Product lifecycle deficiencies in the Swedish fashion industry - a feasibility study on cloud computing adoption in SMEs

DAJANA VLAJIC
Product lifecycle deficiencies in the Swedish fashion industry - a feasibility study on cloud computing adoption in SMEs

Dajana Vlajic

June, 2017
Bristfälligheter i produktlivscykeln i den svenska modeindustrin - en förstudie i användingen av molntjänster i SMF

Dajana Vlajic

June, 2017
Product lifecycle deficiencies in the Swedish fashion industry - a feasibility study on cloud computing adoption in SMEs

Dajana Vlajic

<table>
<thead>
<tr>
<th>Approved</th>
<th>Examiner</th>
<th>Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-06-28</td>
<td>Pär Blomkvist</td>
<td>Cali Nuur</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioner</td>
<td>Young/Skilled AB</td>
<td>Contact person</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Johan Hemberg</td>
</tr>
</tbody>
</table>
Abstract

Over the recent decades, technological developments have revolutionized the industry of retail. As a consequence, challenges and advantages have arisen in the supply chain of retailing. One of the more prominent changes include an increasing amount of information, that has driven the development of product lifecycle management systems. For incumbents in the retail industry, product lifecycle systems are widely adapted and developed. On the opposite, for small and medium-sized enterprises (SMEs), limitations in finance and resources restrict the adoption of these. To overcome the limitations, cloud computing has been proposed as a promising solution to product lifecycle management challenges. Current research focuses mainly on the financial benefits of adopting cloud computing to SMEs and on the factors affecting the actual adoption of cloud computing.

This study aims to investigate current challenges in the management of product information in retail and the obstacles of adopting cloud computing for a more efficient product information flow in the supply chain. An in-depth analysis is conducted amongst Swedish SMEs in the fashion industry, followed by an investigation of the factors that affect the utilization of cloud computing in these.

The results of this study imply that the supply chain of a company in the fashion industry is to a high extent comparable with a net-structure, instead of the more traditional chain alternative. The results imply that the challenges of managing the product information flow in the supply chain occurs both within a company and between entities. The absence of product information format, communication means as well as internal and external information system incompatibilities are main causes for the challenges in product information management. The SMEs in the Swedish fashion industry are to a large extent reluctant towards cloud computing solution as a result of lacking knowledge of technology and possible advantages of the solution.

Key-words
Supply Chains, Product Lifecycle Management, Retail, E-commerce, Cloud Computing, SME, SaaS
Bristfälligheter i produktlivscyklern i den svenska modeindustrin - en förstudie i användingen av molntjänster i SMF

Dajana Vlajic
Sammanfattning

Över de senaste decennierna har teknologiska utvecklingar revolutionerat detaljhandel. En konsekvens av detta är att utmaningar och möjligheter har uppstått i detaljhandelns logistikkedja (supply chain). En av de mer framstående förändringarna är den växande mängden information som har drivit utvecklingen av produkthanteringssystem. Detaljhandelns jättar har både inkluderat dessa och drivit utveckling av produktsystem som hanterar livscykeln till skillnad från små och medelstora företag (SMF) som begränsats på grund av finans- och resursbegränsningar. För att överkomma dessa begränsningar har molntjänster introducerats som en lovande lösning till utmaningarna inom produkthantering. Nuvarande forskning fokuserar främst på finansiella fördelar i användningen av molntjänster för SMF, samt de faktorer som påverkar introduktionen av molntjänster i dessa företag.

Denna studie syftar till att undersöka nuvarande utmaningar av produktinformationshantering i detaljhandeln, samt vilka faktorer som hindrar användningen av molntjänster för att lösa dessa i logistikkedjan. En fördjupande analys kommer därför att utföras bland svenska Svenska SMF inom modeindustrin, följt av en undersökning av de faktorer som påverkar användningen av molntjänster inom dessa.

Resultaten av denna studie tyder på att logistikkedjan i modeindustrin liknar en nätstruktur, istället för det mer traditionella kedjelaternativet. Utmaningarna som uppstår i hanteringen av produktinformation i uppstår både inom ett företag och mellan enheterna i logistikkedjan. Studien visar att frånvaron av standarder för formaten av produktinformation, kommunikationSMEdel och interna och externa inkompatibiliteter mellan informationssystem är det huvudsakliga orsakerna för utmaningarna i hanteringen av produktinformation. SMF i den svenska modeindustrin är till en hög grad motvilliga till användningen av molntjänster, vilket är ett resultat av avsaknaden av kunskap om tekniska lösningar och möjliga fördelar av dessa lösningar.

Nyckelord
Logistikkedjor, Produktlivscykelshantering, Detaljhandeln, E-commerce, Molntjänster, SMF, SaaS
## Contents

1. **Introduction**
   1.1 Background ................................................................. 1
   1.2 Problem formulation ......................................................... 2
   1.3 Purpose ........................................................................... 2
   1.4 Research questions .......................................................... 2
   1.5 Limitations ........................................................................ 3
   1.6 Disposition ...................................................................... 4

2. **Methodology**
   2.1 Research Purpose ............................................................... 6
   2.2 Research Design ................................................................. 7
   2.3 Methods used to answer research questions ............................ 7
   2.4 Data Collection ................................................................... 8
       2.4.1 Literature Review ......................................................... 8
       2.4.2 Interviews .................................................................. 9
   2.5 Quality of Analysis .............................................................. 10
       2.5.1 Reliability ................................................................. 10
       2.5.2 Validity ....................................................................... 11
       2.5.3 Generalizability ......................................................... 12
   2.6 Ethical Aspects .................................................................. 12

3. **Literature Review**
   3.1 Supply Chain Management in Retail ....................................... 13
       3.1.1 Supply Chain Management ........................................... 14
       3.1.2 Logistics and SCM ....................................................... 16
           3.1.2.1 The Bullwhip effect ............................................... 18
           3.1.2.2 Functional silos .................................................... 19
       3.1.3 The Fashion SCM ......................................................... 19
   3.2 Product Management in Retail .............................................. 20
       3.2.1 Defining the Product Data ............................................ 20
       3.2.2 Product Lifecycle Management ...................................... 21
           3.2.2.1 Product related systems ......................................... 21
           3.2.2.2 Content related systems ........................................ 22
           3.2.2.3 Process related systems ......................................... 22
   3.3 Cloud Computing ................................................................ 23
4. Findings

4.1 Company presentations .......................................................... 38
  4.1.1 Company A ................................................................. 38
  4.1.2 Company B ................................................................. 38
  4.1.3 Company C ................................................................. 39
  4.1.4 Company D ................................................................. 39

4.2 Interviews ............................................................................. 39
  4.2.1 Challenges in Product Lifecycle Management ......................... 39
    4.2.1.1 Internal System Integration ..................................... 39
    4.2.1.2. External System Integration ................................ 41
    4.2.1.3 Information formats ............................................. 42
    4.2.1.4 Shipping administration ........................................ 43
  4.1.2 Accuracy ........................................................................ 43
  4.1.3 Incumbent Adaption ......................................................... 45

4.2. Cloud Computing Adoption ................................................... 45

5. Analysis and Discussion

5.1 A&D of RQ1: What are the challenges in PLM for SMEs in the fashion industry? 47
  5.1.1 Internal Integration Deficiencies ........................................ 47
  5.1.2 External Incompatibilities ............................................... 49
    5.1.2.1 Company - Supplier ............................................. 49
    5.1.2.2. Company - Retailer ............................................ 50
    5.1.2.3 Company - Manufacturer .................................... 52
    5.1.2.4 Company - Warehouse ........................................ 54

5.2 A&D of RQ2: RQ2: What causes the reluctance of cloud computing solutions amongst Swedish SMEs in the fashion industry? ........................................ 55
6. Conclusions

6.1 Research Question 1 ........................................................................................................ 59
6.2 Research Question 2 ........................................................................................................ 59
6.1 Future Research ............................................................................................................... 60

Reference List ..................................................................................................................... 61

Appendix A .......................................................................................................................... 69
List of Figures

3.1. The flow in a direct supply chain. ................................................................. 14
3.2. The four perspectives on the relation between logistics and SCM .................... 17
3.3. Illustrating the relationship between data categories ....................................... 21
3.4. An overview of the service models in terms of management scope .................... 24
3.5. The five steps of the innovation-decision process ........................................... 35
3.6. The TOE framework ....................................................................................... 36
# List of Tables

2.1. An overview of the interview setup details................................................................. 9  
3.1. Definitions of Supply Chain Management................................................................. 15  
3.2. Current research on advantages of SME adoption of cloud computing and related services................................................................. 29  
3.3. Advantages and drivers of SaaS adoption in SMEs.................................................... 31  
3.4. Issues in SaaS and the related organizational effects post adoption of SaaS solutions................................................................................................................. 33  
3.5. Categories of Adopters in DOI .................................................................................. 36
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>SME</td>
<td>Small and Medium-sized Enterprises</td>
</tr>
<tr>
<td>SCM</td>
<td>Supply Chain Management</td>
</tr>
<tr>
<td>PLM</td>
<td>Product Lifecycle Management</td>
</tr>
<tr>
<td>ERP</td>
<td>Enterprise Resource Planning</td>
</tr>
<tr>
<td>SaaS</td>
<td>Software as a Service</td>
</tr>
<tr>
<td>PaaS</td>
<td>Platform as a Service</td>
</tr>
<tr>
<td>IaaS</td>
<td>Infrastructure as a Service</td>
</tr>
</tbody>
</table>
Foreword and Acknowledgements

This master thesis was conducted during the spring of 2017, at the department of Industrial Economics and Management at KTH Royal Institute of Technology. Leading to a tremendously steep learning curve, I owe to express my gratitude to the individuals making this possible.

Firstly, I would like to thank Young/Skilled for the opportunity of writing my master thesis at the company and for all material and connections provided that resulted in this thesis. I would also like to express my gratitude towards the interviewees that took their time to answer my questions.

Secondly, I would especially like to thank my mentor Cali Nuur in his steady guidance and provision of information whenever needed. You have been a tremendous source of great feedback, inspiration and motivation.

At last, I feel an inexpressible amount of gratitude of the support of my studies from my friends and beloved family.

Yours Sincerely,

Vlajic, Dajana
2017-06-28, Stockholm
Chapter 1

Introduction

1.1 Background

Since the introduction of the Internet, innovations and technological developments have had major impacts on organizational and social activities (Li et al., 2009). The constantly increased pervasiveness and significance of Internet has had a high impact on many industries, where boundaries to the physical industries have diminished over time. Amongst many industries that have been highly revolutionized by technological developments, few innovations have received as much attention as the rapid transformation of the retailing industry (Vogt and Johnson, 2011).

The transformation in retailing is to a large extent represented by the shift towards multi-channel online purchasing (Melis et al., 2015), referred to as e-commerce or e-retailing. With the introduction of online purchasing, retailing is facing new consumer demands, product availability and delivery options, amongst many other changes. As a result, supply chain management (SCM) systems and logistics systems that manage products from production, through retailing and to the consumer, are exposed to the transformation (Fernie and Sparks, 2009). As part of SCM and logistics systems, product lifecycle management (PLM) systems have been developed. Amongst these, a majority is developed for, or by, industry incumbents such as Amazon and Paypal (Soto-Acosta et al., 2015). To achieve better and more efficient SCM, cloud computing solutions are being developed as a promising part of Information Technology (IT) (Iannone et al., 2013). Cloud computing is regarded as a new technology that with minimal management effort enables sharing and configuration of computing resources (NIST, 2010). Moreover, cloud computing has been introduced as a solution for PLM, and amongst the reasons for why cloud computing solutions are attractive, new cost models, ease of use, reliability, availability and scalability options represents a few (Dillon and Vossen, 2014). Retail incumbents have to a large extent utilized cloud computing to solve their PLM challenges, in contrast to the low adoption rate amongst small to medium-sized enterprises (SME). Despite the advantages promised by cloud computing, a vast amount of SMEs in retail seem to be reluctant towards the adoption of the technology (Assante et al., 2016, Colicchio et al., 2015).
whole includes many sectors with different supply chains. Therefore, the challenges in PLM between these differ. In the fashion sector of retailing these challenges are expected to be more complex than for many other retailing industries, with respect to seasonal products, customer motives for purchases and due to short product lifecycles (Hovmøller and Tambo, 2014). Hence, in the fashion industry it is crucial for a product to be visible and transparent at each stage of the supply chain (Iannone et al., 2013).

To investigate what the reasons for the reluctance of cloud computing adoption amongst SMEs in the fashion sector of retail, this study has been conducted in collaboration with the Swedish digital agency Young/Skilled. The company hosts an e-commerce platform with a variety of PLM solutions, with a customer base mainly represented by approximately 50 SMEs in the fashion sector of retail in Sweden. Operating in the retailing, Young/Skilled is also affected by the transition towards cloud computing industry and therefore investigating new possibilities of cloud computing development of their e-commerce platform.

1.2 Problem formulation

As a result of technological developments, the supply chains and logistics in the retailing industry is undergoing a major transformation. To manage the challenges posed by the transformation, a vast amount of service providers has developed software systems. Simultaneously, cloud computing is an emerging technology enabling advantages for more efficient management of these software systems. Despite the advantages that cloud computing promises, many SMEs in the fashion industry are reluctant towards the adoption of the new technology.

1.3 Purpose

The purpose of this study is to investigate the reluctance of cloud computing adoption amongst Swedish SMEs in the fashion industry. This involves an investigation of current challenges in product lifecycle management and identifying the elements causing the reluctance of cloud computing solutions, based on an empirical study with Swedish SMEs in the fashion industry.

1.4 Research questions

In order to address the purpose of this study, the aim is to answer the following research questions.
RQ1: What are the challenges in PLM for SMEs in the fashion industry?

RQ2: What causes the reluctance of cloud computing solutions amongst Swedish SMEs in the fashion industry?

1.5 Limitations

This study focuses on the challenges posed by product lifecycle management operations in retailing, and the causes of reluctance of cloud computing solutions. Since the companies interviewed are limited to the customer base of Young/Skilled, the focus of this study will be Swedish SMEs in the fashion sector of retailing.

The aim was to investigate 10 customers of Young/Skilled, but the investigation was limited to 4, due to a limited time frame and for the possibility of conducting a deeper investigation of supply chain management and logistical challenges in each. As the findings imply, the companies responded similarly to many of the interview questions on challenges in their PLM, which is an additional reason for why the number of interviewed companies was limited. Hence, the company perspective will be applied, and as a result details on challenges between other entities are left out. To define the size of SMEs, their annual revenue has served as a measure. The companies range from 45,9 MSEK to 338,7 MSEK, where the largest of them is the only company over 100 MSEK in annual revenue. According to (OECD, 2005), an enterprise is defined as an SME based on number of employees and annual revenue. The definition of a small-sized company includes 10-49 employees and an annual maximum revenue of 10 MEUR, whilst a medium-sized company is defined by having 50-249 employees and should not exceed 50 MEUR (The Organization for Economic Co-operation and Development (OECD), 2005).

In terms of challenges that SMEs faces, these will be restricted to PLM related issues. In fact, the focus within PLM systems will be on the information sharing in the supply chain, between a company and other entities. Hence, it does not enlighten competitive factors between companies and mainly investigates the challenges between a company and another entity in the supply chain. These entities are restricted to suppliers, manufacturers, retailers and warehouses. Within the scope of retailers, distributors and stores are included. Hence this thesis does not give any deeper insight in the information sharing with customers.

Since a majority of current literature suggests Software as a Service (SaaS) as the most widely adopted cloud computing solution amongst other SMEs in retail, the focus of this study will be somewhat limited to SaaS solution.
Furthermore, to investigate the reluctance of adoption of cloud computing, DOI theory and the TOE framework serve as innovation foundations. These methodologies have been widely adopted in investigations of innovations in Information Technology (Oliveira and Martins, 2011), and will hence provide insight of cloud computing adoption in SMEs from an innovation perspective.

Lastly, this thesis is written from a combine’s business and technological perspective, which restricts the scope to general conclusions on the cloud computing adoption. Lastly, limited literature on cloud computing implementations of PLM have been found in the investigation, and the results have therefore been generalized to a vast extent to the related Enterprise Resource Planning (ERP) implementations.

1.6 Disposition

This report consists of six main chapters, which are described as following.

1. Introduction
The first chapter serves as foundation of this study and includes a background, problem formulation, purpose, and research questions and limitations.

2. Method
In the second chapter a presentation and discussion is given on how the study have been conducted. The research purpose and design is included in this chapter, as well as a presentation on the methods used to answer the research questions. Moreover, this chapter includes the data collection methods, an analysis of the data used, a quality of analysis in terms of reliability, validity and generalizability. Lastly, ethical aspects of the study are presented.

3. Literature Review
The third chapter presents the results of the literature review and builds the theoretical foundation. This chapter encapsulates relevant findings in recent literature in terms of supply chain management in retail, logistical challenges and product lifecycle management with focus on the information sharing. The literature review also gives an introduction to state-of-the-art cloud computing, and the most relevant adoption of cloud computing in SMEs.

4. Findings
The fourth chapter presents the case companies and the findings from the interviews with the company representatives.
5. Analysis and Discussion
The fifth chapter presents an analysis and discussion of the research conducted in order to answer the research questions. In this chapter, the literature review and the findings from the interviews with the case companies are included.

6. Conclusions
In the sixth chapter, a summary on the findings is provided as well as suggestions on further research.
Chapter 2

Methodology

This chapter describes the steps of the approach of the study and provides an explanation for each step. A presentation on the chosen approach will be provided, including a discussion of the research process.

2.1 Research Purpose

The research purpose is defined as the motive of the research is conducted. The research purpose can be categorized as exploratory, descriptive, explanatory and predictive research (Collis and Hussey, 2009). Each category depends on the level of depth of knowledge developed in the field of research conducted. Exploratory research is characterized by flexibility, and useful when the research requires open-ended questions in order to identify and gain knowledge in the establishment of a problem (Saunders et al., 2012). Moreover, descriptive research examines a specific problem more in depth than exploratory research. Explanatory research aims to describe the circumstances of which the problem studied emerged, and therefore requires a causal establishment of relationships between variables. Lastly, based on the causality from exploratory research, predictive research generalizes the analysis and aims at making predictions of the studied problem (Collis and Hussey, 2009 and Saunders et al., 2012).

The nature of this study is exploratory, since the purpose of this research was to identify current inadequacies in the information supply chain for SMEs, and investigate the options made available by current cloud computing techniques. Previous studies have established the demand for collaboration and information sharing between entities in the supply chain. Several have investigated the benefits and disadvantages of adopting cloud computation to their businesses, although few have enlightened the role of cloud computing for SMEs, as a tool for enhanced collaboration between the entities in the supply chain.
2.2 Research Design

A research design, also referred to research approach or research method, represent the guidelines of how the research should be carried out. Creswell (2014) identifies three research design categories; qualitative, quantitative and mixed methods. A qualitative approach focuses on analyzing interpretations of data and yields to results that are useful and inhere a meaning (Attride-Stirling, 2001). On the other hand, a quantitative approach tests theories that are connected to a specific context through examination of the relation between variables. The variables, that can be quantified and measured, can be statistically analyzed Creswell (2014). Mix methods simply refers to a combination, involving both qualitative and quantitative research.

For this exploratory study, the problem formulation was stated by the representatives of Young/Skilled. This research will be of a qualitative nature, due to the fact that it does not test hypotheses or test former theories in a new context. Moreover, semi-structured interviews with stakeholders in the Swedish retail supply chain will serve as primary sources to capture the knowledge of their supply chains, logistics, information management systems and views on the adoption of new technologies. Secondary sources will constitute by articles from the literature review, as well as the annual reports of the interviewed companies. Due to the fluctuating nature needs and priorities from the primary sources, and inductive research approach will be used in this study.

2.3 Methods used to answer research questions

The sub-questions were answered qualitatively by analyzing primary information from interviews with SMEs and secondary information which included annual reports for the interviewed company and a literature review as foundation.

To answer these questions, the literature reviews initially served as a foundation for the understanding of the landscape of recent technological advances, and their impact on the retail supply chain. The aim of answering the first sub question RQ1: What are the challenges in PLM for SMEs in the fashion industry? was to get a comprehensive understanding of the challenges that a retail supply chain is facing in terms of management of information with the pressure from technological advances. The main insights were gathered from the interviews with the company representatives, and completed with previous case studies in the literature review. In contrast, the second sub-question RQ2: What causes the reluctance of cloud computing solutions amongst Swedish SMEs in the fashion industry? was mainly answered through the literature review. The reason for this is because of the low rate of adoption of cloud computing amongst the interviewed companies. Moreover, the literature review consisted of articles from
several sources, mainly obtained through search bases such as Google Scholar or KTHB Primo, where the latter is a search base provided by KTH.

To gain insight in current and more specific current challenges of product information management in retail, semi-structured interview was conducted with different stakeholders in Swedish SMEs. This is also the source of primary information, where a comprehension of the technological understanding of the companies was obtained.

2.4 Data Collection

This section focuses on the different collection methods of data and information that have been used in this study. Since this study focuses on the specifics of cloud computing that can serve as a solution for SMEs in their pursuit of more efficient product information management systems, rather than general cloud computing solutions from SMEs, multiple sources of data have been evaluated. These sources are mainly represented by series of interviews and a literature study. According to Collis and Hussey (2014) and Blomkvist and Halling (2015), the utilization of multiple data sources enables data triangulation. Hence, the study’s reliability and validity increases whilst the risk for bias decreases.

2.4.1 Literature Review

The literature review represents a significant part of the research conducted in this thesis, and serves as a main foundation for the understanding of the impact of technological advances in a retail supply chain. The study includes material from different sources with a vast majority including material such as books, articles and reports from the professional association Institute of Electrical and Electronics Engineers (IEEE), the website ScienceDirect and the global analytics company Elsevier. The material has primarily been obtained through the web search engine Google Scholar and KTHB Primo, a search base provided by the Royal Institute of Technology. The keywords searched for in these search databases have constitute of a combination of, synonyms of or related keywords to: Supply Chain Management, Small and medium-sized enterprises, Product Information and Cloud computing.

Moreover, the literature review can bee seen as a foundation for the empirical study, which aims to complete the literature study from a more detailed perspective more aligned with the research questions. Hence, the literature review provides a theoretical framework which relates to previous studies, introduces the junction between retailing and technological development, and explains the relevant concepts to answer the research questions of this study. Therefore, it has served as a beacon in the sense of the
structure of this thesis and provided adequate relevant content in order to position this thesis in relevance to literature in the same research context (Collis and Hussey, 2009).

By cause of reliability and validity, a vast majority of the literature review is based on peer-reviewed material.

2.4.2 Interviews

An important aspect of a qualitative study is represented by interviews since they provide the opportunity of finding the unexpected (Blomkvist and Hallin, 2015). In this thesis interviews were conducted with four customers of Young/Skilled. The customers are SMEs within the fashion industry in Sweden, represented by employees perceived as most eligible to answer questions relevant to this study by the customer representative of Young/Skilled. Each representative was approached by a phone call, where a brief was given on the topic of the study and the nature of questions. The interviews lasted for 30 - 50 minutes each, and were conducted by telephone or face-to-face. The interviews were held in Swedish, and the case of a telephone interview, notes were taken. In the case of face-to-face interviews, the interviews were recorded and transcripted after obtaining permission of the recording by the interviewee. The interviews were semi-structured, which opened the possibility for the interviewee to develop on the subject of matter and interest (Collis and Hussey, 2009). The details on the interview and interviewees are presented in Table 2.1.

<table>
<thead>
<tr>
<th>Company</th>
<th>Interviewee(s) position of employment</th>
<th>Interview method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company A</td>
<td>Manager of Supply Chain Operations and Logistics</td>
<td>Telephone</td>
</tr>
<tr>
<td>Company B</td>
<td>Chief Financial Officer</td>
<td>Telephone</td>
</tr>
<tr>
<td>Company C</td>
<td>Interviewee 1: Head of Finance</td>
<td>Telephone</td>
</tr>
<tr>
<td></td>
<td>Interviewee 2: Head Buyer</td>
<td></td>
</tr>
<tr>
<td>Company D</td>
<td>Sales Support Manager</td>
<td>Meeting (face to face)</td>
</tr>
</tbody>
</table>

Table 2.1. An overview of the interview setup details.
2.5 Quality of Analysis

Investing the quality of a scientific paper usually involves evaluation of three essential quality criteria; validity, reliability and generalizability (Collis and Hussey, 2009). The aim of evaluating these criteria is to gain an understanding of the legitimacy of the research design, the appropriateness of the elements studied and the significance to relevant contemporary research. For this study, the criteria will be evaluated for each data source, represented by the literature review, interviews and annual reports of the companies interviewed.

Another phenomenon that will be addressed in the following sections is triangulation, previously mentioned in section 2.4, Data Collection, which has been used for reducing the bias of data. On a positive note, triangulation increases the reliability and validity of a study. On the other hand, data triangulation also results in a reduced possibility of reproduction the study (Collis and Hussey, 2014).

2.5.1 Reliability

According to Collis and Hussey (2009), reliability is defined as an assessment of whether the same results would be obtained in the case of an identical repeat of the research. The ambiguity of this definition exists in the context of research within business and management since a social factor involving people cumbers an identical repeat of the research (LeCompte and Goetz, 1982). Since the research design of this study involved interviews with company representatives, there are several possible scenarios which could affect the reliability. From the perspective of the interviewer, high reliability is related to a good quality of the interview questions (Blomkvist and Hallin, 2009) where the questions should be easy to understand and understood identically by the interviewees. A decreased reliability follows from the consideration that the interviewees had different knowledge and expertise in the areas addressed by the questions. Hence, there was a possible occurrence of misinterpretations of questions and biased answers. To prevent such answers, despite the fact that the interview was semi-structured, the questions were asked in a certain order which was identical for all interviewees. Other indications of a higher reliability were that face-to-face interviews were recorded, and that neither one of the interviewees requested anonymity (Collis and Hussey, 2014).

Reliability is considered considered more important in quantitative studies, since the research in qualitative studies focuses on “whether observations and interpretations made on different occasions and/or by different observers can be explained and understood”. This explains the usefulness of reliability in a quantitative study.
regarding to the interpretivism paradigm, which suggests that a researcher’s perceptions influence the research (Collis and Hussey, 2009). Hence, the reliability is directly related to the interpretation of the results by the author. Since this work was conducted by a single person there is a possibility of objectivity of the results.

2.5.2 Validity

Analyzing the validity of a study intends to give insight in the accuracy of means of measurement and if they measure what the research intended to do. In many cases, a qualitative study yields a high validity, due to the aim of providing elaborate explanations of the phenomena studied which is made possible by acquiring an in-depth knowledge (Collis and Hussey, 2009). To determine the validity of this study, an evaluation with regard to each data source will be provided in the following section.

Considering the literature review, a high validity was obtained by gathering the secondary sources from well established scientific articles, reports and books in the context of the development of supply chain management in retail and the effect of technological advances.

Another increasing factor of validity was the mere presence of interviews in the study. On the other hand, by scrutinizing the conduction of interviews, there are several factors that could affect the validity. According to Blomkvist and Hallin (2015), the relevance of the interviewees has an impact on the validity, where a higher relevance yields higher validity of a study. In this study, the relevance of the interviewed representatives of each company was decided by the customer representative at Young/Skilled, as well as internally decided at each company. The validity is increased here, depending on the factor of knowledge of the context of the customer representative at Young/Skilled, supported by the knowledge of context and decision of appropriateness of the representative within each company. Another aspect is to which degree the representative understood the purpose of the study (Collis and Hussey, 2009). To ensure a higher validity, each interviewee was therefore given context to the research in this study and provided with the purpose of it before the interviews. Moreover, in order to ensure a higher validity, probes were used to some extent for the purpose of avoiding misunderstandings of the questions. On the other hand, only a small number of interviews were conducted, which decreases the validity (Blomkvist and Hallin, 2015).
2.5.3 Generalizability

Based on the definition from Vogt and Johnson (2011), generalizability is “the extent to which the research findings (often a population) can be extended to other cases (often a population) or to other settings (Collis and Hussey, 2014). There are several factors restricting generalizability in this study, primarily related to the size of the case companies, the field of business, the number of companies interviewed and number of interviews. For instance, since all customers of the case company belong to the fashion industry, this limits the conclusions to the fashion industry vertical. Moreover, since the companies all operate in Sweden, this should be considered in terms how geographical limitations. Another aspect is that the interviewed companies are small and medium-sized, which restricts the area to companies of such size.

2.6 Ethical Aspects

To follow the ethics of engineers, the research has to be conducted in accordance with the Swedish Engineers code of honors. Therefore, this study has been conducted in accordance with the four principles of the Swedish Research Council, which include the requirements of information, consent, confidentiality and good use. (Blomkvist and Hallin, 2015). To fulfill the information requirement, all interviewees were informed about the purpose of the study, whereafter their agreement to participate corresponds to the consent requirement. The confidentiality requirement is fulfilled by the agreement to not disclose sensitive information regarding the case company Young/Skilled, as well as by anonymizing the interviewee participants and the respective companies. In addition, all companies will have to approve all information that has been used in the thesis, before it is shared with other persons, institutions or companies or other entities, except for KTH Royal Institution of Technology or individuals related to the process of this thesis, such as fellow seminar students or examiners. Moreover, the requirement of good use was fulfilled by utilizing the collected information from the research solely for research purposes.

Lastly, to present an objective perspective, all literature serving as foundation for the research conducted in this study has been critically reviewed.
Chapter 3

Literature Review

This chapter presents the literature review, including concepts and frameworks, and the theories applied in the thesis from a retailing perspective. Moreover, this chapter presents the essential components of cloud computing and investigate current solutions for SMEs in retail.

3.1. Supply Chain Management in Retail

From the Dictionary of Retailing, the concept “to retail” is defined as “To sell goods or services directly to final consumers or those buying on behalf of such such consumers” (Baron et al., 1991). From this definition, “retailing” was considered as the process involved. Moreover, Davies (1993) claims that retailing should be defined as “The management of resources to supply the product and service needs of the end-consumer, encompassing the supply chain of any physical products and the exchange processes involved”. As a further implication, retailing in terms of large modern businesses embraces both marketing and supply chain management (SCM), but that the crucial implication is management of resources to meet all the needs of a consumer (Davies, 1993). Whilst numerous definitions of a supply chain have evolved through history, a supply chain is often referred to as distribution channels or networks of organizations (DeWitt et al., 2001). According to Handfield and Nichols (1999), a “supply chain encompasses all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows. Material and information flow both up and down the supply chain”. In contrast to other definitions of a supply chains it incorporates the end user as entity (i.e. consumer or customer in this context). This is crucial in the context of retailing, which implies the existence of upstream and downstream flows in the supply chain (Mentzer et al., 2001). A supply chain is comprised by several entities amongst which the activities associated with the flow take place, including one or several suppliers, manufacturers, distributors, retailers and customers (La Londe and Masters, 1994) (Figure 3.1).
3.1.1 Supply Chain Management

The prominence of supply chain management (SCM) has risen remarkably over the past three decades and for reasons as global sourcing, increased performance-based competition and awareness of environmental impact (Mentzer et al., 2001). Hence, for the success of a company, good management of the supply chain is crucial (Graham and Hardaker, 2000). The Global Chain Forum, a consortium of researchers in academia and non-competing firms, define SCM as following:

“Supply Chain Management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders.”

Despite attempts to clarify the definition, SCM has become a result of distributed utilization resulting in imprecise conceptual boundaries (Lambert and Cooper, 2000). To demonstrate this fact, a representation of definitions of SCM in literature has been presented in Table 3.1.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Definitions of SCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monczka, Trent, and Handfield (1998)</td>
<td>SCM requires traditionally separate materials functions to report to an executive responsible for coordinating the entire materials process, and also requires joint relationships with suppliers across multiple tiers. SCM is a concept, “whose primary objective is to integrate and manage the sourcing, flow, and control of materials using a total systems perspective across multiple functions and multiple tiers of suppliers.”</td>
</tr>
<tr>
<td>La Londe and Masters (1994)</td>
<td>Supply chain strategy includes: “… two or more firms in a supply chain entering into a long-term........................................................................................................................................</td>
</tr>
</tbody>
</table>

![Figure 3.1. The flow in a direct supply chain (Chopra and Meindl, 2001).](image)
agreement; ... the development of trust and commitment to the relationship; ... the integration of logistics activities involving the sharing of demand and sales data; ... the potential for a shift in the locus of control of the logistics process.”

Stevens (1989)  
“The objective of managing the supply chain is to synchronize the requirements of the customer with the flow of materials from suppliers in order to effect a balance between what are often seen as conflicting goals of high customer service, low inventory management, and low unit cost.”

Houlihan (1988)  
Differences between supply chain management and classical materials and manufacturing control: “1) The supply chain is viewed as a single process. Responsibility for the various segments in the chain is not fragmented and relegated to functional areas such as manufacturing, purchasing, distribution, and sales. 2) Supply chain management calls for, and in the end depends on, strategic decision making. “Supply” is a shared objective of practically every function in the chain and is of particular strategic significance because of its impact on overall costs and market share. 3) Supply chain management calls for a different perspective on inventories which are used as a balancing mechanism of last, not first, resort. 4) A new approach to systems is required—integration rather than interfacing.”

Jones and Riley (1985)  
“Supply chain management deals with the total flow of materials from suppliers through end users...”

Cooper et al. (1997)  
Supply chain management is “… an integrative philosophy to manage the total flow of a distribution channel from supplier to the ultimate user.”

| Table 3.1. Definitions of Supply Chain Management (Mentzer et al., 2001). |

Based on the definitions provided in Table 3.1, Mentzer et al. (2001) categorizes SCM definitions into three categories: “a management philosophy, implementation of a
management philosophy, and a set of management processes." The management philosophy is based on a systems approach, viewing the supply chain from the perspective of one single entity. In this category, the definition extends to logistics and spans over all intra- and inter-firm activities that relate to customer satisfaction. The second category relates to activities that implement the management philosophy, which are listed below.

1. Integrated Behavior
2. Mutually Sharing Information
3. Mutually Sharing Risks and Rewards
4. Cooperation
5. The Same Goal and the Same Focus on Serving Customers
6. Integration of Processes
7. Partners to Build and Maintain Long-Term Relationships

The third category defines SCM as a set of management processes. The authors providing SCM definitions that fall into this category have different views on the implication of a process in SCM. A general summarization of the different definitions is that “a process is a specific ordering of work activities across time and place, with a beginning, an end, clearly identified inputs and outputs, and a structure for action” (Mentzer et al., 2001). The distinction made between activities in the implementation of a management philosophy and the set of processes, is that customer focus is a key objective in processes, presented in the list below, and in the organization of a firm (Mentzer et al., 2001).

1. Customer relationship management
2. Customer service management
3. Demand management
4. Order fulfillment
5. Manufacturing flow management
6. Procurement
7. Product development
8. Commercialization

3.1.2. Logistics and SCM
The unclear boundaries of the definition of SCM has compromised both research and implementation (Larson and Halldorsson, 2004). One of the overlapping fields is logistics, whose definition provided by the Council of Logistics Management (CLM) changed as a result of SCM. The initial definition was introduced in 1985, as follows:
“Logistics is the process of planning, implementing and controlling the efficient flow and storage of raw materials, in-process inventory, finished goods, services, and related information from point of origin to point of consumption (including inbound, outbound, internal and external movements) for the purpose of conforming to customer requirements.”

This came to a change 1998, when CLM included logistics as a part of SCM in their renewed definition. On the topic of growing SCM literature, Larson and Halldorsson (2004) identified four perspectives on logistics and SCM; traditionalist, re-labeling, unionist and intersectionist. These define the relationship between logistics and SCM, and how different stakeholders choose to define it (Figure 3.2).

![Figure 3.2](image)

**Figure 3.2.** The four perspectives on the relation between logistics and SCM (Larson and Halldorsson, 2004).

In accordance with the SCM definition by La Londe and Masters, stated in Table 3.1, the distinction between logistics and SCM is seldom made in the business of retail. In the survey conducted by Larson and Halldorsson (2004) retailers were prone to belong to the perspectives of Relabeling and Intersectionist. In the Relabeling category, a retailer answered that a supply chain manager “innovates, transforms logistics processes into strategic advantage”, on a question on the responsibilities of a supply chain manager.

Since Forrester's introduction of the demand-amplification, also referred to as the Bullwhip effect in a supply chain in 1961, a vast amount of research on logistics in retail have analyzed this phenomenon. More recent logistical effects have been studied due to the possibilities enabled by technological advances, which have influenced the importance of information sharing in a supply chain.
3.1.2.1 The Bullwhip effect

The Bullwhip effect has been one of the mostly described logistical phenomenon in supply chains management research, and has been investigated in empirical studies, ad hoc examinations and mathematical approaches towards finding a solution (Dominguez et al., 2014). One of the first acknowledged definitions of the bullwhip effect was described by the computer scientist Jay Forrester in 1961, who defined it as the altitude of variability when moving upwards in a supply chain. In recent papers, the bullwhip effect is often defined as demand amplification, referring to the distortion of demand when moving upstream in the supply chain. According to Chen and Lee (2012), there are two main definitions occurring in literature on measurement of the bullwhip effect. The first definition outlines the bullwhip effect as an instance of distortion of information, which is measured by the comparison between order and demand variance. The distortion of information in this definitions is related to the upstream flow. The second definition, used in empirical studies to a vast extent, focuses on the variance comparison between order receipts and sales. In some cases, sales and inventory data replace the order receipt information, in case when it is not available. In essential, the second definition focuses on the material flow distortion going downstream in the supply chain.

More specifically, when consumer demand moves in a slow pace upwards in the supply chain, suppliers experience large production fluctuations (Wang et al. 2015). The result of the Bullwhip effect is visible when production and ordering costs exceeds the costs of the holding inventory. In a study in forecasting methods to reduce the bullwhip effect, Jaipuria and Mahapatra (2014) listed five major sources causing the bullwhip effect in the context of a supply chain. They were “demand forecasting, order batching, price fluctuations, supply shortages and non-zero lead-time” (Jaipuria and Mahapatra, 2014).

According to Metters (1997) the mere discovery of the bullwhip effect does not result in its solution. To eliminate it, the bullwhip effect demands alteration of well-established business methods. Despite debates of causes of the bullwhip effect in research, Metters (1997) concludes that a general agreement on the root cause exists, which can be defined as following “lack of inter-company communication combined with large time lags between receipt and transmittal of information” (Metters, 1997), which is confirmed by more recent studies (Jaipuria and Mahapatra, 2014).

Moreover, to reduce the bullwhip effect Geary et al. (2006) states that the uncertainty must be addressed by making changes in the supply chain. Such changes could be smoothening of material flow and increased transparency in the information flow
(Geary et al. 2006). Hence, the sharing information in the channels between entities in the supply chain, uncertainties in demand can be reduced, and the bullwhip effects as well (Banerjee and Mishra, 2017).

According to Metters (1997), the bullwhip effect can especially have dramatic effects for companies that are removed from the end-user, in this referred to as customer. Ignoring the end-user can result in an increase of the variance. Metters (1997) argues that investments in marketing efforts and information systems that consider this behavior might therefore be a consideration for companies looking to reduce the bullwhip effect. Metters (1997) also stipulates that solutions for the bullwhip effect are expensive and therefore require justification.

3.1.2.2 Functional silos
Functional silos are defined by the individuality of functions in an organization, where own agendas and limited interactions characterized the logistical phenomenon (Han et al., 2017). There are several indicators of the presence of functional silos which can be observed in an organization that is “imposing control on people, rather than eliciting comment from them” Ensor (1988). According to Ensor (1988), these indicators are represented as different manifestos, such as management style, organizational structure and performance standards, to name a few. As a result, functional silos induce increased unit costs, large amounts of inventory and lacking customer service (Han et al., 2017)

The consequences of functional silos exist in both intra-functional and inter-functional relationships, where problems cannot be seen in a context. This results in organizations that act reactively, instead of proactively which results in a prohibition from solving problems at lower levels. In the definition of SCM processes, Lambert et al. (1998) propose that a successful implementation of SCM requires that all entities in the supply chain have to overcome their functional silos. Han et al. (2017) claims that internal integration is a first step in the process integration in a supply chain, and that it can remove the challenges posed by functional silos. In this context, IT plays the role of facilitator of cross-functional sharing of information as well as collaboration. Han et al. (2017) mentions ERP as an example of an IT solution, which serves to seamlessly integrate business processes in order to respond to both suppliers and customer demands.

3.1.3 The Fashion SCM
The technological developments that have resulted in a paradigm shift in retail, have in particular affected the fashion industry sector. In comparison with other retail sectors,
the data of fashion retail can for several reasons be expected to be more complex.
Firstly, in the fashion industry a vast majority of the products are seasonal, meaning that products are developed for the purpose of endurance related to fewer seasons than products in retailing in general and therefore short-lived production must be supported. It is therefore a necessity that a customer can be provided with the product as soon as possible, “before the product is out of fashion” (Iannone et al., 2013).
Secondly, products in the fashion industry are often unique to a chain or a brand.
Thirdly, from a customer perspective, the demand is often based on a customer desire, rather than necessity. Fourthly, in the case of retailing across multiple channels, which is common in the fashion industry, requires entities in the supply chain to adapt and consistency amongst the different channels (Hovmøller and Tambo, 2014).

One of the most important competitive advantages in the fashion industry is speed to market. To meet the demands of customers, flexibility is also required to manage the short product life cycles. Speed and flexibility therefore require time management in order to enhance the supply chain responsiveness, and management of technology becomes a crucial component in this endeavor (Choi et al., 2013). As a result of the omni-channel environment, and other fashion industry characteristics mentioned, both innovation and development of technology capabilities is a challenge for the owners of the brands (Tambo, 2014).

3.2 Product Management in Retail

In many cases product and customer information are both incomplete and inconsistent in many systems due to a lack of global standards and the existence of recurrent data capturing (Brunner et al. 2007). As a result, intermarket supply operations become less complex and non-efficient. Managing product information is therefore critical for modern firms, because it encapsulates centralization, management and synchronization across systems and partners (Brunner et al. 2007). According to (Prajogo and Olhager, 2012), integration of supply chain information is crucial for the entities in order to jointly address demands of the market and create customer value. Product information includes a description of products and their manufacturing processes (Legner and Schemm, 2008).

3.2.1 Defining the Product Data

Organizational data can be categorized into three interconnected categories; master data, inventory data and transactional data (Kokemüller and Weisbecker, 2009) (Figure 3.3). Master data encapsulates product and consumer information, whereas the former includes the characteristics of a products and it’s manufacturing process (Huang et al.,
Inventory data represents the status of master data, and may include information on stock level of products. As implied, transaction data is representative of business transactions, such as orders and invoices (Kokemüller and Weisbecker, 2009). In comparison with transactional data, master data represents core data that can uniquely describe business objects (Legner and Schemm, 2008) has a static property, and usually utilized by multiple stakeholders in an organization.

![Figure 3.3. Illustrating the relationship between data categories (Baghi et al., 2014).](image)

### 3.2.2 Product Lifecycle Management

From the definitions of Supply Chain Management, part of the process is managing the information flow in a supply chain (The Global Chain Forum; Mentzer et al., 2001). The flow of information has a direct effect on the value-adding activities in an enterprise, improvement of innovation, reduction of inventories and more efficient utilization of resources (Graham and Hardaker, 2000). The concept of Product Lifecycle Management (PLM) is to provide support through the lifetime of a product, from the initial idea and concept, to manufacture, until the moment that the product is not sold anymore (Jorij, 2014). Recent technological advances, information overload and escalated global competition have resulted in an increased focus on information management during the product lifecycle (Soto-Acosta et al., 2015). SMEs are therefore considering the adoption of product lifecycle software (PLM) as a solution to challenges related to the management of information and data related to products. PLM encapsulates the entire management of products lifecycles and different systems have been developed to manage different parts of the lifecycle. These systems can be divided based on their relation to products, content and processes (Jorij, 2014).

#### 3.2.2.1 Product related systems

The idea behind Product Information Management (PIM) only covers a part of PLM, and is both comparable with other systems and overlaps with their functionalities. For
instance, Product Resource Management (PRM) and Product Content Management (PCM) are used as alternative terms for PIM depending on context and location Jorij, 2014. For instance, PCM is more commonly adopted by companies in the US than in Europe. Moreover, Product Data Management (PDM) overlaps with some of the functionalities offered by PIM. While PIM refers to the management of product information that relates to marketing and sales, PDM focuses on supporting the development and manufacturing of products. Moreover, Digital Asset Management (DAM) or Media Asset Management (MAM) aim to support the management of processes and systems related to photos, videos and other media documents. PIM systems often provide a light version of DAM/MAM,

3.2.2.2 Content related systems

The systems managing content are encapsulated in the common term Enterprise Content Management (ECM), of which PIM is a sub-entity. Other content related systems under the scope of ECM are Content Management Systems (CMS), Document Management Systems (DMS) and Cross Media Publishing (CMP) (Jorij, 2014).

3.2.2.3 Process related systems

Enterprise Resources Planning (ERP) support logistics and finance and other operational processes, and are considered a critical source to PIM systems. While some ERP systems do support PIM functionalities, most of them are not intended to. Another system overlapping with PIM is Master Data Management (MDM), which mainly focuses on offering a repository for data that is central for the management of business critical data, allowing for management of key data which represents customers, products and partners (Jorij, 2014).

After an investigation of current commercial PLM software, the authors listed the most common advantages offered, namely “enhanced quality of the product; less time to launch the necessary documentation; environmental responsibility (less paper); centralized databases; better internal processes; reduced time-to-market” (Soto-Acosta et al., 2015). Hence, advantages of adopting PLM solutions include fast interexchange of expertise and documents, improvements in communication, real-time control and improved accessibility of information that is product-related. Nonetheless, PLM adoption can improve the inter- and intra communication and accessibility of information (Soto-Acosta et al., 2015).

On the other hand, a vast majority of the current commercial PLM solutions are today directed toward industrial incumbents, resulting in challenges of PLM management for SMEs (Soto-Acosta et al., 2015). Soto-Acosta et al. (2015) conducted a case study where
they recognized three areas of information challenges for an SME manufacturer. The first area includes in the use information and formats which focuses on challenges of conversion processes and the compatibility of formats. The second area includes information consistency, which is a challenge in terms of guaranteeing information availability at the same time as satisfying the terms for confidentiality. Lastly, the third area regards the issue of information redundancy which includes challenges posed by information duplication.

3.3 Cloud Computing

Posing the next technological revolution, cloud computing has become one of the major topics in the field of modern Information Technology (Puthal et al., 2015). Rapid growth in storage technologies, cost reductions in computing and processes and successful adoptions of Internet services have escalated the interest of cloud computing as a compelling solution.

Various descriptions of cloud computing and related terms such as architecture and deployment occur in academic and industrial settings. The U.S National Institute of Standards and Technology (U.S NIST) definition of cloud computing is one of the most widely adopted ones (AlMorsy et al., 2016):

"Cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (NIST, 2010)

Moreover, Marston et al. (2010), define cloud computing as following “...an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location. The resources required to provide the requisite quality-of-service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction”. To provide these solutions, cloud computing has three cloud stack service models and three deployment models, explained in the following sections.

3.3.2 Service Models

Cloud computing models depends on different layers and objects, where higher layers depend on the lower ones in terms of functionality and security. These layers and objects include Application Programming Interfaces (APIs), Virtual Machines (VMs), Applications and Services) (Al Morsy et al., 2016). Based on the latter, cloud computing
offers different layers of models, here referred to as cloud stack service models. In literature, a wide range of layers is presented, but following NIST’s definition, cloud computing mainly encapsulates three cloud stack service models, namely Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Customers of cloud vendors can choose to either deploy their own applications on IaaS and Paas, or buy accessible applications through the SaaS model (Villamizar et al., 2015).

Hence, these service models represent different levels of cloud infrastructures, mainly differentiating in the extent of ownership or management of the infrastructure.

**Figure 3.4.** An overview of the service models in terms of management scope.

### 3.3.2.1 Software as a Service

The most mature service model of the three presented in Figure 3.4 is Software as a Service (SaaS) (Kavis, 2014). The SaaS vendors typically offer SaaS through a web-based user interface for customers, that can be accessed from any device and without requirement of installation on their computers (Al Morsy et al., 2016). The other common way of offering SaaS is by providing APIs to their customers which then can offer their own consumer the services that can be integrated with current applications.
into the platform (Kavis, 2014). The underlying cloud infrastructure is entirely managed and controlled by the cloud provider, implicating that the customer has none or very little responsibility of servers, networks, storage, operating systems and application capabilities (Song et al., 2016). SaaS can either be hosted directly on a cloud infrastructure, or on top of PaaS or IaaS (Al Morsy et al., 2016).

3.3.2.2 Platform as a Service

According to Kavis (2014), Platform as a Service is the least mature service model. In this case, the cloud provider delivers entire platforms and other services. Without installation of any platform or tools, the customer is enabled to manage, develop and deploy their own applications onto the platform using tools and programming languages that the cloud provider supports (Song et al., 2016). Similar to the case with SaaS, the customer is not intended to control or manage the cloud infrastructure. PaaS can either be hosted on a cloud infrastructure or at on top of the IaaS model (Al Morsy et al., 2016).

3.3.2.3 Infrastructure as a Service

The cloud providers of IaaS deliver web-based services in form of provision of fundamental computing resources, including processing, networks and storage. In contrast to SaaS and PaaS, the customer can deploy and manage their own software on the infrastructure, which includes both applications and operating systems (Song et al., 2016). Important to mention is that the customer does not control or manage the cloud infrastructure, but has control over the services deployed on the infrastructure. According to Al Morsy et al. (2016) IaaS is based on virtualization technology, including the virtualization layer of hypervisors and a resource layer consisting of VMs, virtual storage and networks and a virtualization layer (hypervisors) (Song et al., 2016).

3.3.3 Deployment models

NIST mentions four deployment models in the cloud model offering different services to the users, namely private cloud, public cloud, community cloud and hybrid cloud. The choice of deployment model depends on an organization's customization capabilities, sharing of cloud services, security challenges and hosting location of the services (Xue and Xin, 2016).

3.3.3.1 Public Cloud

The services offered in the public cloud is available for all Internet users. For instance, public cloud services include e-mail services and photo storage capability. The services are shared with other organizations and provided by third party providers. Often, the
service providers inhere their own charging models, policies costs and values. Examples of public cloud providers are Amazon and Google (Ross and Blumenstein, 2015). The services in the public cloud are available to a high degree, however, users of the public cloud are considered untrustworthy to a large extent. Therefore, challenges regarding security and privacy in the public cloud are often discussed amongst the users. Amongst SMEs, the public cloud is the most commonly used deployment model due to its advantages in terms of providing immediate hardware access, no upfront costs and fast time to market (Senarathna et al. (2016).

3.3.3.2 Private Cloud

The private cloud differs from the public cloud in that it is created in-house, to provide cloud services to and organization. The services offered by the private cloud include the sharing of customer data to other entities. Since the services are only accessible by users within the organization (Ross and Blumenstein, 2015), the security is considered higher in the private cloud than in the public cloud. According to Xue and Xin (2016), the private cloud services pose higher security options, lower complexity, reductions of costs and less risks. Therefore, banks tend to create their own private cloud to lower the security challenges regarding sensitive client data (Ross and Blumenstein, 2015). On the other hand, the services provided by the private cloud are often related to higher costs in terms of software and other equipment.

3.3.3.3 Community Cloud

The community cloud shares many similarities with the private cloud. For example, a services offered by the community cloud can be educational resources between universities. Located between the private cloud and the public cloud, the services can be shared between organizations that have common operations and requirements of services. As a result, the cost of the community cloud setup is less low than of the private cloud (Xue and Xin, 2016). The community cloud offers a higher level of security and privacy than the public cloud, although the risks imposed due to sharing between organizations. In a study on the effect of adopting the community cloud for better information integration of 395 randomly chosen companies in Spain, the results indicated that adoption of the community cloud improved integration of informational flows in the supply chain (Bruque-camara et al., 2016). According to Bruque-camara et al. (2016) adoption of the community cloud can in several ways “lead to the integration of data between internal and external functions, provide broader and more reliable data access for inventory management and facilitate the real-time interconnection of raw materials, production and ordering processes”.

26
3.3.3.4 Hybrid Cloud

The hybrid cloud can be considered a combination of several clouds, including both private, public and community clouds. The composed cloud shares hardware to provides services, mainly involving backup storage services. Since it is composed by the other deployment models, it offers similar advantages. One way of managing the security concerns in the hybrid cloud is using a private storage for sensitive organizational data.

3.3.4 Cloud Computing in SMEs

Recent research on cloud computing suggests that the advantages of adopting cloud computing are many and broad for an SME (Table 3.2). According to Assante et al. (2016), cloud computing offers opportunities in terms of business improvements and technological efficiency. In a review of research on cloud computing, Venters and Whitley (2012) attempted to segment the current research on cloud computing into technology and service. The purpose of the segmentation was to distinguish different cloud computing based on user needs. Technology represented those who were inclined towards scalability, equivalence and variety needs, whilst service included efficiency and simplicity needs. Nevertheless, literature existing before the review was conducted implies the existence of a combination technology and service. According to Marston et al. (2010), there are five key advantages of cloud computing allowing for these opportunities in business and technology, including lower costs, faster hardware access, lower innovation barriers, service scalability and new opportunities for application development.

<table>
<thead>
<tr>
<th>Source</th>
<th>Advantages of adopting cloud computing</th>
</tr>
</thead>
</table>
| Ross and Blumenstein, 2014 | • enhanced ability for firms to access new global markets  
• reduce capacity  
• reduce financial constraints |
| Salleh et al., 2012      | • low cost (relieve SMEs from higher cost investments)  
• concentrate on its core business and reduce their IT burden  
• provides SME a chance to advanced business software to join the competition of its marketplace  
• commercially viable  
• efficient, flexible and scalable processing power. |
<table>
<thead>
<tr>
<th>Reference</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcary et al., 2014</td>
<td>• compete more effectively</td>
</tr>
<tr>
<td>Brender and Markov, 2013</td>
<td>• lower costs (for investing in IT infrastructure and to use software)</td>
</tr>
<tr>
<td></td>
<td>• flexibility</td>
</tr>
<tr>
<td>Heng, 2012</td>
<td>• cost reductions</td>
</tr>
<tr>
<td></td>
<td>• flexibility</td>
</tr>
<tr>
<td></td>
<td>• management benefits</td>
</tr>
<tr>
<td>Jarting and Persson, 2015</td>
<td>• increased flexibility in handling of IT portfolio</td>
</tr>
<tr>
<td></td>
<td>• platform independence</td>
</tr>
<tr>
<td></td>
<td>• reach customers globally</td>
</tr>
<tr>
<td>Agostini, 2013</td>
<td>• limited financial risk</td>
</tr>
<tr>
<td></td>
<td>• an efficient way to manage the information</td>
</tr>
<tr>
<td></td>
<td>• the ease-of-use</td>
</tr>
<tr>
<td>Mourtzis et al., 2015</td>
<td>• distributed shop-floor monitoring</td>
</tr>
<tr>
<td></td>
<td>• adaptive decision-making</td>
</tr>
<tr>
<td></td>
<td>• capability of process planning</td>
</tr>
<tr>
<td>Assante et al., 2016</td>
<td>• cost efficiency</td>
</tr>
<tr>
<td></td>
<td>• scalability and flexibility</td>
</tr>
<tr>
<td></td>
<td>• sustainability</td>
</tr>
<tr>
<td></td>
<td>• maintenance by cloud provider</td>
</tr>
<tr>
<td></td>
<td>• security</td>
</tr>
<tr>
<td></td>
<td>• improved service delivery</td>
</tr>
<tr>
<td>Tutunea, 2014</td>
<td>• reduction of software costs</td>
</tr>
<tr>
<td></td>
<td>• reduction of hardware infrastructure costs</td>
</tr>
<tr>
<td></td>
<td>• increase in productivity</td>
</tr>
<tr>
<td></td>
<td>• efficiency of activities</td>
</tr>
<tr>
<td>Rocha et al., 2016</td>
<td>• develop new business</td>
</tr>
<tr>
<td></td>
<td>• use advanced engineering and management tools easily</td>
</tr>
<tr>
<td></td>
<td>• collaborate with other companies or technical institutions to innovate</td>
</tr>
<tr>
<td>Sen et al., 2016</td>
<td>• cost-effective solution</td>
</tr>
<tr>
<td></td>
<td>• innovation possibilities</td>
</tr>
<tr>
<td></td>
<td>• more precisely tailored products or services</td>
</tr>
</tbody>
</table>
As presented in Table 3.2, recent research focus in mainly directed towards the adoption of cloud computing in SMEs and how SME adoption of cloud computing affects the development of the latter (Low et al., 2011). In terms of the advantages of adopting cloud computing, cost reductions are heavily investigated, followed by innovation possibilities and business globalization.

According to Jartin and Persson (2015), SMEs have shown a particular interest for SaaS based cloud computing solutions. This is supported by results of an empirical study on SaaS observations which indicated that smaller enterprises have an adoption rate of SaaS solutions than midsized and larger corporations. In the study, smaller companies were considered those having 50M USD in annual revenue. The results showed that 26% of the smaller companies utilized SaaS solution, in comparison to midsized companies (4%) and large companies (5%) (Castellina, 2012). Furthermore, SaaS is predicted to provide 27.8% of the enterprise applications by 2018 (2014), which in comparison to 2013 implies a revenue growth by 125%. Amongst the service models, SaaS is the one that cloud providers have most responsibility of. The advantages of adopting SaaS in a SME is presented in Table 3.3.

<table>
<thead>
<tr>
<th>Source</th>
<th>Nature of study*</th>
<th>SaaS Solutions</th>
<th>Advantages and Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu et al., 2012</td>
<td>1</td>
<td>Cloud oriented account service mechanism</td>
<td>• Simple access to account information</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Scalability and availability</td>
</tr>
<tr>
<td>Faseen et al., 2013</td>
<td>2</td>
<td>ERP Software</td>
<td>• Improved IT reliability</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Perceived cost reduction</td>
</tr>
<tr>
<td>Gerhardter and Ortner, 2014</td>
<td>1</td>
<td>ERP Software</td>
<td>• Chance to establish in the SME market for providers</td>
</tr>
<tr>
<td>Purohit et al., 2012</td>
<td>1</td>
<td>ERP Software</td>
<td>• Elimination of investment and maintenance costs</td>
</tr>
<tr>
<td>Lewandowski et</td>
<td>1</td>
<td>ERP Software</td>
<td>• Critical information becomes</td>
</tr>
<tr>
<td>Source</td>
<td>Year</td>
<td>Type</td>
<td>Benefits</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>------</td>
<td>----------</td>
</tr>
</tbody>
</table>
| al., 2013 | | | closer to the decision-maker  
| | | | - Increased internal collaboration  
| | | | - Potential innovation enhancement of products and services  
| Bezemer and Zaidman, 2010 | 1 | Multi-tenant applications | - Easier and cheaper deployment of software  
| Elmonem et al., 2017 | 1 | ERP Software | - Lower upfront costs  
| | | | - Lower operating costs  
| | | | - Rapid implementation  
| | | | - Scalability  
| | | | - Focus on core competencies  
| | | | - Access and use of advanced technology  
| | | | - Rapid updates and upgrades  
| | | | - Improved accessibility, mobility, and usability inside and outside an enterprise  
| | | | - Easier integration with cloud services  
| | | | - Improved system availability and disaster recovery  
| | | | - Cost transparency  
| | | | - Sales automation  
| | | | - Using security standards  
| | | | - Free trials  
| Danaiata and Hurbean, 2010 | 1 | ERP Software | - Low cost of entry  
| | | | - The responsibility is on the vendor  
| | | | - Less risky investment  
| | | | - Location independent access to data  
| | | | - Safe storage  
| | | | - Less prone to human errors  
| | | | - Automatic backup  

The nature of study explains the characteristics of the research presented in the literature. If the literature focuses on the adoption of SaaS solutions, such as investigating critical success factors, intention to adopt and reluctance, it have been categorized under (1) Adoption. Otherwise, in case of literature where an implementation of a SaaS solution has been developed, including improvements and hypothetical solutions of current software, it has been categorized under (2) Implementation. Lastly, observations of the current solutions mentioned in literature represents a major adoption of SaaS solutions in terms of ERP software, which belongs to the process related PLM systems.

A major part of current literature on cloud computing in SMEs is either focusing on investigating factors that affect adoption of cloud computing (Low et al., 2011). On one hand, the adoption process seems to have a great impact in the actual development of cloud computing solutions for SMEs. On the other hand, there already exist solutions in product information management cases, that despite the obstacles in the adoption have successfully adopted cloud computing solutions. As shown in Table 3.3, a majority of the found literature on SaaS solutions for SMEs regard ERP software solutions, followed by investigations on multi-tenancy models. Hence, limited research is investigating the cloud computing solutions of logistical challenges in product lifecycle management. On of the more prominent advantages for SMEs in particular when implementing ERP is the flexibility of the investments in cloud computing solutions (Ross and Blumenstein, 2015; Salleh et al., 2012; Brender and Markov, 2013; Agostini, 2013; Assante et al., 2016) Moreover, these advantages highly correspond to the financial advantages in the implementation of SaaS in SMEs (Faseen et al., 2013; Purohit et al., 2012; Bezemer and Zaidman, 2010; Elmonem et al., 2017; Foglin and Holmander, 2014).

<table>
<thead>
<tr>
<th>Study</th>
<th>Product</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foglin and Holmander, 2014</td>
<td>CRM</td>
<td>• Faster innovation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Accessibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pay-per-usage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduces administration and operational overhead</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Security management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Flexibility/Adaptability</td>
</tr>
<tr>
<td>Ruivo et al., 2015</td>
<td>ERP</td>
<td>• Cost reductions</td>
</tr>
</tbody>
</table>

Table 3.3. Advantages and drivers of SaaS adoption in SMEs.
In a study on organizational effects of post implementation of SaaS in SMEs, Jarting and Persson (2015) listed the five most relevant post issues of adoptions of SaaS solutions, based on an empirical study which included both a literature review and case studies with SMEs (Table 3.4).

<table>
<thead>
<tr>
<th>Issues in SaaS</th>
<th>Organizational effects of adopting SaaS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price model</td>
<td>• Pay-per-unit complicates the cost estimation</td>
</tr>
<tr>
<td></td>
<td>• Pay-per-unit enables scalability</td>
</tr>
<tr>
<td></td>
<td>• Pay-per-unit creates the risk of costs increasing more than income when the usage becomes more extensive</td>
</tr>
<tr>
<td></td>
<td>• Less effort managing hardware and updates</td>
</tr>
<tr>
<td></td>
<td>• Using the system becomes an operational cost</td>
</tr>
<tr>
<td>Vendor Relation</td>
<td>• Increased costs and lowered system quality compared to alternative systems increases the intention to</td>
</tr>
<tr>
<td></td>
<td>change systems, and thus could lead to the organizational impact of changing system.</td>
</tr>
<tr>
<td></td>
<td>• The nature of the contracts between the customer and vendor in regards to, for example, data</td>
</tr>
<tr>
<td></td>
<td>ownership and subscription binding period affects the degree of lock-in.</td>
</tr>
<tr>
<td></td>
<td>• SaaS system customers have frequent and long term interaction with their vendors, and the customers</td>
</tr>
<tr>
<td></td>
<td>put importance to this relationship.</td>
</tr>
<tr>
<td></td>
<td>• If the vendor puts their self-interest before that of the customer then that could damage the trust,</td>
</tr>
<tr>
<td></td>
<td>leading the customer to implement control mechanisms to discover future destructive behavior of that</td>
</tr>
<tr>
<td></td>
<td>vendor and other vendors.</td>
</tr>
<tr>
<td></td>
<td>• Vendor misbehavior causes trust damage which leads the customer to put extra effort into continuously</td>
</tr>
<tr>
<td></td>
<td>evaluating the vendor services.</td>
</tr>
<tr>
<td>Frequent Updates</td>
<td>• Frequent updates sometimes lead to bugs that demands time consuming work around solutions.</td>
</tr>
<tr>
<td></td>
<td>• Frequent updates can cause system failure that hinders or stops work. Vendor-managed, frequent updates,</td>
</tr>
<tr>
<td></td>
<td>when there are no bugs or</td>
</tr>
<tr>
<td></td>
<td>• downtimes, save time in the organization.</td>
</tr>
</tbody>
</table>
Table 3.4. Issues in SaaS and the related organizational effects post adoption of SaaS solutions (Jarting and Persson, 2015).

3.4 Cloud Computing Innovation

Despite the proposed advantages above, research suggests a reluctance of cloud computing adoption in SMEs (Assante et al., 2016; Colicchio et al., 2015). The hesitation towards cloud computing can be explained by several reasons, including issues with data security, location of the stored data and a higher dependence on the cloud provider (Colicchio et al., 2015). Moreover, limitations in technology investments is one of the prominent reasons in current research, specific for SMEs in industries highly centred around their supply chain (Oliveira et al., 2014, Lin and Chen, 2012). To investigate the adoption of cloud computing in retail SMEs, two theories of innovation will be used, namely the diffusion of innovation theory (DOI) (Rogers, 2003) and the technology, organization and environment framework (TOE) (Tornatzky and Fleisher, 1990). These have been extensively used in empirical research, resulting in a better comprehension of the adoption of innovations in technology (Walker et al., 2016).
3.4.1 The Diffusion of Innovation Theory

Despite having roots in earlier research, the interest in DOI was remarkably increased after presented by communication studies professor Everett Rogers in 1962. Originating from different disciplines, including education, anthropology and industrial sociology amongst others, different versions of DOI have been developed.

Rogers (2003) defines diffusion of innovation as “the process in which an innovation is communicated through certain channels over time among the members of a social system”. From the definition, DOI is based on four elements; the (1) innovation concerned, (2) communication channels used for the spread of information about the innovation, (3) time and (4) social system. The definition of an innovation “is an idea, practice, or project that is perceived as new by an individual or other unit of adoption” (Rogers, 2003, p. 12). Despite being introduced previously, if it’s considered new by individuals, then it’s still regarded as an innovation. One of the prominent obstacles in the adoption of innovation is uncertainty. Rogers claims that uncertainty can be reduced by informing individuals about its advantages and disadvantages, in order to increase the awareness of its consequences. Used for the spread of an innovation, Rogers described communication as the process involving the creation and sharing of information to reach mutual understanding between the participants (Rogers, 2003). The communication occurs between two sources, which are defined as an institution or an individual originating a message. For instance, mass media and communication between two persons are two examples of communication channels, differentiating in the medium used for communication. According to Rogers, the time aspect in the diffusion of innovation model illustrates one of its principal strengths, but is often ignored in behavioral research. Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system.

For Rogers (2003), structure is “the patterned arrangements of the units in a system”. He further claimed that the nature of the social system affects individual’s innovativeness, which is the main criterion for categorizing adopters. The fourth element in the diffusion of an innovation is the role of the social systems. According to Rogers, a social system is defined as “a set of interrelated units engaged in joint problem solving to accomplish a common goal” (Rogers, 2003). The structure of a social systems has a great impact on the diffusion of innovations and the innovativeness of individuals. By recognizing the nature of it, adopters of the diffusion can be categorized.

The process of innovation-decision can be described by the seeking and processing of information, where a motivation exists to reduce the uncertainty about an innovation’s
advantages and disadvantages (Rogers, 2003). The innovation-decision process is based on five steps; knowledge, persuasion, decision, implementation and confirmation (Figure 3.5).

![Figure 3.5. The five steps of the innovation-decision process (Rogers, 2003).]

Rogers explained the adoption of innovation in an organization based on five attributes. (1) relative advantage, (2) compatibility, (3) complexity, (4) observability and (5) trialability (Oliveira et al., 2014). Firstly, relative advantage refers to which extent an innovation has improved in relation to the previous generation. Secondly, compatibility is the degree to which an innovation is assimilated into existing operations, including business processes, value systems and practices. Thirdly, complexity represents the difficulty of the utilization of the innovation. Fourthly, observability stands for the visibility of the innovation to others. Fifthly, and lastly, trialability represents the level of difficulty of experiments of the innovation. Collectively, these attributes determine to the degree of propensity in organizations towards adopting a new technology (Sabi et al., 2016). Moreover, adoption of an innovation highly depends on the human factors, and is based on the perception of innovation by the users and the characteristics of the technology. There are four major theories that deal with DOI (Rogers, 2003), namely (1) innovation decision process, (2) the individual innovativeness, (3) the rate of adoption and (4) the perceived attributes.

According to Rogers (2003), there are five different type of adaptors (Table 3.5).
<table>
<thead>
<tr>
<th>Categories</th>
<th>Innovators</th>
<th>Early Adopters</th>
<th>Early Majority</th>
<th>Late Majority</th>
<th>Laggards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Adopters</td>
<td>2.5%</td>
<td>13.5%</td>
<td>34%</td>
<td>34%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Table 3.5. Categories of Adopters in DOI (Rogers, 2003).

DOI mainly focuses on the challenges of innovation, rather than behavioral patterns related to the adoption of innovation. Therefore, it’s necessary to triangulate it with another theory (Sabi et al., 2016).

3.4.2 The Technology-Organization-Environment Framework

Introduced by Tornatzky and Fleisher 1990, the Technology-Organization-Environment (TOE) framework identifies three different aspects of an enterprise’ context that influence adoption and implementation of new technological innovations (Figure 3.6).

![Figure 3.6. The TOE framework (Tweneboah-Koduah et al.,2014).](image)

Each one of the enterprise contexts encompass advantages and disadvantages for the adoption of a technological innovation. Firstly, the technological context reflects how internal and external practices and structure in technology influence the processes of innovation adoption in an organization. Adopting technological innovations are
therefore dependent on how the existing technology landscape fits with the innovation. According to Borgman et al. (2013) common constructs are complexity, compatibility and relative advantage, where the latter defines “the degree to which an innovation is perceived as being better than the idea it supersedes” (Rogers, 2003). If an organization perceives a higher relative advantage of the innovation, the probability of adopting it increases (Bergman et al. 2013). In the results of adoption of cloud computing technologies, Bergman et al. (2013) confirm that a higher relative advantage was perceived amongst adopters than non-adopters.

Secondly, the organizational context encapsulates organizational characteristics, such as communication structures, firm size, amount of slack resources, managerial systems, human resources, that might affect the adoption of the innovation.

Thirdly, the environmental context focuses on the surroundings of an enterprise that impact the demand for innovation, the ability of pursuing innovation and capability of innovation deployment. These include entities in the supply chain, such as suppliers and customers, and other stakeholders such as competitors and the government (Tornatzky and Fleischer, 1990). For instance, an organization is more prone to adoption of an innovative technology with and increased competition in business (Doolin and Troshani 2007).

In addition, the TOE framework classifies attributes within each context rather than offering attributes that affect the adoption of a technological innovation (Borgman et al., 2013). Being consistent with DOI, a vast amount of empirical studies has received credit from adopting the TOE framework in their analyses of organizational adoption of IT. According to Low et al., 2011, the utility of the TOE framework in e-business studies is broad, in particular in studies at an organizational level. There exist several other motivations for why the TOE framework is feasible for investigating cloud computing adoption. In contrast to other conventional innovations, cloud computing technology consists of several entities for the reason that the services mainly are offered by a third party, hence the cloud provider. The other entities can be defined as the cloud computing services and the clients. According to Saedi and Iahad (2013), the technological context includes the characteristics of cloud computing, the organizational context refers to companies and organizations and the environmental context focuses on the third party.
Chapter 4

Findings

This chapter presents the findings of interviews with company representatives of small and medium-sized enterprises in the Swedish fashion industry vertical. The findings include the presence of inefficiencies in product information management, logistics and the current adoption level of cloud computing amongst SMEs.

4.1 Company presentations

The company presentations are based on information provided by the interviewee from each company, as well as information from respective annual reports established from 2015.

4.1.1 Company A

Established in 2007, Company A is a Swedish fashion company which designs, manufactures and markets watches and accessories. They design all of their products in Sweden, but sell them globally. The distribution of products either performed directly or through agents and distributors, in approximately 25 countries all over the globe. Their main market is represented by Japan, followed by Sweden and Norway. Two thirds of the collection consist of main assortment, while the other third is replaced after a season. Company A sells its products through their online store, physical stores, wholesale and retailers. In 2015, the company had a revenue of 64,3 MSEK where a majority (69%) was represented by wholesale. In 2015, the company had a representation of of 44% women and 56% men, in a total of 18 employees. According to the interview, their main customer pool is represented by both men and women, in the age of 20 to 55.

4.1.2 Company B

Company B is a Swedish outdoor company that has developed and sold outdoor and sport clothing since 1993. 99% of their production is located in Europe, primarily in the Baltic States and Poland. The distribution of products goes through Sweden, but also
through other distributors and agents, and the company also sell their products through their physical stores in Sweden. Approximately 20% of the products are sold through their physical and online store, and the rest is represented by retailers. Company B has 37 employees and had a revenue of 94,6 MSEK in 2015.

4.1.3 Company C
Company C was established in 2007 and is a Swedish designer and producer of retro inspired shoes. Their main target group is females of any age. Their products are sold in over 25 markets and 300 stores, where the US represents approximately 50% of the market, followed by European countries. In 2015 the company worked towards a more optimized supply chain. For instance, they outsourced their logistical operations to a third party, in order to become more financially efficient. The company has ten employees, including seven women and three men. In 2015 the company had a revenue of 45,9 MSEK.

4.1.4 Company D
Company D is a Swedish company that was established in 2002, with 71 employees. The company designs, market and sells fashion products to women, and home interior to everyone. Their products are sold through their own physical stores, online store, and through shop-in-shops owned by their retailers. In 2015, the company had 13 own physical stores and an online store that reaches customers in the US, Canada and Europe. Moreover, the products of Company D are sold in over 33 countries. A majority of their products are sold in Sweden (72%), followed by Germany (7%) and other countries in northern and middle Europe. The company had a revenue of 338,7 MSEK in 2015, an increase in 17% from the previous year. Company D claims that this increase was a result of the opening of several own physical stores.

4.2 Interviews

4.2.1 Challenges in Product Lifecycle Management
In the following section, the challenges relating to the management of a product lifecycle will are represented based on interviews with four Swedish SMEs in the fashion sector of retailing. Since the thesis is written from a perspective of an SME company, internal challenges are those occurring within the company whilst external challenges mainly refer to those between a company and another entity in the supply chain.

4. 2.1.1 Internal System Integration
According to the interviewee of Company A, a majority of their supply chain operations, such as purchases from suppliers, are managed in the platform. Company A
utilizes another program to manage their finance, but the interviewee states that this information is also connected to the platform provided by Young/Skilled. The interviewee states that they are currently working on solutions that will enable a direct information flow to their suppliers and improved storage management, purchasing, product information flow and billing. The information that is not managed in the platform is stored in Excel-files.

Company D also uses a business system in addition to the platform provided by Young/Skilled, which serves as the ordering system. To pass product information into their systems, Company D first types product information to their business system. From the business system, product information is then passed onto the platform. As a result of insufficient integration between the system, a vast amount of product information is not transferred from the business system to the ordering system. According to the interviewee, this causes a major challenge in terms of manual efforts and time lags. Involving efforts from several departments within the company, product information updates have to be administered in order to place all information completely and correctly in the ordering system. Another challenge for the company is modification of information that depend on the outgoing channel. Each channel, the website for instance, requires product information to different extent. Company D therefore has to modify the product information for each channel, in order for the outcome to be displayed correctly. In analogy with Company D, the main challenges in their product information management is related to Company B the internal flow of information. The interviewee of Company B states that the have to share information manually between their internal platforms as well, including information from their own business system to their website and locations. To manage the flow of information between different systems, a vast amount of these operations are managed manually and the interviewee states that the company would therefore benefit from having a product information management (PIM) system. Moreover, since the company does not have any extensive knowledge on IT internally, the company has therefore outsourced a majority of their IT operations to a partner. Hence, the main reason for the outsourcing is limited knowledge and resources for IT operations.

Moreover, the interviewee from Company D mentions that different departments in the company utilize different systems to communicate product information to different entities. For instance, their production department utilize their business system to communication product information to their manufacturers while the sales department uses both the business system and the ordering system to manage product information, and communicate it to their retailers. As a result, the company has chosen to internally keep most of their product information in their business system, since the mutual
utilization of this is of a larger extent than of the ordering system. Depending on the product information attributes, different departments in Company D utilize different systems in order to communicate the product information to relevant entities in the supply chain.

### 4.1.1.2. External System Integration

In their exchange of information with suppliers, Company A mention that the latter do not utilize the platform for product information management. Instead the suppliers often demand Excel-formatted product information. To approach this challenge, the company manage product information by compressing it into different codes. The problem that occurs is that much of the product information is coded into certain numbers that implicate certain products attributes which results in a high probability of information errors. For instance, the size and color of a product is coded into numbers instead of using description. Company A mentions that despite the fact that most of the product information is stored on one internal server at the platform, there are some resources that they share directly to other entities. For instance, their product designs are sent directly from the company to their supplier by email. When they intend to send marketing material to retailers, this information is sent directly to them from the company as well. The same challenge is evident for Company C, since the product information is rarely shared with their stores. In this case, Company C has to share information to their stores through agents which act as representatives for several stores and retailers. In summary, depending on the recipient of product related information, Company C has to utilize different means of communication. The interviewee from Company A argues that more information on a product level would be beneficial in several ways. For instance, a more detailed product information would increase their efficiency when ordering products and product components.

In accordance with the challenges of product information flow of Company A, Company B face similar challenges in manual transfer of information to other entities in the supply chain. They mention that the product information is currently only available for the company itself and their manufacturers, and they they see an increasing demand of sharing it to more entities.

Furthermore, since the information containing the cost of the goods sold cannot be matched automatically with the platform, Company C has to manage it manually. According to Company C, limited parts of their product information is shared between the company and their manufacturers. In relation to this, the main concern expressed from Company C is that they prefer having direct product information sharing between the company and their manufacturers, due to several reasons. Firstly, from the
information accommodated by the platform only a limited number is used by the manufacturer. Secondly, from Company C’s perspective, the manufacturers do not have the knowledge or any inclination towards using the platform due to challenges with understanding the interface. Company C therefore expressed concerns about sharing all information between the entities, since they presume that the troubleshooting between them and the manufacturers would increase and therefore result in more time spent on problem solving. A solution proposed by Company C is an interface that is more user friendly for the manufacturers, or a business system designed for the manufacturers that could be integrated with the platform.

In terms of production information exchange between entities, Company D also expresses concerns related to certain limitations. The interviewee of Company D states that the retailers and physical stores utilize the ordering system for restocking, but not for the purpose of taking part of the product information. When restocking, the logistical department manages the specifics of the products to be selected as stock. This information is passed to the warehouse that can select the products on given directions. Therefore, the warehouses only receive information about the stock and orders, and do not have access to any product information.

4.1.1.3 Information formats

In order to understand and calculate the demand, Company A argues that they need to have as much purchasing data as possible. According to the interviewee, forecasting and understanding purchasing data is of high significance in their production operations. They make a clear distinction between their operations with historical data and real time data, which they claim is more challenging to obtain. In order to gain more knowledge about real time purchasing data they have to make efforts by working more closely with their suppliers. According to Company A, the time delay of information about sold products and hence inability to pinpoint real time transactions is not the only challenge in the information flow. When a product is sold, and the company have received information regarding the sale, they have to manually extract it and prepare it in Excel.

Company B also mentions challenges with Excel as a product information sorting tool. The company claims that there is a great risk of spending vast amounts of time on assuring that no mistakes are made and that it is sensitive to human errors. The same challenge is evident in Company C, that chooses to manage their product information in Excel before importing it to the platform. According to the interviewees they would prefer using the platform to import product information directly but since this is mainly done during the release of a new seasonal collection, the amount of new product
information that has to be imported is too large to be typed in directly to the platform. By managing the product information to Excel before importing it to the platform, the Company states that their current management of product information therefore is more time-saving and as a result more efficient.

In contrast to the other interviewed companies, Company D does not manage product information in Excel. As mentioned in the previous section, all of the information is directly managed in their business system whereafter they import it to the platform.

4.1.1.4 Shipping administration

For Company A, it’s trivial that they can ship in a timely manner to a reasonable price, in order for the logistics to add up. To customers in the European Union, the products are first sent from manufacturers in Asia to their storage in Sweden, and then sent out to the customers. Otherwise, the products are directly sent to the customers. Depending on the location of the end customer, different transportation companies are used. For instance, in the case of a Swedish customer, Schenker transport the products, whilst UPS manages the transportation to customers in Europe. Despite efforts of administering the transportation the occurrence of unexpected happenings such as strikes or weather conditions are circumstances which are out of their control.

Moreover, Company B does not state any specific challenges with their shipping administration. All the products are sent to their storage in Sweden, whereafter they are transported to their customers.

To administer their shipping to other retailers, Company C communicates with their manufacturer directly through mail or over telephone. In the case of larger shipping volumes, communication over telephone is usually more common. A challenge with administering the shipping by themselves is that shipping companies tend to have their portal for scheduling transportation details, requiring Company C to master all different shipping company portals. Despite perceiving their current shipping administration convenient for the time being, they express a preference of having the warehouses managing the shipping administration more independently in the future.

4.1.2 Accuracy

To gain more insight in their sales reports, Company A mentions that the ability to extract information on a more detailed level would be beneficial. Company C sees the same challenges posed by current limitations in the platform. They experience challenges both in terms of limited customer information and in their management of the cost of products sold. One of the constraints in their usage of the purchasing module
that limits their customer insights is the fact that they receive receipts of sold products from the warehouses on a monthly basis, instead of in real time. Another result from the limitations in the purchasing module in terms of increased lead times is that they need to make extra efforts, such as investing time in creating subprojects and keeping better communication with the warehouse, in order to obtain more real time updates. The most common scenario for Company C is that information about products sold is usually delivered after a month, usually when their warehouses send a receipt for the sold products.

Company C explains the effects of manually handling products information more in detail, presented below.

1. Product duplicates in the platform.
2. Products sharing the same warehouse, unintentionally.
3. Impossible to automatically control that different barcodes have distinct barcodes (EAN), which must be managed manually.
4. A vast amount of time is spent on importing product information of large collections into the platform, which requires great precision since one faulty row can lead to a change in the entire assortment.
5. When importing product information of several products at once, Excel is used as the primary format due to its simplicity in contrast to separately typing in information about each product directly in the system.

In an attempt to regulate the information provided from their own stores, Company C receive weekly newsletters containing summarized information of the products sold and limited customer information.

As a majority of the products of Company B are sold every new season, the company does not mention having any challenges regarding real time date. Most of their production is based on historical data, and therefore the utilization of real time data is not as necessary as for a company with greater changes of products between seasons.

According to the interviewee of Company D, their main source for insights in customer information and sales data is provided through daily contact with their own selling employees in their stores. On the other hand, if they want to gain insights in selling information from other retailers or agents, they have to make extra efforts in reaching out to these entities.
4.1.3 Incumbent Adaption

A challenge that relates to the size of operations of SMEs is the adaption to industry incumbents. The representatives of Company C state that “if you want to play in the big game, you have to adapt to the rules of the incumbents”. This statement implies an underlying constant presence of subordination, due to an industrial lock-in effect created by incumbents. For instance, Company C sell their products through Amazon to reach a wider audience. To do that, their product information has to be imported to Amazon’s own product management system. In other words, product information that is available in their current platform cannot be transferred directly to Amazon’s platform. On top of that, Company C states that they operate not only with Amazon’s platform, but with several other systems. Therefore, adapting to other product information management systems have several effects on SMEs. According to Company C, the main challenge is being able to handle a variety of systems internally, and in some cases know how to adapt. For instance, one of their retailers in the UK was not compatible with their operating system and Company C had to make a purchase of a computer which was compatible.

4.2. Cloud Computing Adoption

According to the interviewee of Company A, the company shares an increased amount of information with their subsidiary in Asia. For this reason, the idea of managing increasing amounts of product information more efficiently have been a topic of interest for the company. On the other hand, Company A has not looked at any specific solutions yet, which involved cloud computing. They explain that they are not unaccustomed with technology, but for them to adopt cloud computing, they want to and need to gain more information on the advantages of cloud computing solutions.

According to Company B, the recurring format challenge has encouraged them to look for alternative solutions using a product information management system. Despite that, Company B claims that they have no previous experience of working with cloud computing solutions as well as no current knowledge. A majority of their IT-operations are currently outsourced to a third party, which they perceive as efficient for several reasons. Firstly, they are a small company and the knowledge of IT is limited. Secondly, they do not perceive any disadvantages with their current IT-solution. Hence, the interviewee states that their current solution is advantageous from a resource perspective, as well as from a knowledge perspective.

Despite the challenges that Company C faces in terms of internal and external product information flow, they do not express any necessity for cloud computing solutions. On
the other hand, Company C has no knowledge of current cloud computing solutions, nor experience of the technology.

To solve the inefficiencies in their product lifecycle management, Company D mention that they have consider adopting a PIM system and that they have put efforts in finding a suitable one. On the other hand, the interviewee mentions that the company has limited knowledge and experience of cloud computing solutions to their challenges.

In summary, the interviewed companies have none or very little knowledge and experience of cloud computing solution. In the case of having some knowledge on cloud computing solutions, such as for Company A, the express a curiosity towards possible solutions but are in need of more insight in benefits of adoption. Lastly, cloud computing solutions have not been regarded as an option for the challenges in their product lifecycle management.
Chapter 5

Analysis and Discussion

This chapter will present an analysis and discussion of the empirics and literature review related to each sub question, RQ1 and RQ2, in order to answer the main question: is cloud computing in its current state an appropriate solution for more efficient product information management in SMEs in the fashion industry.

5.1 A&D of RQ1: What are the challenges in PLM for SMEs in the fashion industry?

5.1.1 Internal Integration Deficiencies

From the perspective of internal integration challenges, a majority of the interviewed companies experience challenges related to the sharing of information between their systems. For Company A, Company B and Company C, the main challenges related to internal operations are often related to the information format. A vast majority of the interviewees mention using Excel as a product information sorting tool. One of the reasons for this is simply due to the impression that Excel is a better facilitator of product information than the ordering system provided by the platform. Nevertheless, the interviewed SMEs express a concern regarding the management of product information in Excel of several reasons. According to Company B and Company A, one of the fundamental issues with Excel is the high risk of information redundancy. Recognizing this issue at an earlier stage, their Young/Skilled have adopted an integration process which involves the insertion of information in the system by providing support of Excel formats. The companies interviewed have provided a self-made solution which involves coding product information in a numbering system to increase the integration between themselves and the receiver of the product information. Several of the interviewed companies mention a high risk of human errors when managing product information in this way. On the note of human errors, a common way of managing inefficiencies that occur in the product information management is through manual efforts. Company B mentions that in order to share
product information between internal channels, such as from the platform to their website, the company has to perform this manually.

Company D mentions experiencing challenges related to a high level of incompatibility between their management system and their ordering system. The information provided to the management system is analogous with the information passed to their ordering system, but due to limitations in the information transfer between the systems a large amount of information has to be manually managed in order to be complete. To solve this internally, several of the employees have to spend a vast amount of time and effort in order to complete the information in the platform. On the other hand, Company D is larger than the other companies in this study, which indicates that the existence of several internal PLM systems is highly plausible. Since Company A, Company B and Company C are relatively small in relation to Company D, they did not mention using any PLM system other than the platform services provided by Young/Skilled. On the other hand, both Company A and Company D mention that they would benefit from adopting a PLM system.

Moreover, in the findings from the interview with Company D, the results implicate that different departments in the company utilize different systems to handle their product information. The logistical department mainly uses a business system to store product information, whilst the sales department has to combine it with their ordering system. In general, Company D uses the business system primarily to store product information. As an indication of the existence of functional silos, this implies that the implementation of SCM of Company D cannot be successful until the company overcomes this logistical phenomenon, according to Lambert et al. (1998). Since the source of this statement is nearly two decades old, the validity of this conclusion might and should be questioned. On the other hand, even if perfection of SCM implementation is not reached in the supply chain of Company D according to Lambert et al. (1998), the findings reveal that there is reason for consideration of the efficiency in the internal management of product information in the company. In addition, Han et al. (2017), suggests that PLM solutions can serve as a first step in the internal integration of a supply chain and hence reduce the effect of functional silos. Company A also mentioned using other programs to manage parts of the product lifecycle, such as financial operation, but they do not mention any significant challenges in the cross-management of product information within the company.

Due to the difference in company size, the other interviewed companies are perceived too small to have these issues. Many of the employees have overlapping responsibilities, which lead to a natural cross-collaboration between different
departments. Hence, the risk for functional silos is relatively low for Company A, Company B and Company C and the logistical theory might therefore not be an appropriate tool for measuring internal incompatibilities.

In conclusion, the inefficiencies within a company are highly related to the integration of systems and formats used according the interviewees. The findings show that the risk of functional silos is highly likely to occur in Company D, but as the other companies are restricted by size, this logistical effect is less likely to occur. I

5.1.2 External Incompatibilities

The extensive use of Excel as a product information formatting tools is not merely restricted to the internal operations in a company. The findings show that incompatibilities highly occur between the entities, resulting in inefficiencies for both companies and other entities in the supply chain. Since the interview answers encapsulate inefficiencies from a company perspective, the inefficiencies that were mentioned occur between a company and another entity. The same perspective applies to the logistical challenges posed.

5.1.2.1 Company - Supplier

According to Company A, the inefficiencies product information flow between a company and a supplier primarily appear in the form of insufficient sales and limited customer insight. Despite utilizing historical information in their production, Company A is highly aware of the need for real-time information in order to improve future product development or restocking of specific products. To gain better insight, Company A is contrived to constantly communicate with their supplier and work more closely when the demand for such information emerges. Apart from the monthly updates provided through the receipt sent to the company, no sales information is automatically sent to Company A from their supplier unless they actively request it. Company D experience the same challenges in terms of time lag of information about sold products. In terms of lag times in transmitted customer information, a majority of the companies interviewed have a highly remote relation to their customers. According to literature, a remote relation to customers can increase the Bullwhip effect for companies, since ignorance of end-users has an increasing effect on the variance (Metters, 1997). Nonetheless, the findings indicate that efforts to forecast demand are present in some of the companies, such as for Company C and Company D. Company B on the other hand, does not have the same considerations based on the fact that a majority of their products sold are invariant from season to season.
Moreover, the time lag between a product is sold and the time point of the company acknowledging the purchase varies and is highly dependent on the setup of the supply chain. In the Case of Company A, the supplier has responsibility of delivering the products to the customer and managing the payments. On the other hand, the findings show that other setups, such as selling through retailers, physical stores or agents that manage the latter, result in other a different information flow. Looking at Company D, the transmittal of product and customer information from their physical stores result a shorter time lag than in the case of selling products to agents, retailers or consignment partners. As a result, updates about sold goods and customer information can be managed more or less accurately, depending on setup. Consistent with literature, the findings show large time lags in term in transmittal of receipt and hence indicate that Company A, Company C and Company D might be posed the the Bullwhip effect (Metters, 1997; Jaipuria and Mahapatra, 2014). In several cases the companies have taken actions in order to decrease the time lags. Company C states that when the sales information of a product or product group is of high interest, they create subprojects in order to facilitate the information more efficiently. Since speed to market is a crucial factor for the competitive advantage in the fashion industry, time lags can be considered a relatively alarming issue for the participating SMEs. In consistency with the literature, this shows an example of an action towards decreasing the the uncertainty in the supply chain (Geary et al., 2006), hence reducing the Bullwhip effect.

Another challenge that Company A has constantly encounter is the specific product information adaption to the suppliers that do not utilize the same e-commerce platform for management of product information. According to Company A, these suppliers often require Excel-formatted information. As mentioned in section 5.1.1 Internal Integration Inefficiencies, similar Excel-related problem occurs when managing the product information, which are highly prone to human errors.

In summary, the main product information challenges that the interviewed companies experience in relation to their suppliers are limitations in sales reports, resulting in limitations of customer and production insights, as well as future production. Another prevalent challenge is the adoption towards the requirements of suppliers on the matter of product information formatting.

5.1.2.2. Company - Retailer

The product information shared between the company and it’s retailer or stores is of another character than the one between a company and a supplier. According to the findings, the human factor seems to be more prominent for insight of products sold by retailers or stores. As mentioned in the previous section, Company A and Company D
receive updates on products sold and customer information is more regular when it comes directly from their stores than from retailers. In case of Company D, they consider that this sort of communication gives them better insight in customer information and which products that are sold more. One of the main contributing factor to this is their close collaboration with their own salespersons in the stores, that are all a part of the company as well. As a result, they can adapt their future production more precisely. According to Company D, retailers provide very limited information on the products sold. Hence, the communication between the companies and their own stores result in a shorter lead time in terms of product information transmittance. From this, an assumption can be made that the variance describing the Bullwhip effect is less likely to occur, or at least decreased, in the relation between a company and it’s store than in the relation to its retailers.

Moreover, Company C states that despite gaining historical insight based on the monthly updates from their suppliers, they can gain information from their stores faster due to weekly newsletters passed from the stores. In these, product- and customer related information is stated by the salesperson in their stores, similar to the communication channels of Company D. Another setup presented by Company C and Company D, is using agents that manage a group of stores. Through their agents, that act as a man in the middle between the company and their stores/retailers, they gain insight in insight about products sold and customers. On the other hand, the agents are employed by the company and not a part of it. This implies that the communication between companies and their agents give less insight about products sold and customers, than from communication with their salespersons. Hence, the bullwhip effect is more likely to occur as a result from the communication between the companies and their agents than in direct communication with their stores.

Moreover, amongst the companies interviewed there seem to exist various communication standards between different product information dependent entities in the supply chain. For instance, marketing material is sent directly from Company A to their retailers by e-mail. Therefore, the occurrence of information consistency is relatively high in this case, which is a common challenge in organizations. In conclusion, the reason for information inconsistency is highly related to a lack of global standards in terms of communication means, which is consistent with literature (Brunner et al. 2007). On the other hand, since the companies are SMEs, their size might allow them to use communication means more flexibly.

A recurring challenge for the exchange of product information between a company and their retailer, similar to the company to supplier exchange, is the compatibility between
different product information systems. This challenge is specifically challenging in the context of SMEs that intend to sell their products through large retailing companies, where adoption to their systems is inevitable. These challenges do not only occur in terms of obtaining sufficient knowledge for each system, but also other adoption within the company. Company C mention for instance that they had to purchase devices with matching operating system, since the retailer's product management systems were not compatible with their own from the beginning.

To summarize, the product information insights seem to be more challenging for companies in their relation with retailers and agents, than in the communication with selling employees from their own stores. This implies that the more distanced a company is from their physical point of sale, the larger is the gap in the information flow.

5.1.2.3 Company - Manufacturer

A prominent challenge mentioned by both Company B and C is the product information exchange between the company and their manufacturers. The challenge evolves from the fact that only a limited amount of information is shared between these, and at different time periods. Consistent with literature (Metters, 1997; Jaipuria and Mahapatra, 2014), both of these challenges highly relate to the two general causes of the Bullwhip effect; lack of inter-company communication in combination with time lags between the receipt issuing and transmittal of information. On the other hand, the definitions of the Bullwhip effect imply that it is a theory that describes the variance in the upstream flow. Now, since the theory was founded in 1961 or even earlier, there is a great possibility that supply chains have changed since then. Two implications can be drawn from this fact. Firstly, according to current supply chains in retail, especially in the omni-channel environment in the fashion industry, the supply chains can rather be considered as a net than as a chain. Secondly, and as a result from the previous implication, the existence of the bullwhip effect can be debated. Does it exist if the upstreams and downstreams are intertwined? Since there are two general scenarios from which the company can obtain its products, there are as many implications on the role of the Bullwhip effect. In the case of in-house design and manufacturing facilitation, the companies in this study have contact with their manufacturer before the products are produced. For instance, designs and other agreements have to be exchanged before the product is manufactured. This is for instance, the case of Company C. Looking at the other option, represented by Company D in this study for instance, a part of their products are produced without provision of design or other agreements. Nonetheless, the products always go through an approval process before it is sold and transported to retailers. Therefore, communication with manufacturers exist
in the initial stage of the product lifecycle, and hence the product information flow between a company and their manufacturers can be regarded as upstream, as the following section exemplifies.

According to Company C, there are three underlying problems related to this phenomenon. Firstly, production information with the manufacturer is naturally exchanged before product information of a finished product can be entered in the platform. Therefore, product information has already been shared back and forth with the manufacturer to a point where the company sees the communication as efficient and natural. Secondly, the company expresses concern about the manufacturer’s comprehension of the platform used. Their impression is that the manufacturer would have difficulties managing the system that the product information is stored in the platform, mainly depending on the user interface. The company anticipates that it would cause more questions from the manufacturing side, resulting in an increased amount of time spent on managing issues at the manufacturing site from the company. Thirdly, the company would rather not share all product information with the manufacturer that is currently stored in the platform. Despite several product information regulations on which information is shared, depending on user, they express that further restrictions would have to be made possible in order for them to allow manufacturers into the platform. In contrast, Company A share their product information with their manufacturers through their platform. From the challenges mentioned by Company C, Company A is less exposed to the bullwhip effect in comparison with Company C. Nevertheless, despite perceiving an increasing demand, the exchange of product information through the platform is restricted to the company and the manufacturer, and does not include other entities in the supply chain.

In addition, the setup of the supply chain has a fundamental effect on the challenges posed. In terms of management of shipping, Company C relies on their manufacturers to a vast extent. The company administer the shipping by themselves, although different conditions in relation to the transport affects how often and which mean of communication that is used. The most common scenario for administering shipping is through email or telephone contact with their manufacturers. When the volume of products to be shipped is large, the telephone contact increases accordingly. Moreover, Company C states that the reason for in-house management of the shipping is that different transportation companies have different systems. This results in a higher involvement from the company in the transportation, requiring knowledge of each different transportation company system. Again, due to the limited size of the enterprises, there seem to exist a high flexibility in terms communication means. As for
Company A that has a close and long-time relation with their manufacturers, this does seem to be a prevalent challenge.

5.1.3.4 Company - Warehouse

An additional cause for inefficient product information is the product information exchange between a company and a warehouse. Storing all products in warehouses, sometimes at different locations for different products, poses challenges in terms of shipping and control of the location of the products. In accordance with the shipping administration of Company C, they express an inclination towards moving parts of the shipping administration to the warehouses. This would lead to a more independent approach for the company, saving them resources and efforts in the future. According to literature (Metters, 1997), well-established business methods are required for elimination of the bullwhip effect. For Company C, the current solution does not imply any extra efforts in term of shipping administration. Therefore, despite considering the foundations for a well-established business method, the company does not express any concerns with their current methods. Again, since the company is of a relatively small size in comparison with industrial incumbents, communication and administration of shipping might not be of high significance in terms of challenges.

Several companies express an interest in increase product information accuracy, as well as receiving information in less time. Company A states that improvements in those areas would result in more precise orders of products and their components, as well as better insight in their sales reports. According to Company B, current limitations in the purchasing module causes time delays and granularity issues in terms of product information. As a result, the company have to make extra efforts to obtain this information from the warehouses directly. Since the setup for Company B is obtaining reports of the products sold within from the warehouses a month post the product has been sold, the company is forced to actively request more specific information when necessary. The efforts made by the company aligns with the approach towards eliminating the Bullwhip effect by increasing the transparency of product information and sharing information between the entities in the supply chain (Geary et al. 2006). Therefore, findings implicate that a majority of the companies interviewed take actions towards decreasing the uncertainty, whether they are obliged to or not, which results in a reduction of the Bullwhip effect. On the other hand, it is not possible to determine the amplitude of the Bullwhip effect. Neither does this report include a study on effects before and after possible actions towards reducing the Bullwhip effect, and can therefore not give a detailed discussion on the implications of different actions of the Bullwhip effect.
In summary, the Bullwhip effect is caused mainly by high lead times between a company and other entities, as well as of poor sharing of information between these. According to the answers from the interviews, a majority of the interviewed SME representatives indicate a manual approach towards many of the challenges related to product information management. The empirics show that in several cases, results of these self managed solutions highly contribute to the inefficiency of product information management in their supply chain as well.

5.2 A&D of RQ2: RQ2: What causes the reluctance of cloud computing solutions amongst Swedish SMEs in the fashion industry?

Current research indicates that a vast amount of focus is directed towards the advantages that cloud computing in SMEs, but still, they describe a reluctance in SMEs towards the adoption (Assante et al., 2016; Colicchio et al., 2015). Based on the fact that cloud computing is relatively new amongst SMEs, it has been regarded as an innovation in this study in consistency with research (Borgman et al., 2013). Supported from the definition of an innovation (Rogers, 2003) describing it as the perception of an idea or technology from an individual's perspective, this study has regarded the individual perspective synonymous with the perspective of SMEs. In order to determine the adoption of cloud computing in SMEs, a combination of the DOI theory and the TOE framework have been utilized.

According to the DOE theory, adoption of an innovation is highly related to the perception of its uncertainty (Rogers, 2003). To reduce uncertainty, it is necessary to increase the awareness of the consequences by informing about the advantages and disadvantages of the adoption of the innovation. The findings show that a majority of SMEs have a non-existing or very limited previous experience and knowledge about cloud computing. In fact, their technological overall knowledge is currently low, which is confirmed by all of the interviewed companies. Since the knowledge of cloud computing is low or non-existing amongst the interviewed companies, the question of uncertainty can be addressed in two ways. The uncertainty of cloud computing can either be explained by the lack of knowledge of cloud computing or by the fact that since the companies have not engaged in the search of appropriate cloud computing solutions, the level of uncertainty is not a matter of discussion. From the findings, Company A was the only company that expressed having knowledge, although limited, about cloud computing. The interviewee stated that although the solutions were rather unfamiliar to the company, they would like to know more about cloud computing.
possibilities. This can be seen as an indication of that knowledge, even to a limited extent, can trigger the adoption towards cloud computing. The interviewee self does not have a technical position at the company, but still perceives cloud computing as interesting for future solutions. On the other hand, this conclusion is solely based one in-depth interview, which is a vast restriction in order to make a conclusion.

According to the customer manager at Young/Skilled, the interviewees chosen were the most appropriate employees at the companies for investigation of product information challenges and cloud computing. As they all confirmed, their own technical competence in regard to cloud computing was limited, and so was the competence amongst their employees. Since the interviewed companies are SMEs, a conclusion on the technological limitations of other employees made by the interviewees therefore has a relatively high validity. Moreover, despite coinciding with current research on cloud computing amongst SMEs, the limitation of the number of companies interviewed in this study should be taken into account on this matter. The interviewed companies all operate in the retailing vertical within the fashion industry. For this reason, the results implicating limited technological experience and knowledge might not be applicable to SMEs in other industries or retail verticals. Nevertheless, apart from the technological element in the adoption of innovation, the DOI theory is based on three additional elements, including communication channels, time and social system. Hence, these should be considered to complete the understanding of the diffusion of cloud computing in SMEs.

Amongst the prohibiting elements of cloud computing amongst SMEs mentioned in research, a vast majority can be categorized according to the Technology-Organization-Environment (TOE) framework. The constructs of the technology give and indication of cloud computing from a complexity, compatibility and relative advantage perspective. In terms of relative advantage, the advantages of cloud computing have to be contrasted to the current solutions of the systems encapsulated by the PLM concept. According to literature, many of the current PLM systems are developed for industry incumbents (Soto-Acosta et al., 2015). This results in challenges for SMEs, often related to the high investments that are related to acquirement of PLM systems. Other challenges mentioned in literature, are that SMEs in many cases do not possess the technical knowledge to fully take advantage of PLM solutions. Analyzing the findings, these implications can be confirmed by the interviewed companies. In contrast, one of the outstanding advantages of cloud computing for SMEs in specific, is that a firm can establish new services without being responsible for or owning the computing resources (Borgman et al., 2013). As implicated by previous research, this implicates two main advantages of adopting cloud computing in terms of new innovations (Rocha
et al., 2016; Sen et al., 2016); and reduction financial constraints (Ross and Blumenstein, 2015; Salleh et al., 2012; Brender and Markov, 2013). On the other hand, the literature found does not provide extensive information on the specific management of product information challenges by the utilization of cloud computing solutions. Amongst research, investigations of SaaS ERP solutions seem to be highly favored. Since ERP systems share common attributes with other product information systems, the implementation of ERP in SaaS should imply similar effects of implementing other information management functions in the cloud. Moreover, cloud computing advantages seem to highly relate to the advantages posed by implementation of SaaS solutions.

Another challenge with current PLM system adoption is that they often require a large part of an organization’s IT infrastructure to be changed. As a result, amongst the companies adopting PLM solutions, the systems are only partly used. Looking at the cloud computing solutions, they can often offer the utilization of services on a pay-to-go basis, such as in the examples of advantages of SaaS implementations presented in literature review. According to these, SMEs can choose to which degree they want to adopt cloud computing. As a result, the SMEs can manage their investments more flexibly by increasing or decreasing the utilization of services needed. As mentioned in the current challenges of product information, several of the companies struggle in the management of other entities’ systems. According to Company C for instance, this requires additional knowledge and the constant ability to manage several systems. The advantages mentioned by SaaS for instance, imply the opposite in fact. So the reason for why SMEs in the fashion industry in Sweden have not adopted cloud computing as a solution mainly seems to be based on the limitation of knowledge, rather than the perception of disadvantages.

Moreover, organizational context in the TOE framework includes characteristics of an organization that relate to the size of the company, managerial structures and slack resources, to mention a few. From this perspective, one of the largest differences between an industry incumbent and an SME is the amount of financial resources available. This implies that the probability of investments in cloud computing are higher amongst incumbents than for SMEs. On the other hand, cloud computing again proves to be a possible solution for SMEs as well, since cloud services are often provided as a pay-as-you-go option. Once again the knowledge of cloud computing advantages seems to restrict the companies from possible solutions to their product information management challenges.
Lastly, in the definition of environmental context in an organization, one of the characteristics mentioned is competition. Hence, in the evaluation of cloud computing amongst SMEs, a lack of competition poses one of the possible explanations towards the reluctance of adoption. On the other hand, this contradicts literature claiming that global competition has increased (Soto-Acosta et al., 2015; Mentzer et al., 2001). To offer a competitive advantage, Salleh et al. (2012) states that SMEs should adopt cloud computing through “flexibility, scalability and independence in IT infrastructure and capabilities”. In the scope of the environmental context, the other entities in the supply chain affect the adoption and implementation of cloud computing. From a perspective of product lifecycle management, the findings indicate that there exist several inhibiting causes in the external integration, between a company and another entity. For instance, suppliers often require Excel-formatted information from the companies. This could be one of the reasons for the extensive use of this format amongst the interviewed companies. Therefore, one of the possible inhibitors of cloud computing solutions is posed by the requirements of the suppliers. Looking at other entities, such as retailer, system incompatibilities between the entities lead to challenges in terms of company adoption of other systems. A solution to this problem could be better integration between the systems through the platform. The findings show that similar challenges occur in the communication between a company and their manufacturers. According to Company C, their manufacturers prefer communicating using other means than the product information system. This inhibits the use of the current platform, and hence restricts the companies to the preferences of the manufacturers. These are several examples of how the environmental context of the companies inhibit the adoption of new technologies, including cloud computing. If the company constantly has to adapt to technologies from the other entities in the supply chain, cloud computing providers should consider approaching these entities instead.

The adoption of cloud computing in SMEs has in this study been regarded as a technological innovation. From the interviews with the companies, several factors describe the reluctance towards cloud computing based on the DOI theory and TOE framework. According to literature on adoption of cloud computing amongst SMEs, the obstacles coincide with the findings. For instance, the technological knowledge amongst SMEs is low, and hence poses a barrier towards the adoption of cloud computing.
Chapter 6

Conclusions

First, this chapter presents conclusions on research question 1 and 2, whereafter implications and suggestions for future research are presented.

6.1 Research Question 1

To fulfill the purpose of this research, the study aimed to answer first research question which encapsulates current challenges in the product lifecycle management amongst SMEs in the fashion industry. For a Swedish SME in the fashion sector of retail, product lifecycle management is often challenged by factors related to the product information. The causes of product information related inefficiencies occurs both within a company, and between entities in the supply chain. In the external causes, this study has focused on the inefficiencies that occur between a company and an entity. The focus is therefore limited to the inefficiencies related to an SME and their supplier, manufacturer, warehouse and retailer. The challenges that occur highly relate to the formatting of product information, time delays in the sharing of product information between entities and system incompatibilities.

Moreover, the since product lifecycle management challenges related to the management of information, logistical errors are likely to occur both within a company and in the linkage to other entities. Due to the omni-channel environment that is a main characteristic of the modern fashion industry, supply chains tend to have a net-based structure rather than “chains”. Therefore, the fashion industry becomes increasingly complex to analyze in terms of the logistical phenomenon such as the Bullwhip effect.

6.2 Research Question 2

The second part of the purpose of this study was to investigate the reluctance of cloud computing solutions amongst Swedish SMEs in the fashion industry.
According to recent research, implementations of cloud computing solutions pose several advantages for SMEs, where literature often refers to SaaS as the service model that is the most applicable to SMEs in general. The reasons for this are in many cases related to the financial restrictions that SMEs have, in contrast to industry incumbents. Despite the proposed advantages of cloud computing, research suggests a reluctance of cloud computing adoption in SMEs. The reasons include the level of maturity that the technology has reached, lack of conformity to standards and a high level of cost and risks. Several of these assumptions can be confirmed in the fashion industry by the empirical findings. This study shows that the main reason for the reluctance amongst the companies interviewed seem to be the level of awareness and knowledge of cloud computing in general amongst Swedish SMEs in the fashion industry. Hence, a crucial factor for the adoption is increased knowledge on the advantages of cloud computing solutions, which is consistent with the DOE theory. Knowledge and information about cloud computing advantages is therefore a first step towards the adoption of cloud computing in SMEs in the fashion industry.

6.1 Future Research

For future research, it is important to include a large base of companies from the fashion industry. Since this thesis gives a perspective from Swedish companies, a global perspective should include a broader geographical area of investigation. Since the current supply chains in the fashion industry are complex and intertwined, logistical challenges should be considered in relation to this fact. A suggestion on further research is to investigate which product lifecycle problems between other entities in the supply chain that can be reduced using cloud computing techniques.

Since the findings imply a low or non-existing knowledge of technology in SMEs in the fashion industry, future research can include how to improve the knowledge of cloud computing amongst SMEs.
Reference List


Appendix A

Below is a presentation of the questions asked in the semi-structured interviews with the case companies. The questions were asked in Swedish, since all interviewees could speak Swedish. However, the questions below are translated to English. Moreover, the questions were divided into three general topics; supply chain management, logistics, product lifecycle management and cloud computing solutions.

In the introduction of the interviews, the interviewee was informed about the subject, the background of the study, the purpose of it and that the interviews would be anonymized.

1. **Supply Chain Management**
   1.1. What is the structure of your supply chain?
   1.2. How do you manage your supply chain?
   1.3. Have you experience any challenges in your supply chain management?
      1.3.1. If any, how do you currently manage these?

2. **Logistics**
   2.1. How do you manage your logistical operations?
   2.2. Have you experienced any challenges in the management of your logistical operations?
      2.2.1. If any, how do you currently manage these?

3. **Product Lifecycle Management**
   3.1. How do you handle your product information?
   3.2. To which extent is the product information shared to other entities in your supply chain?
   3.3. How do you utilize product information in your product development?
   3.4. Have you experienced any challenges in the management of product information?

4. **Cloud Computing Solutions**
   4.1. Do you have experience of cloud computing solutions?
   4.2. Do you consider adopting cloud computing solutions?