marketing: A case of online hotel booking	Relationship marketing; Website features; Customer loyalty; E-commerce; Hotel booking	Customer loyalty is vital in e-commerce; By focusing on both hedonic and utilitarian web-site features, customer loyalty can be achieved; Web design is vital in online relationship marketing
2004	Boisot, M. Canals, A.	Data, information and knowledge: Have we got it right?	Information; Knowledge; Economics of information; Information theory; Physics of information	The differences between the concepts of data, information and knowledge are important to understand

(continues)

(Appendix 4 continued)

2015	Cai, L. Zhu, Y.	The Challenges of Data Quality and Data Quality Assessment in the Big Data Era	Big data; Data quality; Quality assessment; Data science	Data quality as a concept and its dynamic assessment process
2010	Chua, W. S. Jiang, Z. Tan, B.	Effects of website interactivity on consumer involvement and purchase intention	Interactivity; Website involvement; Product type; Purchase intention; Ecommerce	Cognitive involvement is achieved if websites have high level of active control; Affective involvement is achieved if websites have bi-direction of communication; Consumer involvement and purchase intention correlate
2006	Cohen, M. A. Agrawal, N. Agrawal, V.	Winning in the Aftermarket	Aftermarkets; Success; Profit; Services; Spare parts	How to manage service networks; After sales services model; Framework for service product creation
2016	Columbus, L.	Predicting The Future Of B2B E-Commerce	E-commerce; B2B e-commerce; Born-in-the-cloud e-commerce; Manufacturing industry; Wholesaler industry	B2B e-commerce is twice the size of B2C; Born-in-the-cloud platforms are selling speed and simplicity; B2B buyers expect high quality customer experiences; Delivering unique experiences is increasing its importance
2004	Constantinides, E.	Influencing the online consumer's behavior: the Web experience	Internet marketing; Worldwide web; Online operation; Consumer behaviour; Buying behaviour	The Web experience framework
2001	Cox, J. Dale, B. G.	Service quality and e-commerce: an exploratory analysis	E-commerce; Service quality; Internet	Suitable determinants for e-commerce success/environment need to be identified
2003	Dahlén, M. Rasch, A. Rosengren, S.	Love at First Site? A Study of Website Advertising Effectiveness	Website; Advertising; Effectiveness; Web experience; Website design	Brand attitude increases with websites selling high-involvement products and decreases with websites offering low-involvement products; Advertisers prefer generating traffic to high-involvement product websites; Customers expect to find relevant information quickly

(continues)

(Appendix 4 continued)

2002	Dai, Q. Kauffman, R. J.	Business Models for Internet-Based B2B Electronic Markets	B2B ecommerce; Buyer-supplier relationships; Electronic markets; Information systems; Procurement; Supply chain management; Technology adapters	Analytic framework for B2B electronic markets
2004	DeLone, W. H. McLean, E. R.	Measuring eCommerce Success: Applying the DeLone & McLean Information Systems Success Model	E-commerce; Evaluation of information systems; Information system success; User satisfaction; Value of IT	E-commerce success dimensions and measures
1992	DeLone, W. H. McLean, E. R.	Information systems success: The quest for the dependent variable	Information systems assessment; Information systems success; Measurement	IS success taxonomy; IS success taxonomy dimensions; IS success model
2003	DeLone, W. H. McLean, E. R.	The DeLone and McLean Model of Information Systems Success: A Ten-Year Update	Evaluation of information systems; Impact of information technology; Information quality; Information systems success; Service quality; Systems quality; Use of information systems; User satisfaction	The original model is still current and a viable basis for IS success measurement also in the context of e-commerce
2004	Ding, Y. Fensel, D. Klein, M.	The role of ontologies in ecommerce	B2B; E-commerce; Ontology; Product information; Information integration	Ways into solving the issues with product information and its management in e-commerce
2000	Earl, M. J.	Evolving the e-business	E-business; E-commerce; Business evolution	Six stages of becoming an e-business; The challenges in and lessons from each stage
2003	Easton, G. Araujo, L.	Evaluating the impact of B2B e-commerce: A contingent approach	E-commerce; Industrial networks; Contingency; Virtual Markets; Interorganisational Systems	Mechanisms and contingencies affecting a company's situation must be noted; General prescriptions not applicable in every situation

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2003	Eroglu, S. A. Machleit, K. A. Davis, L. M.	Empirical Testing of a Model of Online Store Atmospherics and Shopper Responses	Online store; Atmospherics; Shopper responses; E-commerce; Shopping outcomes	Shopper attitudes and satisfaction are significantly influenced by online shopping site atmospherics; Emotions experiences during online shopping result in various approach/avoidance behaviors
2017	export.gov	Finland Country Commercial Guide Finland -eCommerce	E-commerce; Commercial guide	C2C e-commerce is becoming popular; B2C e-commerce continues to be favored and is growing; Customer experience is important in B2B
2003	Fang, X. Salvendy, G.	Customer-Centered Rules for Design of E-commerce Web Sites	E-commerce; Customer requirements; Design rules	Customer centered design rules for e-commerce sites; The required attributes for a good e-commerce
2013	Fauska, P. Kryvinska, N. Strauss, C.	The role of e-commerce in B2B markets of goods and services	B2B markets; B2B e-commerce; B2B e-commerce strategy; Services in B2B market; Types of B2B e-commerce; Evaluation of B2B e-commerce; International perspectives	Review and summary of B2B e-commerce theoretical background; How e-commerce can be utilized in B2B context
2001	Fensel, D. Ding, Y.	Product data integration in B2B e-commerce	Product information; Standardization; Content management; Product information management challenges; Content management challenges	Challenges: Extracting information; Classifying information to make it maintainable and accessible; Personalizing information; Creating mappings between different information; Product description heterogeneity and transparency; Semantics of information; Information incompleteness and inconsistency; Lack of PIM standards
2006	Forza, C. Salvador, F.	Product information management for mass customization: Connecting Customer, Front-office and Back-office for Fast and Efficient Customization	Product configuration; Product modelling; Product information management; Mass customization	The fundamentals, problems and system specifics of product configuration process; Product modelling basics; Guidelines on selecting & implementing a system for product configuration

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2006	Främling, K. Ala-Risku, T. Kärkkäinen, M. Holmström, J.	Agent-based model for managing composite product information	Product information management; Product lifecycle management; Product assembly; Product agent; Middleware	A platform of information management based on seven messages, for achieving information management requirements; A software implementation for platform
2002	Fui, F. Nah, H. Davis, S.	HCI Research Issues in Electronic Commerce	Web usability; Navigation; Trust; E-commerce	Summary of the trends and issues in e-commerce present in prior literature; Concepts of online navigation and trust
2014	Gupta, A.	E-Commerce: Role of E-Commerce in Today's Business	E-commerce; B2B; B2C; C2C; B2G; M-commerce	A set of definitions for the e-commerce concept and its diverse types
2011	Haug, A. Zachariassen, F. van Liempd, D.	The costs of poor data quality	Data quality; Master data management; Data quality costs	Definition of the optimal data maintenance effort; Classification of costs inflicted by data of inferior quality
2011	Heilala, J. et al.	Parhaat tuottavat - Valmistavan teknologia-teollisuuden tutkimusagenda 2020	Finland; Technology industry; Innovation; R&D	Common guideline for new programs or projects within technology industry, research organizations, and financiers
2015	Hoar, A. Sheldon, P.	Latest Trends in B2B E-Commerce Strategies and Tech Investment	B2B; E-commerce	B2B is 2x the size of B2C in USA; B2B eCommerce in USA will reach \$1.1 trillion by 2019; B2B buyers expect to buy more online; Manufacturing & wholesale are driving B2B growth
n.d.	Investopedia	Peer-to-Peer (P2P) Service	P2P; E-commerce; Services	P2P definition and examples
2001	Kalakota, R. Robinson, M.	E-business 2.0: Roadmap for Success	E-Business; Business model; Business opportunities	Managers of "old economy" companies need right tools for improving the effectiveness of their company; Use of digital strategies must increase; E-business is a solid basis for success
1999	Keeney, R. L.	The Value of Internet Commerce to the Customer	Internet commerce; Customer value; Value focused thinking; Value proposition; Objectives	Means-objectives and fundamental objectives for the minimal requirements customers have for internet commerce

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2001	Kim, Y. Kang, S. H. Lee, S. H. Yoo, S. B.	A distributed, open, intelligent product data management system	Product data management; PDM; DOI-PDM; Product data; Competitive power	Summary of PDM system requirements; DOI-PDM system definition
2010	Kotler, P. Armstrong, G.	Principles of Marketing	Marketing; Business; Principles; Guidelines	Marketing in today's business environment is about creating customer value and building profitable relationships
2009	Kropsu- Vehkaperä, H. Haapasalo, H. Harkonen, J. Silvola, R.	Product data management practices in high-tech companies	Product lifecycle management; Product data management; Large enterprises	PDM activities are similar in many firms but diversity in the practices is evident; Company background and current organizational state affect PDM challenges
2016	Kujansuu, J.	Laadukas tuotetieto luo voittavan asiakaskokemuksen	Customer experience; Customer satisfaction; E-commerce; Online shops; Product information; PIM	Reasons why top-notch product information and its management is of high importance for businesses exploiting e-commerce
2017	Kujansuu, J.	Tuotetiedonhallinta	E-commerce; Product information management; PIM solutions; Customer experience; Customer satisfaction	The steps to for PIM system implementation that ensure easy commissioning and better e-commerce customer experience
2011	Laudon, K. Traver, C.	E-Commerce 2011. Business. Technology. Society.	E-commerce; Technology; Society; Driving forces	The driving forces behind the expansion of e-commerce field are technology change, business development, and social issues
2006	Lee, T. et al.	Building an operational product ontology system	E-catalog; E-commerce; Ontology; Product information management; Product ontology	A keyword search interface that enables users to reference the created framework for product information ontology

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2002	Lightner, N. J. Eastman, C.	User Preference for Product Information in Remote Purchase Environments	E-commerce; Information processing style; Individual differences; Product information	Web site product presentation with sentential style is preferred over the diagrammatic style; Individual information processing style does not affect the preferred style; Website including both pictures and text was preferred the most
2001	Liu, T. Xu, W.	A review of web-based product data management systems	Product data management; Computer-aided design; Enterprise resource planning; Web based technology	The fundamentals of PDM with additional examples of a few PDM systems
2000	Lucking-Reiley, D. Spulber, Daniel F.	Business-to-business electronic commerce	E-commerce; B2B; Intermediary; Economy; Industry; Cost reduction	B2B e-commerce definition; Several types of B2B e-commerce intermediaries; B2B e-commerce benefits; Examples of B2B e-commerce companies
2010	Manenti, P.	Key strategic challenges in B2B e-commerce in manufacturing	B2B; E-commerce; Challenges; Strategy	Key challenges of strategy in B2B e-commerce in manufacturing industry
2012	Markus	B2B companies finally going digital	B2B; E-commerce; Digital commerce; Online sales; Aftersales; Services	A discussion on the listed objectives
2007	Meyer, C. Schwager, A.	Understanding Customer Experience	Customer experience	More attention should be paid on customer experience and its importance for the success of company functions
2011	Nemat, R.	Taking a look at different types of e-commerce	E-commerce; E-commerce types; Business	The definitions and examples of the different e-commerce types
2001	Omelayenko, B. Fensel, D.	A Two-Layered Integration Approach for Product Information in B2B E-commerce	B2B; E-commerce; B2B e-marketplace; XLM; RFD; Mapping problems	Appropriate technology needs to be developed for B2B marketplaces for allowing easy definition of the complicated mappings
2011	OpenText	GSA Advantage - An Example of How B2G Technologies Can Help to Lower the US Federal Deficit	E-commerce; B2G; GSA Advantage	Companies could follow the great example of GSA Advantage in B2G e-commerce

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1998	Orr, K.	Data quality and systems theory	Data quality; Systems theory	Data quality is achieved by improving its use
2012	Otto, B.	Managing the business benefits of product data management: the case of Festo	Product data management; Business benefits; Case studies; Data governance; Product lifecycle management	Nature of PDM business benefits; The basics of PDM; Directions for supporting PDM business benefit management
2013	Otto, B. Gizanis, D. Österle, H. Danner, G.	Designing solutions and strategies for the sustainable improvement of data quality in large organizations	Data quality; Data quality management; Corporate data quality management; Center corporate data quality; European foundation of quality management	Implementation of the framework for CDQM by using SAP Solutions for Information Management products
2009	Otto, B. Hüner, K. M.	Functional reference architecture for corporate master data management	Master data; Master data management; MDM; Functional reference architecture	Software products for MDM should meet some functional requirements from a business perspective
2017	Oxford Univ. Press	Customer	Customer	Customer definition
1985	Parasuraman, A. Zeithaml, V. A. Berry, L. L.	A Conceptual Model of Service Quality and Its Implications for Future Research	Service quality	A model for service quality
2006	Permalla, D.	Product Information Management for e-commerce	PIM; PIM solution; E-commerce; Customer requirements; Customer experience; Customer satisfaction	PIM helps in managing complex e-commerce information; PIM solution should yield well-managed data; Efficiently managed high-quality data leads to consistent user experiences
2006	Petre, M. Minocha, Sh. Roberts, D.	Usability beyond the website: An empirically-grounded e-commerce evaluation instrument for the total customer experience	E-commerce; Usability; Customer experience	E-SEQUAL model

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2006	Petre, M. Minocha, Sh. Roberts, D.	Usability beyond the website: An empirically-grounded e-commerce evaluation instrument for the total customer experience	E-commerce; Usability; Customer experience	E-SEQUAL model
1996	Philpotts, M.	An introduction to the concepts, benefits and terminology of product data management	Product data management; PDM	Review of the concepts, benefits, and terminology of PDM
2010	Power, D.	Why Product Information Management?	Product information management; Enterprise resource planning; Customer relationship management; Master data management; PIM; ERP; CRM; MDM	CRM and ERP solutions are not suited for MDM management, which is why PIM and its solutions are needed
2000	Reichheld, Frederick F. Schefter, P.	E-Loyalty: Your secret weapon on the web	E-loyalty; Trust; E-commerce; Customer loyalty	Advantages of retaining online customers; Importance of gaining the loyalty of the most profitable customers; E-loyalty from customers leads to business benefits
2016	Robinson, A.	The Expanding Use of E-Commerce for Manufacturing Companies	E-commerce; B2B; Manufacturing	Manufacturing company e-commerce is growing in popularity; The idea of multi-/omnichannel e-commerce environment needs to be considered
2011	Rose, S. Hair, N. Clark, M.	Online Customer Experience: A Review of the Business-to-Consumer Online Purchase Context	Online customer experience; B2C e-commerce; Online purchasing	A framework for testing the online customer experience, its antecedents, and potential consequences
2013	Rund, B.	ROI of Product Data for Multi-channel Commerce: Measurable Results in Terms of Margins, Revenue, Costs and Product Launches	Business model; IT systems; Key performance indicators; Product information management system	KPI quality is important; Consistent use of PIM is fundamental for business success

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2004	Saaksvuori, A. Immonen, A.	Product Lifecycle Management	Product lifecycle management; PLM	What PLM is, how it can be provided, what challenges it faces
2016	Silvennoinen, P.	Product information management: PIM, PLM and PDM - what do they stand for?	PIM; PDM; PLM	The differences between PIM, PLM, and PDM
2014	Sivapalan, S. Sadeghian, A. Rahnama, H. Madni, A. M.	Recommender systems in e-commerce	Recommender systems; E-commerce; Online shopping; Online communications	A taxonomy of recommender systems for e-commerce
2008	Smith, H. A. Mckeen, J. D.	Developments in Practice XXX: Master Data Management: Salvation Or Snake Oil?	Master data management; Information management; MDM; Data quality; Data management; Data integration	MDM delivers clear benefits for companies willing to make an effort in implementing it into their business functions
2017	Solteq	Tuotetiedonhallinta: Hyvästä tuotetiedosta on tullut kaupankäynnin perusvälttämättömyys	Product information management	To enable better search engine visibility and improved customer experience, product information needs to be enriched; PIM is not effective if it depends solely on the employees' memory
2002	Srinivasan, S. S. Anderson, R. Ponnavolu, K.	Customer loyalty in e-commerce: An exploration of its antecedents and consequences	E-commerce; E-loyalty; Internet retailing	E-retailers need to develop and maintain customer loyalty in order to be successful
2011	Srinivasan, V.	An integration framework for product lifecycle management	Business needs; Framework; Standards; Product data; Product meta-data; Business process; Services-oriented architecture	An integration framework for product lifecycle management using open standards and SOA; Positive results on the initial implementations of the framework
2005	Stark, John	Product lifecycle management: 21st century paradigm for product realization	Product lifecycle management; PLM; Product data management; PDM; Challenges; Issues; Problems; Benefits	The fundamentals, basics, and how-tos of PLM and its challenges and benefits

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2002	Suomala, P. Sievänen, M. Paranko, J.	The effects of customization on spare part business: A case study in the metal industry	Customization; Cost management; After sales; Spare parts	Personnel costs are in a significant role if customization leads to more sales regarding seldom sold items
2016	Swerdlow, F. et al.	The Forrester Wave™: Product Information Management Solutions, Q4 2016 The 10 Providers That Matter Most And How They Stack Up	PIM; Product information management; Product information; Product data; E-commerce; E-business; Integration; Syndication; Usability	Informatica, Riversand, and Stibo Systems are PIM solution leaders; The future of e-business leaders is in self-service, connectivity, and automation; Integration, syndication, usability, and vendor portal tools are the key differentiators
2002	Sääksvuori, A. Immonen, A.	Tuotetiedonhallinta - PDM	Product data management; PDM	What PDM is, how it can be provided, what challenges it faces
2004	Thusy, A. Morris, L.	From CRM to customer experience: a new realm for innovation	Customer experience; Online commerce; Commerce; Customer service	Companies that take customer experiences into account should gain advantages
2012	Toews, T.	Product Information Management for Today's eCommerce Initiatives: PIM Considerations for eCommerce Re-Platforming	Product information management; PIM; E-commerce; Commerce; Retailing industry	List of specific problems retailers are looking to solve with PIM; Reasons for implementing PIM before launching e-commerce; How to pay for a PIM investment
2008	Trappey, A. J. C. Taghaboni-Dutta, F. Trappey, C. V.	A Framework for a Green Product Lifecycle Management System	Product Lifecycle Management; Green Component; XML; Mapping Hub	Framework for an information exchange platform enabling increased usage of green parts in order to satisfy the requirements for environmentally regulated products
1999	Tuomi, I.	Data Is More than Knowledge: Implications of the Reversed Knowledge Hierarchy for Knowledge Management and Organizational Memory	Information; Knowledge; Knowledge management	The reversed hierarchy of knowledge: knowledge needs to exist before information can emerge; information needs to exist before data can emerge

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2009	Walther, M. Schuster, D. Schill, A.	Federated product search with information enrichment using heterogeneous sources	Federated Search; Information Extraction; Ontology; Product Information Management	A reference architecture for the heterogeneous federated consumer product search; Methods for extracting semi-structured information
1996	Wand, Y. Wang, R. Y.	Anchoring data quality dimensions in ontological foundations	Data quality; Ontology; Data-centric; System-centric	Data quality dimensions: completeness, unambiguousness, meaningfulness, and correctness
1996	Wang, R. Y. Strong, D. M.	Beyond Accuracy: What Data Quality Means to Data Consumers	Data quality; Framework; Data consumers	Data quality (DQ) dimensions for data consumers: intrinsic DQ, contextual DQ, representational DQ, and accessibility DQ
2011	Wells, J. Valacich, J. Hess, T.	What Signals Are You Sending? How Website Quality Influences Perceptions of Product Quality and Purchase Intentions	Signaling theory; Signals; Cues; Website quality; eCommerce; Perceived quality; Credibility; Information asymmetries	Website quality affects consumers' perceptions of product quality; Product quality affects online purchase intentions
1999	Wenninger, J.	Business-to-Business Electronic Commerce	Electronic commerce; Business-to-business	Utilizing Internet is a way to B2B e-commerce success and cost savings in the manufacturing and distribution process
2011	Xiao, B. Benbasat, I.	Product-related deception in e-commerce: A theoretical perspective	Product-based information practices; Electronic commerce; Typology; Stimulus-organism-response framework; Model of deception detection	A set of theory-based propositions addressing why consumers are deceived and fail in detecting the deceptions
2004	Zhu, K.	The Complementarity of Information Technology Infrastructure and E-Commerce Capability: A Resource-Based Assessment of Their Business Value	Electronic commerce; Firm performance; Information technology business value; Resource complementarity	A strong positive interaction effect between IT infrastructure and e-commerce capability; Integration of resources is a feasible path to e-commerce value