The Global Data Synchronization Network in the Consumer Goods Industry

Adoption Framework & Critical Success Factors

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Adoption Framework and Critical Success Factors

by

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Preface

This Master's thesis is the final assignment to obtain the Master degree in Management of Technology at the faculty Technology, Policy and Management at Delft University of Technology. The research was conducted during my internship at Henkel. The job title was project implementation intern, a position where I had to manage large data sets and project information. Coordination with involved department and stakeholders was essential. This cross-functional role allowed me to observe and learn about the inefficiencies that consumer goods manufacturers have in their internal operations. There, I realized the huge amount of resources that are invested in fixing product data exchanged between suppliers and retailers. By that time, I already knew there was a software solution (the Global Data Synchronization Network) that can improve the efficiency of product information exchanged between suppliers and retailers. However, this software´s adoption still remains an issue nowadays. This fact made me wonder why supply chain networks encounter barriers to adopt it and motivated me to perform a research on this direction. This research focuses on the first steps that need to be investigated by the involved stakeholders before considering the implementation of a software system, namely the preconditions that need to be in place in order to implement the Global Data Synchronization Network in a supply chain network.

I want to thank my first supervisor Prof. Marcel Ludema for all his support and unfettered enthusiasm. From the first moment Marcel helped me in all the possible aspects to obtain a top-quality thesis. I would also like to thank my chair Prof. Lori Tavasszy, especially for steering the scope of the subject at the very beginning of the project. He helped me gain insight into the topic by providing me with very useful tips and tricks to carry out a good scientific study. I also want to express my gratitude to Prof. Zofia Lukszo for contributing to this research with good advices, making it more relevant from a practical point of view. I want to acknowledge all the persons that have participated in informal interviews and questionnaires from Henkel and the retailers. This thesis is the culmination of the Master Program in Management of Technology. It was two challenging years of hard work and study. Finally, all this work would not have been possible without my parents, friends and girlfriend.

Manuel García Millán
Delft, February 2018

Summary

Digitalization is revolutionizing the way organizations manage their internal operations. Many of them are still characterized by waste and inefficiencies, however, innovative digital tools are already changing the way large corporations operate in a variety of sectors. One of the fields that still have room for improvement is product data management (PDM) in the consumer goods industry. Supply chain partners spend huge amount of resources in just fixing manual errors and adapting large data formats. There is not enough standardization in the way product data is exchanged among entities. Inter-organizational information systems (IOS), and more specifically the Global Data Synchronization Network (GDSN), represent the most promising digital tool towards leaner PDM processes.

IOSs are computer-based information systems that extend beyond the borders of one organization. They provide automated information exchange to support linked business processes among two or more organizations. The GDSN is a specific IOS for product data management that extends to all the supply chain partners that are exchanging product data, mainly suppliers and retailers. This system can have a big impact in PDM process, potentially reducing errors and inefficiencies to zero.

This research aims at addressing the preconditions that are needed to successfully implement this system in a supply chain network. There is evidence that this critical phase can often be underestimated by supply chain professionals. Many FMCG organization have not been able to implement the system despite of the benefits that would bring to the network.

A case study is the research methodology used to gather primary data. Other sources such as scientific articles and consulting reports are used to gather secondary data. Henkel and its retailers in the Netherlands and Belgium is the supply chain network used in this case study.

The research is performed using an adapted IOS adoption framework. The IOS framework from Pang & Bunker is adapted with the particular characteristics of the GDSN in order to be able to analyze the case using this stand-alone framework. This methodology proves the reliability and validity of the research, as it is founded in a scientific framework.

The new research framework is used in the case study to identify the preconditions that play a fundamental role in the success of the project. Finally the critical success factors are outlined, discussed and validated.

Keywords: Global Standards, Global Data Synchronization Network, Supply Chain Visibility, Operational Efficiency, FMCG Industry, Inter-Organizational Information Systems

Abreviations

CSFs	Critical Success Factors
GDSN	Global Data Synchronization Network
SCM	Supply Chain Management
IOS	Inter-organizational Information Systems
PDM	Product Data Management
ERP	Enterprise Resources Planning
FMCG	Fast Moving Consumer Goods

Contents

1. Introduction

The introduction provides an overview of the current situation and challenges that supply chain management faces in the consumer goods industry. In addition, the need for the Global Data Synchronization Network to achieve an efficient PDM is outlined. The research context is also detailed. This section explains the process that has led to the research topic and the main research question. Finally, problem statement and research objective are formulated.

1.1. Background

Supply chain management (SCM) is increasingly becoming more important for the overall economic growth. It constitutes an integral part of many large and small businesses and it is essential for company success and customer satisfaction (CSCMP, 2017).

Today's economy faces a new paradigm. The focus relies on the global character of supply chains. Supply chain leaders have to adapt to a changing landscape as new market boundaries and channels are emerging rapidly. Contract manufacturing with multiple tiers and partners have increased the complexity of the modern sourcing chain. The distribution side has also grown more complex, as logistics networks have evolved to multi-tiered strategies (IBM, 2010). Moreover, costumers are increasingly becoming more demanding, with educated and digitally savvy consumers pressing companies toward customization, transparency and tailored delivery (Capgemini, 2017). Both the supplier and the consumer sides have to evolve to cope this new paradigm for which technological innovation seems to be a must (Oke et al., 2013).

Best practices in supply chain management may constitute one the main sources for sustainable competitive advantage (Gebremichael & Rao, 2014). The traditional focus on the competitive advantage of single firms is not sufficient any longer. Nowadays, networking becomes more important than ever before and organizations need to build strong networks with their business partners in order to satisfy customer demand and attain a competitive position in the market (Delimitros, 2016). Organizations are aware of this fact and supply chain best practices is one of the hottest topic for top managers.

Inter-organizational information sharing systems (IOS) are increasingly gaining importance in this industry. Computer-based information systems that extend beyond the borders of one organization are needed to provide automated information exchange to support linked business processes between two or more organizations. Today's markets are increasingly becoming more globalized and complex so both information sharing and data quality are essential to achieve operational efficient supply chains.

The quality of how information is exchanged between business partners is what will determine how efficient supply chains will perform (Ross, 2013). Besides that, an efficient supply chain not only allows to reduce costs for the FMCG and its retailers. It also enables to reduce product costs for the end consumer, which in turn increases the competitive advantage of all the firms of the supply chain (Juan Ding et al., 2014).

1.2. Collaboration, Supply Chain Visibility, Supply Chain Design and the Need for the Global Data Synchronization Network in PDM

Today's global markets are becoming more volatile. Like economies and financial markets, supply chains have grown more global and interconnected with more exposure to shocks and disruptions. The result is the appearance of multi-tiered global supply chains with multiple partners and channels. Consequently, supply chains are becoming more complex, costly, and vulnerable (Butner, 2010).

Collaboration and cooperation among business partners is essential to cope with this complexity and volatility that characterizes today's global supply chains (Holweg et al, 2005). In addition, supply chain visibility has been remarked as another important element by the business community (Yu et al., 2014). Supply chain visibility can be defined as *the awareness of, and control over, specific information related to product orders and physical shipments, including transport and logistics activities, and the statuses of events and milestones that occur prior to and in-transit* (Aberdeen Group, 2012).

The business community is clear about the elements that today's supply chains require to be more operational efficient. The question that emerges is: How can collaboration and supply chain visibility be achieved?

The foundation to achieve visibility and a high degree of collaboration relies on the efficiency of inter-organizational information systems (IOS). (Marinagi et al., 2014). Computer-based information systems are needed to process the data needed to operate many supply chain processes as keeping track of sales and inventory, forecasting future demand, and maintaining customer information. When such information systems extend beyond the borders of one organization, and provide automated information exchange to support linked business processes between two or more organizations, they are deemed to be inter-organizational information systems (IOS) (Robey et al., 2008).

Inter-organizational information systems allow supply chain and business processes to be better integrated and synchronized. The main problem is the quality of the information that flows among partners. Private or internal information sharing is no longer enough to have visibility and coordination due to the complex and global character of today's supply chains. Open standards are needed in order to ensure a more uniform data sharing among partners. The role of global standards lie on improving information quality along the supply chain (Robey et al., 2008).

Standards can be proprietary or open standards. According to Zhu et al. (2005, p.3) "*If a standard is developed and then available only to a closed set of firms that require a private communication platform and translation software, it is considered to be a proprietary standard. In contrast, if a standard is developed by an open community that uses public communication platforms and software, it is considered an open standard.*"

However IOSs is a general concept that refers to any system that is used/shared by two or more organizations. When this system manages the product information of an entire supply chain network, we are talking about the Global Data Synchronization Network (GDSN).

The GDSN is an interconnected network of interoperable data pools that enable companies around the globe to exchange standardized and synchronized product data with their trading partners.

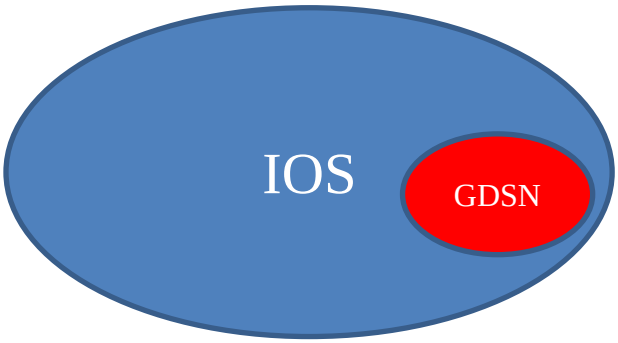


Figure 1. The GDSN is a particular type of IOS

Product data management (PDM) in the consumer goods industry is still very inefficient. Entities spend huge amount of resources in just fixing errors and adapting formats to match them with the bunch of formats that are used by the retailers. Excel files, emails or even phone calls are still ruling the data that is exchanged among suppliers and retailers. There is not enough standardization in the way data is exchanged, what leads to an inefficient usage of resources. Standardized systems could make product data exchange much more efficient.

This GDSN can have a big impact in PDM and bring great results to FMCG companies and retailers. The consumer goods industry moves high volumes in short periods of time. Moreover, products are updated more often, specifications change frequently, packaging experiments new designs and new product launches are fast and frequent. In consequence, amount of product data is greater and PDM among partners become a difficult task to deal with (Pantano, 2014). The GDSN is a necessary system to cope with these trends. FMCG supply chains definitely need to have a tighter degree of collaboration and visibility to fulfil market requirements (Aberdeen Group, 2010).

According to Pantano (2014), the consumer goods industry is evolving at a very fast pace. More data is needed to manage product portfolios. This data is becoming more difficult to be managed and coordinated among all business partners. According to Capgemini (2017), customers demand constantly better quality on products, new and more accurate product information and tailored delivery. FMCG organizations need to find a better way to manage product information together with their supply chain partners to be able to offer what the customer demands. The GDSN is the system that can build the bridge between the new trends in the industry and the customers' demands.

In this context, the GDSN becomes a great tool with a lot of potential to improve the efficiency in an area that is growing and becoming more complex throughout the time. As mentioned, this tool is an important enabler of supply chain visibility. However, there is a third component to be added in this relationship: the environments in which information sharing takes place. They are actually enablers of implementing the GDSN, as supply chain designs significantly influence the need for supply chain visibility and the role of the GDSN in achieving it. It is important to understand the link between these three terms as it is the foundation upon which this thesis develops a framework to analyze the GDSN adoption process.

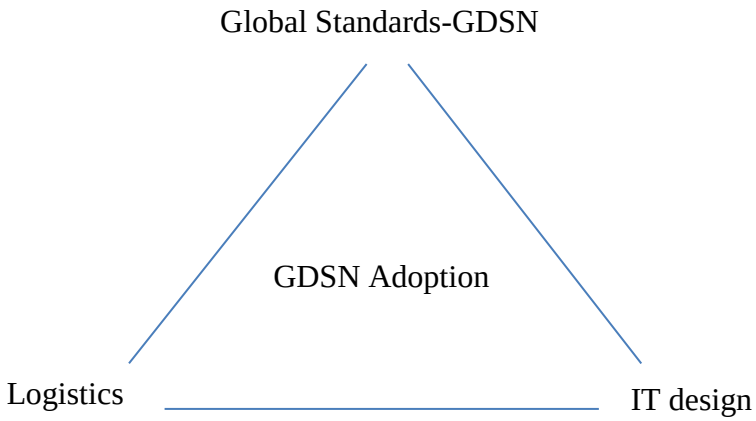


Figure 2. Linking the three main concepts of the research

Therefore, supply chain design and the visibility needed in the network are the two main variables that influence the need of the GDSN in a supply chain network. This relationship is shown in figure 3.

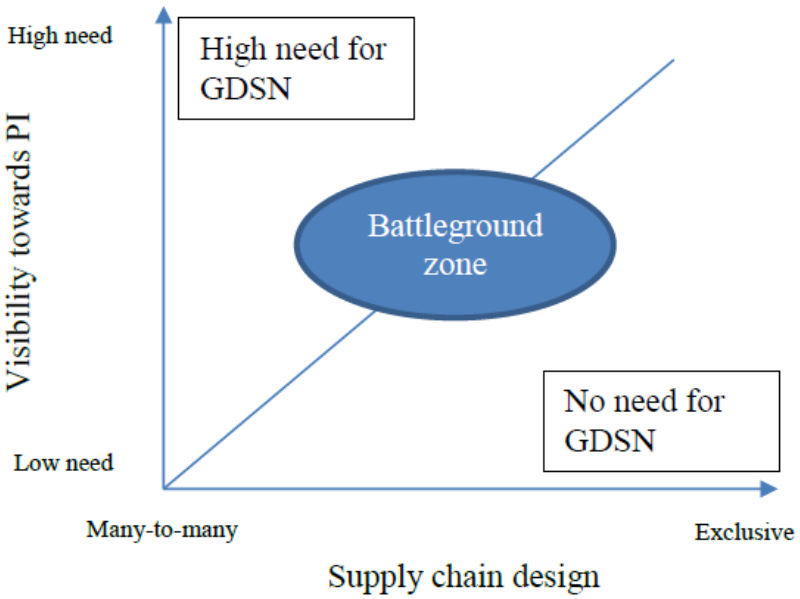


Figure 3. Relationship between visibility and design

On the one hand, many-to-many supply chains that need a high degree of visibility are the ones that will be in more need of adopting the GDSN. On the other hand, if the network has enough visibility and operate in exclusive supply chains, then they will not obtain much benefit out of the GDSN in relation to the investment that requires. Finally, supply chains that have average needs for supply chain visibility and intermediate supply chain design are in the battleground zone, meaning, the investment and the benefits are similar. Supply chain designs will be further explained in the section 4

Therefore, analyzing the CSFs for the GDSN adoption is only relevant in those cases where the degree of many-to-many supply chains and visibility compensates the investment (above the battleground zone).

It is important to mention that the model is analytical and does not aim at providing strict rules regarding standard adoption. However, the model proposes a structured approach to evaluate when the GDSN can improve PDM of a supply chain network.

1.3. Research Context

CSFs for GDSN adoption is a topic that required a deep investigation on the current-state-of-the-art of the consumer goods industry and the challenges that it currently faces. The initial motivation laid on addressing operational efficiency in the consumer goods industry. Efficiency throughout the whole supply chain of FMCG businesses is even more important than in other industries because of the particular characteristics of the industry; low margin and high volume business. Therefore, the first milestone was to find an interesting topic addressing efficiency of supply chains in this industry. A topic that could contribute to the current research and have practical implications. FMCG supply chains present issues in different areas that sub optimize the performance of the supply chain. There is room for improvement and this thesis aims at contributing to this research line by analyzing potential solutions to improve the efficiency in this industry.

Narrowing the scope down was necessary to obtain reliable results. Otherwise, the outcome would become too fuzzy with little practical implication. The preliminary analysis is aimed at identifying key areas. Many solutions and innovations are being investigated by a variety of research groups, consultancy firms and other organizations. Desk research, literature review and interviews with experts were performed to gather information and gain more insight on the topic.

These findings are grouped into four areas: Reasons for carrying out a research on operational efficiency in the consumer goods industry, main problems identified in FMCG supply chain operations, key concepts and existing solutions.

The main sources of information come from L. Bode (Supply Chain Manager Benelux Henkel) and sector reports of the consulting companies Deloitte, Accenture and KPMG. Research papers were also used to get more insights.

The next conceptual map depicts these findings.

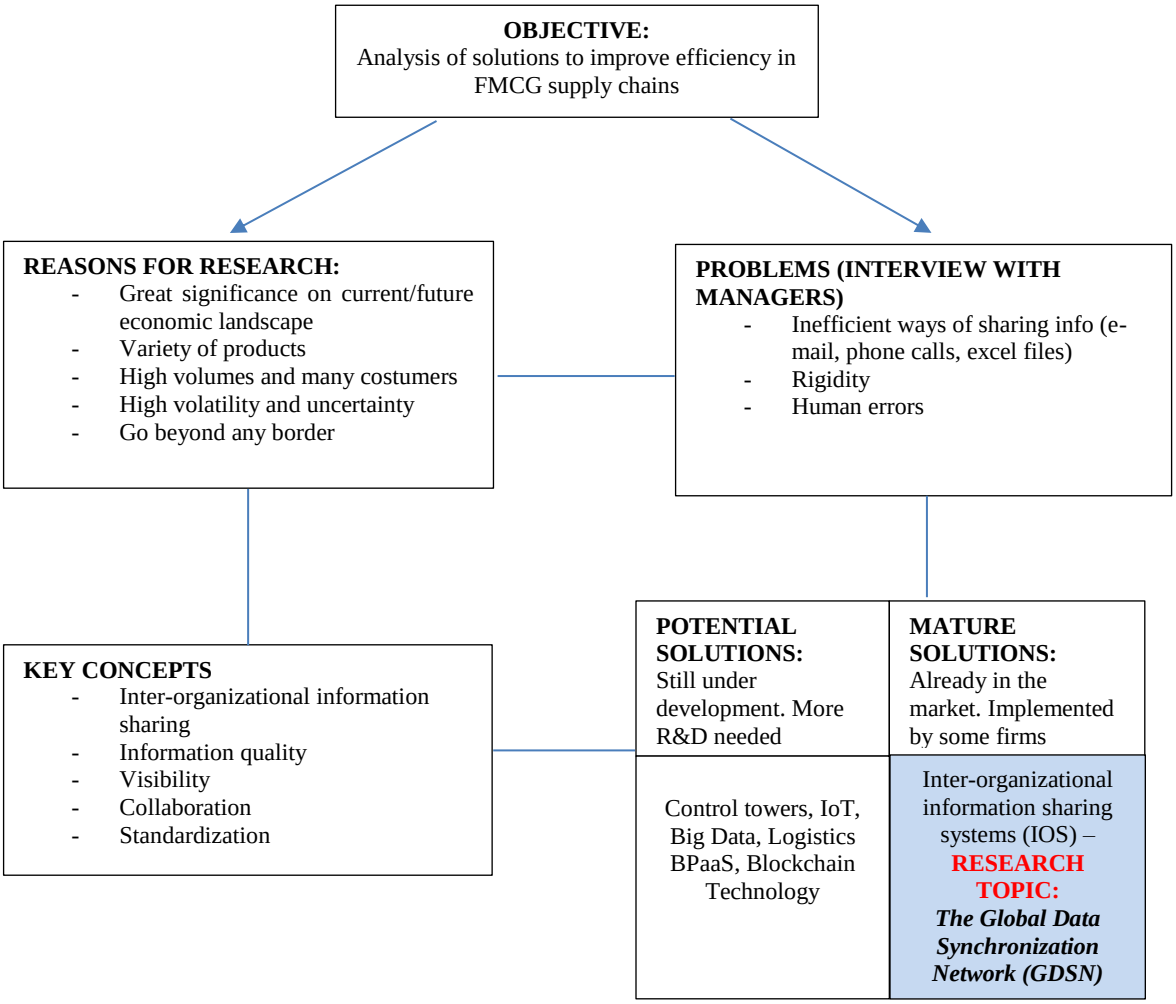


Figure 4. Research Context

- **Reasons for research**

Good reasons must be provided to justify the impact that a research study may have in a specific area of study. These reasons explain and support why improving operational efficiency in the retailer industry is a topic that has to be further addressed.

- *FMCG industry has great significance on the current/future economic landscape*: A more efficient FMCG industry is synonym of progress and better quality of life for everyone. The future of supply chain passes by decreasing costs for the final consumer. Developed countries could further improve everyone's quality of life by making products even more accessible for low-income people. Developing countries could increase the access of some social groups to products that nowadays are inaccessible.

- *Variety of products*: The retailer industry trades a great variety of products such as food, clothing, cosmetics, medicines, appliances, electronics…Therefore, improvements in FMCG supply chains will have big impact in a variety of industries and consumers around the world.

- *High volumes and many customers*: It is an industry that moves high volume of products every day as these products are the basis of everyone's life. Everyone needs them so the number of customers is high in comparison to other industries.

- *Volatile and uncertain industry:* Products are updated more often, specifications change frequently and packaging experiments new designs, resulting in a volatile industry. Customers are more demanding than ever before. Innovation is needed to meet these requirements.

- *It is an industry that goes beyond any border:* Regardless of the country, this industry is very important all over the world. There are countries or regions where certain industries have more weight than others. This industry will always have an important significance in any region as every single person is a consumer.

- **Problems**

The two most relevant issues identified in supply chains are (L. Bode, Supply Chain Manager Benelux Henkel, personal communication, February 22, 2017).

- *Inefficient ways of sharing information* (e-mail, phone calls, excel files): Informal interviews and desk research are performed to understand the current paradigm of the inefficiencies that sub optimize the supply chain network. Great resources are invested to make supply chains competitive. However, many of them are used in operations that sub optimize the efficiency of supply chains. New digital technologies are giving rise to a sea of data and the evolution of a smarter, more efficient networked supply model (Accenture, 2017). Therefore, technological innovation is a must to improve supply chain operations. Digital technologies need to ensure more visibility and better communication to eliminate inefficient ways of sharing product data.

- *Rigidity and human errors:* The FMCG industry is volatile and uncertain. Flexibility is needed to face this volatility and uncertainty. Rigidity is unfortunately something that still characterizes current supply chains. Most of the operations and decisions are subject to human errors. Technology is needed to automatize processes and reduce human intervention. Business partners can then tolerate last-minute changes and cope better with the dynamic and flexible character of supply chains.

Even though supply chains are increasingly becoming more efficient, many companies find difficult to improve the ways in which the information is shared. Rigidity and resistance to change are the main root causes.

- **Key Concepts**

Key concepts have been identified. These concepts provide a better picture of the topics that are addressed in the literature in relation to operational efficiency in global supply chains. *Google Scholar* was used as the research search engine to retrieve articles. 10 articles were selected and analyzed to extract these concepts (Petersen, Ragatz, & Monczka, 2005; Nagy, 2006; Wang & Wei, 2007; Van Baalen, Zuidwijk & Van Nunen, 2009; Steinfield, Markus & Wigand, 2011; Saeed, Malhotra & Grover, 2011; Du, et al., 2012; Rampersad, Troshani & Plewa, 2012; Lee & Kim, 2014; Hudnurkar, Jakhar & Rathod, 2014).

- Visibility: mentioned 7 times
- Collaboration: mentioned 8 times
- Information quality: mentioned 4 times
- Inter-organizational information sharing systems: mentioned 3 times

These concepts provides a notion of what areas need special attention in SCM. Visibility and collaboration are among the top concerns expressed by researchers. In addition, supply chain managers such as L. Bode (Supply Chain Manager Benelux Henkel) states that visibility and collaboration should constitute the main features of efficient supply chain networks. Enablers such as information sharing and information quality are needed to achieve a visible and collaborative supply chain. They play a crucial role in supply chain performance (Marinagi et al., 2015). Supply chain partners coordinate their processes through effective information sharing. In addition, the preservation of the quality of the exchanged information is a very important issue that need to be taken into consideration as proprietary and confidential information is shared between various businesses partners, putting sensitive information at stake.

Technological innovation is improving the way in which companies exchange information with one another. The role of Inter-organizational Information Sharing Systems (IOS) is increasingly becoming more important in creating more efficient and competitive supply chain networks (Lee et al., 2014).

New challenges are emerging in the current market. Globalization and complexity are overtaking supply chains. The increased complexity and multi-party nature of global supply chains has led to longer lead times, more pipeline inventory and the need to control downstream and upstream logistics. This, in turn, has contributed to increased supply chain management costs. Organizations need to seek for ways to reduce costs, while enabling faster and more efficient responses to changing customer demands. FMCG companies need to implement and use IOS efficiently to meet customer demands and remain competitive in the market. IOS improves information quality along the supply chain.

It constitutes the bridge between information quality and supply chain performance, something that every company needs to take into account in their long-term strategy.

- **Solutions**

Improving operational efficiency in supply chains is a broad topic that can be tackled from multiple perspectives. Solutions may adopt a pure organizational approach or a hybrid one involving organizational and technological changes (Kersten et al., 2015).

According to the results obtained from the literature review and desk research, solutions to improve supply chain efficiency can be divided into *potential solutions & mature solutions* (Alias et al., 2014; Majeed & Rupasinghe, 2017; Waller & Fawcett, 2013). Potential solutions are the ones that are still at an early stage of development. They are not mature enough to be introduced in the market and help organizations solve their current issues. Potential solutions are based on technologies and infrastructures that require further R&D before they can be introduced in the market. Some of these solutions/technologies include: *Control towers, IoT, Big Data, Logistics BPaaS, Blockchain Technology*, among others (Alias et al., 2014., Ralston, 2017., Kache, 2017., Glöckner, 2017., Pilkington, 2015). The second category is *mature solutions*. These solutions are introduced in the market and are already being used by some organizations to improve their supply chain efficiency. However, the fact that they are mature does not imply they can be adopted by all major FMCG organizations. A cost-benefit analysis would be a good method to estimate the need of these systems (C. VanDaele, Customer Service Manager Benelux Henkel, informal interview, February 22, 2017).

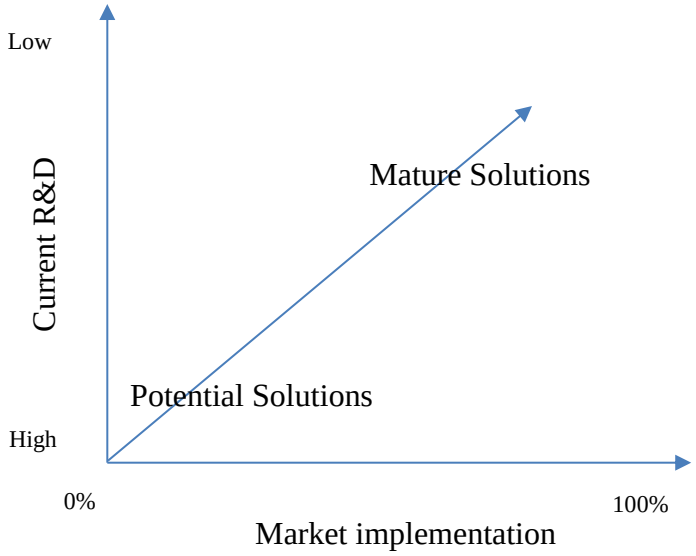


Figure 5. Potential vs Mature solutions

- **Conclusion**

This exploratory research has enlightened the current situation of FMCG supply chains. The most important problems and challenges have been made explicit. Finally, two categories of solutions have been identified. This new knowledge serves as a starting point to formulate the research topic.

The next step is to inquire this new knowledge to understand how visibility and collaboration can be further improved in FMCG supply chains.

Global standards have been identified as one of the most powerful and realistic solutions for FMCG chains nowadays. The advantage of global supply chain standards is clear. They provide an end-to-end visibility resulting in more responsive and agile supply chains. A supply chain that is able to respond to the volatility of the market will more likely reach an advantage position over competitors.

One of the areas where FMCG supply chain networks could be further improved (according to the interviews performed with supply chain professionals) is in their product data processes. This business area is very inefficient, as supply chain partners still exchange information inefficiently (e-mail, phone call, excel files). Moreover, it is a very rigid process that is full of human errors.

The GDSN is a global standard that can fill the gap for effective PDM. Suppliers and retailers currently experiment many problems when exchanging product information and it is one of the main reasons of inefficient relationships between suppliers and retailers.

A literature review is performed to understand the impact of the issues related to inaccurate product information that experiment business partners in the chain. The most extensive study that has been carried out is the one by A.T Kearney in the consumer goods sector. The main outcomes are:

- $40 billion or 3.5% of sales are lost each year due to supply chain information inefficiencies

- 30% of item data in catalogues used by retailers and manufacturers for replenishment of stock have errors. Each of those errors costs $60-$80 to address.

- Companies invest an average of 25 minutes per item per year manually cleansing out-of-sync item information - operational costs for manually cleaning 250,000 is over $3M in annualized.

- 60% of all invoices generated have errors. Each invoice error costs up to $400 to reconcile.

- New item introductions remain costly and manual. It takes an average of 4 weeks to roll out a new product.

This data shows that without a Product Information Management (PIM) solution in place, the supplier and the retailer would incur in high costs associated to inaccurate data.

Many FMCG organizations have successfully implemented the GDSN with their retailers. Nevertheless, some important FMCG companies still find some barriers that prevent the launch of the GDSN. A case study is found in Henkel, where the GDSN has been implemented in the Netherlands but could not be in Belgium. The adoption phase seems to be a critical phase that can often be underestimated by supply chain professionals

The purpose of this thesis is to study the preconditions that are needed to implement the GDSN in a supply chain network. These factors or preconditions are needed to ensure a successful adoption and a subsequent implementation of the project. Successful is a subjective term that can have different connotations, especially when addressing big projects that involve multiple entities. A successful adoption of the GDSN is considered in this paper as the project that fulfills these 2 conditions:

1. The project has specific deadlines set from the very beginning, they are agreed by all the parties involved and they are respected in a timely manner. Delays are admitted but only in case of unexpected events. Project management is efficient and professional

2. The responsibilities are clearly outlined from the beginning. They should be equally distributed according to the resources that the different parties can provide.
Therefore, a successful adoption would meet the pre-agreed deadlines in a timely manner and would allocate the resources equally and fairly.

It is also very important to point out the difference between adoption and implementation. This work focuses on the adoption stage. This stage involves the analysis of the preconditions that are needed to have in place before launching the project officially. This is a critical stage as the success of the project will greatly depend on having the necessary conditions in place. The next image shows the phases of a project and indicates where the scope of this thesis is located:

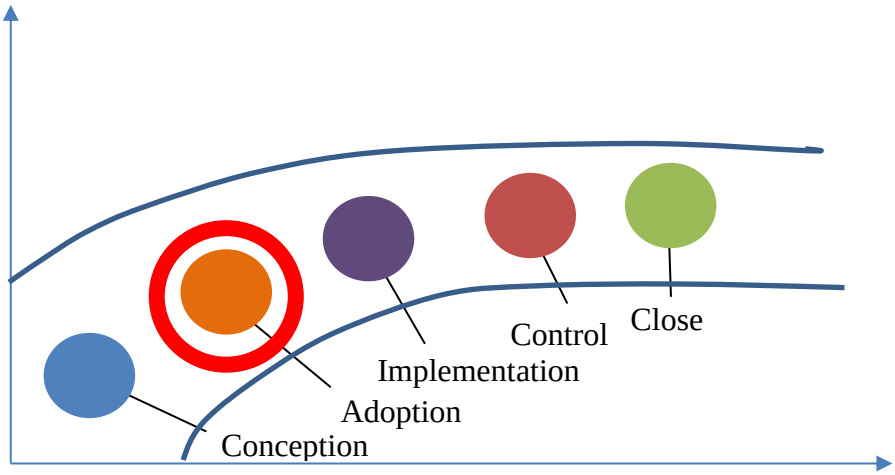


Figure 6. Project phases

The outcome of this paper can help supply chain professionals understand the preconditions that need to be in place to ensure that the implementation of the GDSN is in a timely manner, providing the expected results to all the entities.

The main research questions that this thesis aims at solving is:

RQ. What are the critical factors for GDSN adoption in the consumer goods industry?

This research question and research subquestions will be further described and justified in section 2.2.

The next figure depicts the line of reasoning behind this conclusion sub section in a more visual way

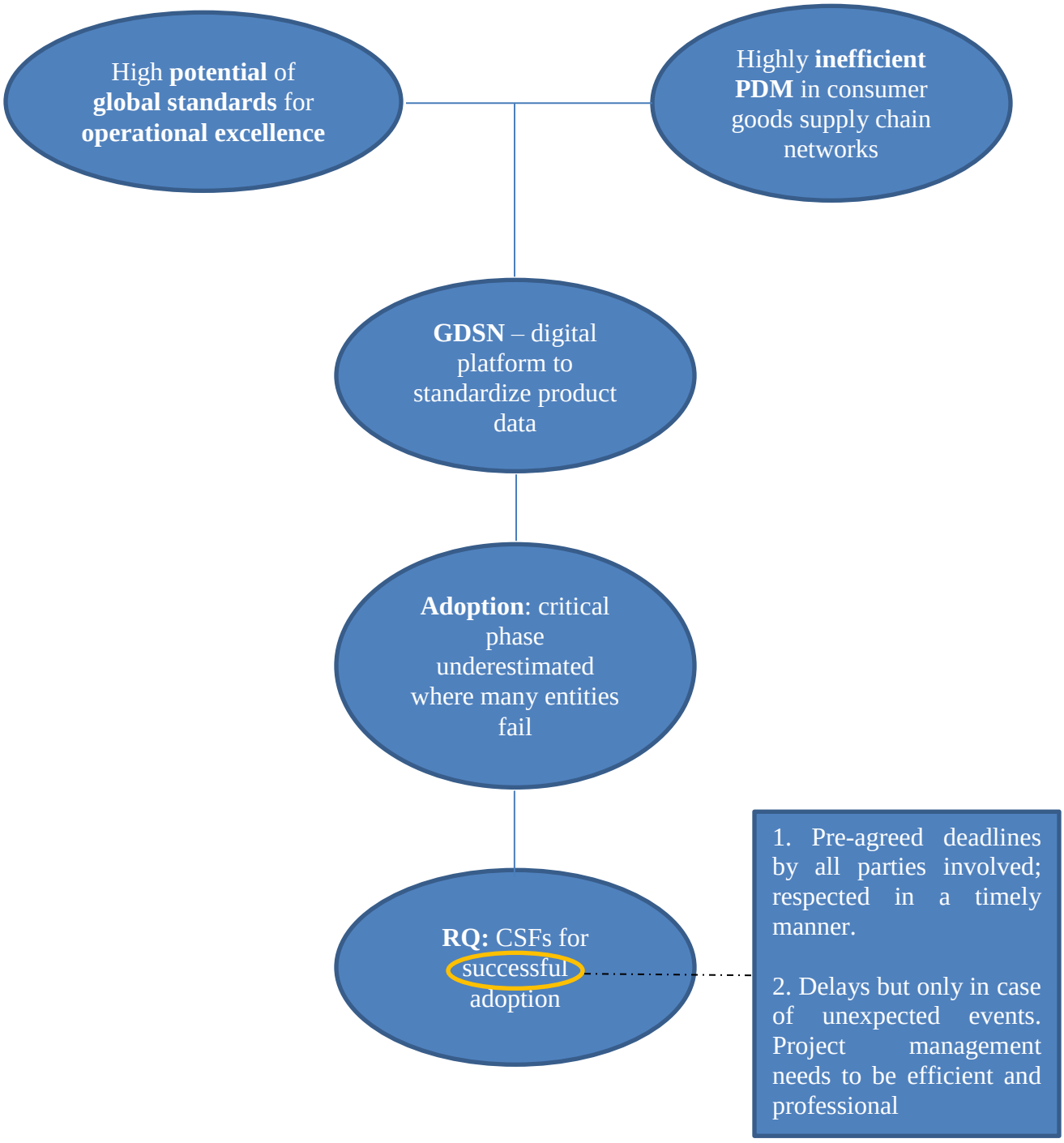


Figure 7. Conclusion line of reasoning

1.4. Problem Formulation and Research Objective

PDM between suppliers and retailers in major consumer goods companies is inefficient. Entities spend huge amount of resources in just fixing errors and adapting data formats, what causes extra costs and delays in project launches. The main reason is that there is no standardization in the way data is exchanged among entities. The Global Data Synchronization Network (GDSN) is the system that aims at standardizing product information so that these inefficiencies and errors can eventually be reduced to zero.

Many FMCG organizations have successfully implemented the GDSN, greatly improving PDM with their retailers. Nevertheless, some important FMCG companies still find some barriers that prevent the launch of the GDSN. A case study is found in Henkel, where the GDSN has been implemented in the Netherlands but not in Belgium.

Based on this problem formulation the objective of the thesis is:

To investigate the critical success factors of the GDSN adoption process in the consumer goods industry.

1.5. Outline Thesis

This paper is organized as follows:

The *Introduction* provides an overview of the background of the topic, while familiarizing the reader with the key research areas of the thesis. The three most important concepts in relation to operational efficiency in the retail industry: collaboration, supply chain visibility and the need for global standards are presented. Then the problem and research objectives are formulated. The problem statement summarizes the background of the research and pinpoints the main trends regarding supply chain efficiency and global standards implementation. This is the basis on which the thesis objective and the research questions are formulated.

The *Research methodology* chapter describes the process of conducting the research. An explanation of the preliminary research conducted is provided. This research was needed to define the topic more specifically. This preliminary research is the foundation to identify the reasons for research, the existing problems in the industry, key concepts and the possible solutions. Then, the research framework is outlined. The added value of the framework is to the show the path and steps that are taken to pursue the objective stated on section 1.3. The research questions and sub-questions are also placed in this framework to clearly understand what steps are needed to answer each of them. Afterwards, the main research questions and sub-question are presented and justified. Some lines are included to explain the reasons of each of those sub-questions in order to give more insight on them.

Finally, theory development and data collection are presented. These two sections explain what sources were used to develop the theoretical concepts and how the data was collected from the case study at Henkel and its retailers. Reliability and validity issues are also discussed and proven.

The *Theoretical concepts and framework* chapter provides a theoretical context for subsequent chapters and consists of two subchapters. Literature review on GS1 and GDSN is performed to understand the scope of global standards and what the GDSN consists of. The review reveals a massive literature gap, especially in the area of implementation and adoption of GDSN in the retailer industry. This leads to the ambition of theory development and the creation of the analytical model. On the basis of this model an assumption regarding potential adoption of a global data identification standard can be made. The model is further used in the empirical chapter of this thesis.

The *Empirical case studies and analysis* chapter gathers empirical evidence for the developed analytical model and consists of a description and case analysis of two cases within the same company – Henkel. GDSN is implemented in the Netherlands but no in Belgium. This chapter summarizes the respondent supply chain practices. It also describes the current level of supply chain visibility in both countries, and the types and benefits of data identification standards implementation. This chapter compares findings from the two case studies to chosen theoretical frameworks and verifies the usability of the previously developed analytical model.

The *Discussion* chapter reflects on what was known prior to case studies and how empirical findings have enlarged the understanding of the concepts of supply chain visibility, supply chain design, and adoption of GDSN standards. In the end, the contribution of the research to supply chain management literature and fulfillment of the stated purpose are assessed. The Conclusion discusses the limitations of the research as well as any managerial implications and possible areas open to future investigation.

The *Conclusion* section aims at analyzing how this research has addressed the research questions that were formulated at the very beginning of the work. Finally the critical success factors are outlined.

1.6. Conclusion

This section introduces the need for global standards to tackle some of the current supply chain challenges that the consumer goods industry faces.

Global standards can be proprietary or open. Proprietary standards are usually used by a closed set of firms. Open standards are used by an open community that uses public communication platforms and software. As the thesis will be based on the retailing industry, only open standards are discussed since this industry is very standardized. Proprietary standards would be used in exclusive supply chains such as the ones that are responsible for making high-quality products in some industries (automotive, aerospace).

The GDSN is increasingly getting more attention, taking into account the latest trends of the industry, which is getting more digitalized, moving towards omnichannel. It is the enabler needed for a better collaboration and supply chain visibility over product data. Some companies in the industry have been able to implement while others are lagging behind. The objective of the thesis is to investigate those critical success factors of the GDSN implementation process in the retailing industry.

Finally the section ends with an overview of the thesis outline, where it is explained what the outcomes of each section.

2. Research Methodology

This section introduces the research framework and research questions. The choice of the methodology and cases is also explained. Moreover, data collection and data analysis is outlined. Finally, the last section argues how reliability and validity are proven.

2.1. Research Framework

This research framework has been developed based on the strategies that are used to pursue the objective stated in section 1.4. A research framework is a schematic representation of the research objective and strategies undertaken to pursue it. It includes the steps that are taken to realize the objective. This scheme also indicates the necessary theoretical background (key concepts, theoretical frameworks) required for carrying out the research project.

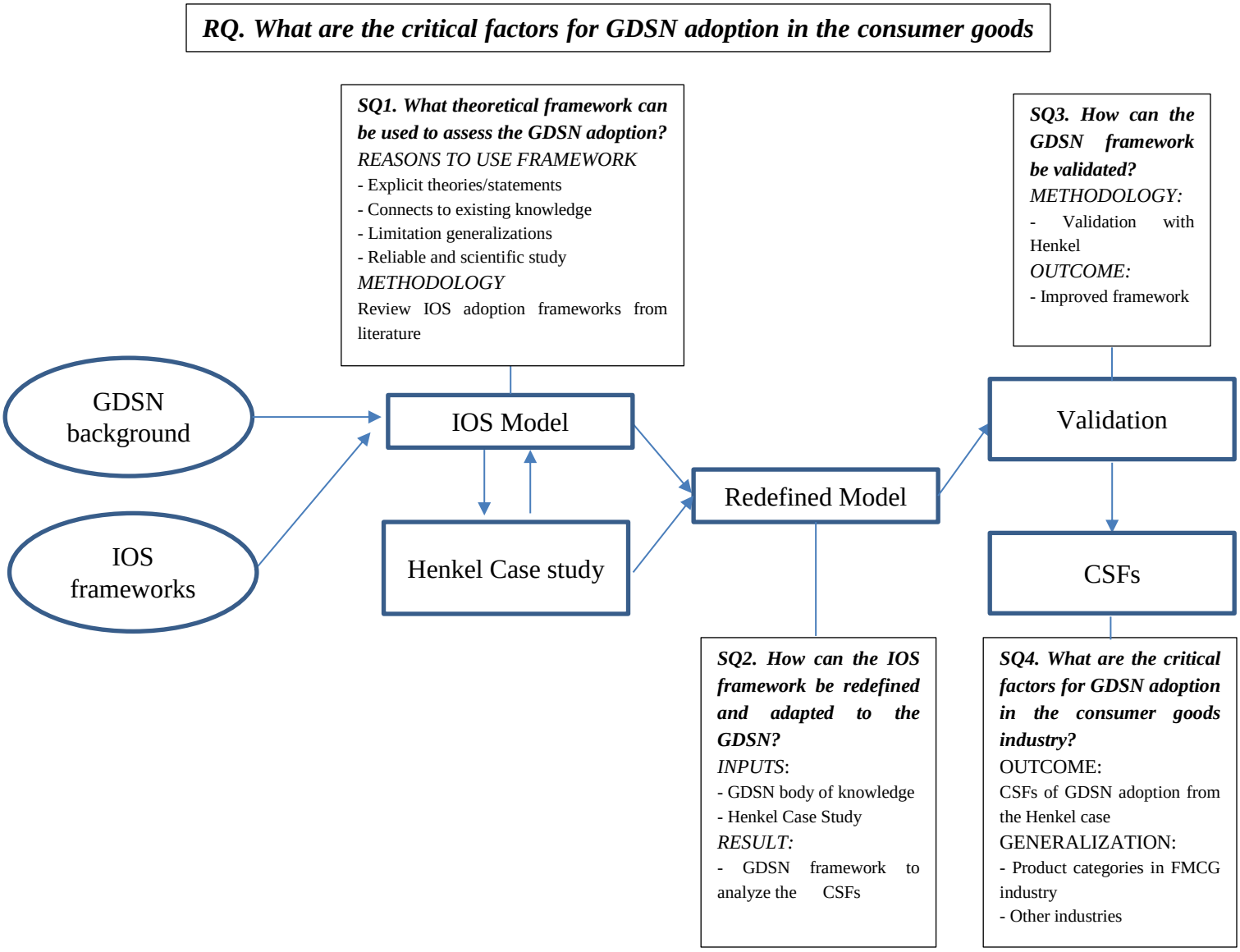


Figure 8. Research Framework

This research starts with the preliminary research described in section 2.1. A literature review, desk research and informal interviews with managers from the supply chain and customer service departments from Henkel were part of the preliminary analysis to dig into a topic that still has a long way to go; improving operational efficiency in supply chains. My interest was more specifically towards the consumer goods industry since it is an industry whose improvement and digitalization can play an important role in future's economic growth. Business related to improving efficiency in global supply chains is a market that is gaining more importance over the years.

The most important consulting organizations have specific business divisions to tackle all the challenges that derive from supply chain issues in both strategic and operational areas. In addition, multinational companies in a variety of industries offer positions in strategic management of supply chain related areas. This topic is increasingly gaining more importance for global companies. Certain decisions on this field can have an enormous impact on the future of such organizations. Therefore, seeking new ways to improve and optimize decisions over supply chain topics becomes crucial for today's organizations.

This preliminary research served to identify existing problems and key concepts. The knowledge acquired in this stage was enough to discover an interesting field of study to improve operation efficiency in supply chains. The Global Data Synchronization Network is a global standard to exchange product information. This information is usually very volatile in the FMCG industry since new designs and new product launches are frequent. In addition, companies are required to comply with national, federal and/or local regulations. There is a changing regulatory environment in which governments are examining increasingly aggressive approaches to the regulation of different categories of consumer goods (Deloitte, 2017).

In this scenario, the GDSN turns out to be a very powerful tool to improve the efficiency between retailers and suppliers when exchanging product information. It is a tool that tackles all the problems stated in section 2.1. Nevertheless, the adoption of new IT systems in such big organizations is always a complicated and long process since significant changes need to be done in most areas of the organization. If the adoption process is not properly addressed, new IT systems could even damage more the organization than what it can benefit it. Therefore, an analysis of critical success factors for GDSN adoption is essential for managers and consultants so that the right steps are taken towards a successful implementation.

Figure 2 depicts the framework that is used throughout the thesis to reach the objective. According to this line of reasoning, the main research question formulated in this master thesis aims at identifying these critical success factors to help consultants and mangers take the right decision and steps towards a successful GDSN implementation.

A research path needs to be defined in order to know the steps that need to be taken to realize the objective. This is a scientific thesis that needs to follow rigorous and scientific steps to obtain reliable and valid results. To meet these requirements, the first step towards the objective consists of the identification of a scientific framework to analyze implementation of an IOS. This framework is the starting point from which a GDSN framework is created. This framework provides the rigor and reliability that a thesis of such characteristics requires.

The second phase of the research consists of adapting the general IOS framework to the GDSN in order to generate a redefined one to use it to analyze the GDSN. The inputs for such phase are the IOS framework and the theoretical knowledge on the GDSN, which is analyzed in section 3.

The third and last phase consists of the identification of the CSFs of the GDSN implementation in the FMCG industry. The inputs for such analysis are the GDSN redefined framework and the information collected from the case study performed at Henkel and its corresponding retailers.

2.2. Research Questions

RQ. What are the critical factors for GDSN adoption in the consumer goods industry?

The GDSN is an inter-organizational information system that helps improve the flow of product information between suppliers and retailers. The current way in which product information is exchanged between these two partners is far from efficient: (Lockhead, 2011):

- *Non-standardized exchange* of product information. Suppliers may have different ways to share product information with retailers, what potentially increases the number of errors and inaccuracies.

- *Lack of Traceability*. Suppliers have to use a variety of instruments to exchange product information (excel files, emails, phone calls or even specific web portals provided by the retailer). All these instruments cause a lack of traceability since information is not located in just one source but in various.
- *No trusted and real-time* product information. Partners cannot use product information accurately to make real-time decisions since all this information needs to be verified.

- *Processes duplication*. The different ways in which product information is shared makes the duplication of processes more likely to occur. It is not rare to search something again in an old email because the information contained in this email was no retrieved and recorded properly.

The GDSN constitutes a real solution to solve all the problems associated to product information that sub optimize the supply chain network. As explained in section 1.2, supply chain design and supply chain visibility have to be evaluated case by case to actually decide if the GDSN is a system that can bring benefits to the supply chain network or otherwise it would not compensate the benefits vs the required investment to implement it. Therefore, this thesis only takes into consideration those cases where the GDSN adoption can bring improvement to the PDM of a supply chain network.

There are quite a lot of factors that influence the success of the project. The objective is to differentiate the critical ones of those ones that are not, so that managers clearly know what they really need to consider and what they need to put in place before the GDSN implementation starts to ensure the success of the project. A successful adoption of the

GDSN was already defined in section 1.2. The conditions described there are the ones considered to state that the GDSN adoption was successful.

This question will be addressed scientifically to obtain valid and reliable results. To do so, different steps to find out the critical success factors for GDSN adoption are needed. These steps were already made explicit in the research framework. Each of these steps leads to the formulation of the research sub questions.

SQ1. What theoretical framework can be used to assess the GDSN adoption?

A master thesis is a scientific research that requires rigor and reliability. For such studies, a theoretical framework is often needed to explain, predict, and understand phenomena and, in many cases, to challenge and extend existing knowledge within the limits of critical bounding assumptions (Abend, 2008). A theoretical framework strengthens the results obtained in a research because (Ravitch & Riggan, 2011):

1. Allows the formulation of explicit theories and/or statements that permits the reader to evaluate them critically.
2. Connects the researcher to existing knowledge and forms the basis upon which hypothesis and research methods are guided.
3. Facilitates the formulation of why and how research questions since it articulates the theoretical assumptions of the research study
4. A theoretical framework helps identify the limits of generalizations. A theoretical framework specifies which key variables influence a phenomenon of interest and highlights the need to examine how those key variables might differ and under what circumstances.

A good theory is of value precisely because it provides the researcher with the knowledge and understanding to perform an analysis in more informed and effective ways.

Another reason to use a theoretical framework is to make a more rigorous and scientific study. This topic focuses on contemporary events rather than historical events, in which knowledge and data is readily available. Therefore, a theoretical framework gives the foundation for a rigorous and reliable research.

Nevertheless, an IOS framework cannot be directly used to analyze the CSFs of the GDSN. The GDSN is a specific type of IOS but that does not mean that the IOS framework selected from the literature can be used with no modifications. An adaptation and redefinition of the IOS framework needs to be done so that the reliability and validity of using such framework can be maintained. The next sub-question addresses this issue.

SQ2. How can the IOS framework be redefined and adapted to the GDSN?

This question is about redefining the IOS framework into a GDSN framework. The two inputs to answer this question are:

1. Knowledge and understanding of the GDSN. Section 3 addresses the necessary body of knowledge of the GDSN. In addition, the organization that is responsible for the GDSN (GS1) is introduced. The main points that are explained are:

- What the GDSN is, its main benefits and how it works (synchronization process)
- GDSN's main elements: data pools, GS1 global registry and product attributes
- KPIs used to measure GDSN performance
- Analysis of GDSN and non-GDSN business processes

2. The Henkel case study. A case study is the research strategy that is used to generate data. There are many ways of doing scientific research. Experiments, surveys, histories or analysis of archival information. A case study is the methodology used to answer this question because the research focuses on contemporary events. Data is not available and need to be generated. A real case can illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result (Schramm, 1971). All this information from a company that has been able to implement the GDSN in a supply chain network (the Netherlands) but not in another one with similar characteristics (Belgium) can shed some light on the factors that makes then GDSN adoption successful.

SQ3. How can the GDSN framework be validated?

This research sub question is formulated with the purpose of validating the GDSN framework. Validation is done when the entities or people you have collected primary information from confirms or disagree with the findings. This step is important to improve the reliability and quality of the research.

This validation step will only be performed with Henkel, as it is the central company of the case study. Validating the framework with the retailers is an additional step that would also bring value to the research.

The outcome of this research question is a validated and improved GDSN framework.

SQ4. What are the critical factors for GDSN adoption in the consumer goods industry?

This last sub question aims at identifying the critical success factors for GDSN adoption in the consumer goods industry. All the information collected throughout the thesis is used to formulate the CSFs. This sub question not only answers the main research question. It also addresses the generalization of the results in the consumer goods industry, as the results

are mainly obtained from the information gathered in the Henkel case study. In addition, other industries will be study to check to what extent the results can be generalized.

2.4. Theory Development

The main sources of information for the development of the theoretical concepts comes mainly from literature and desk research.

Literature and desk research were used firstly to understand more about the current challenges of supply chains and the actual needs for FMCG companies. Secondly, when the topic was already defined, to elaborate the theoretical part of the research. This includes a complete analysis of the GDSN and the choice of the IOS framework.

Literature research includes scientific articles found in *Google Scholar*, the only search engine used in this thesis. In addition to this, reports from the most important consulting firms in the world were used to gain more insight on the main global supply chain challenges and the possible solutions to overcome them.

Some points of all this new knowledge was double-checked and discussed with Lieven Bode, Benelux Supply Chain Manager at Henkel and Chris Van Daele, Head of the Customer Service and Product Information Management departments at Henkel. These two managers were involved in the project from the very beginning and they even helped me understand some of the concepts found in the literature that were complicated to me. Therefore, they can also be included in this theory development section.

2.5. Data Collection

The main techniques used for data collection includes informal and semi-structured interviews and questionnaires. Each of them for different purposes.

On the one hand, informal and semi-structured interviews were conducted at Henkel. Two workers with high degree of responsibility were interviewed: Lieven Bode, Benelux Supply Chain Manager and Chris Van Daele, Head of the Customer Service and Product Information Management departments. These two data collection methodologies were used due to the proximity and easy accessibility I had to these managers. They knew from the beginning of my internship what I wanted to do and they guided me appreciably well throughout the entire process.
They were especially helpful on the first steps that I needed to undertake to define a suitable topic remaining faithful to my initial interests.

On the other hand, questionnaires were created to interview retailers. It was not possible to interview all the retailers that were significantly important, but the information gathered was diverse and sufficient for the analysis.

2.6. Reliability and validity

Reliability refers fundamentally to replicability and trustworthiness (Collis and Hussey, 2009).

Replicability is assured by standardization and operationalization of the concepts and results derived from this thesis. The framework for the GDSN implementation serves as a standardized tool to assess the implementation process.

Trustworthiness is supported by reliable sources of information. Primary sources of include informal and semi-structured interviews with the two managers at Henkel and the questionnaires sent to Henkel's retailers in Belgium and the Netherlands. It was very important to ensure reliability to cross-check the information to eliminate bias from both sides. Last but not least, academic articles from well-known journals and reports from consulting firms and research agencies were analyzed, all of which is grouped as secondary sources of information.

Validity can be divided into construct, internal and external validity (Yin, 2013).

Construct validity is an appropriateness of operational measures for the phenomenon studied (Yin, 1994). Construct validity in this thesis is proofed by means of:

- Data triangulation (evidence from multiple sources), which eliminates subjective information.

- Theoretical triangulation: the concepts from supply chain management, inter-organizational information systems, global standards were used to build the GDSN framework.

Internal validity deals with finding proper linkages between concepts (Yin, 2013). This thesis explains and shows the interrelation that exists between operational efficient supply chains, inter-organizational information systems and global standards.

External validity is the generalization of the study's findings (Yin, 2013). Theoretical replication is used to proof the generalization of the findings. In this thesis, the theoretical concepts become the main mechanism by which the results of the case study can be generalized. The results of case studies are supposed to illustrate and proof the model.

2.7. Conclusion

This section describes the research methodology followed in this paper.

The research framework and research questions are outlined. These are presented and justified. Some lines have been added to explain the reasons why each of those

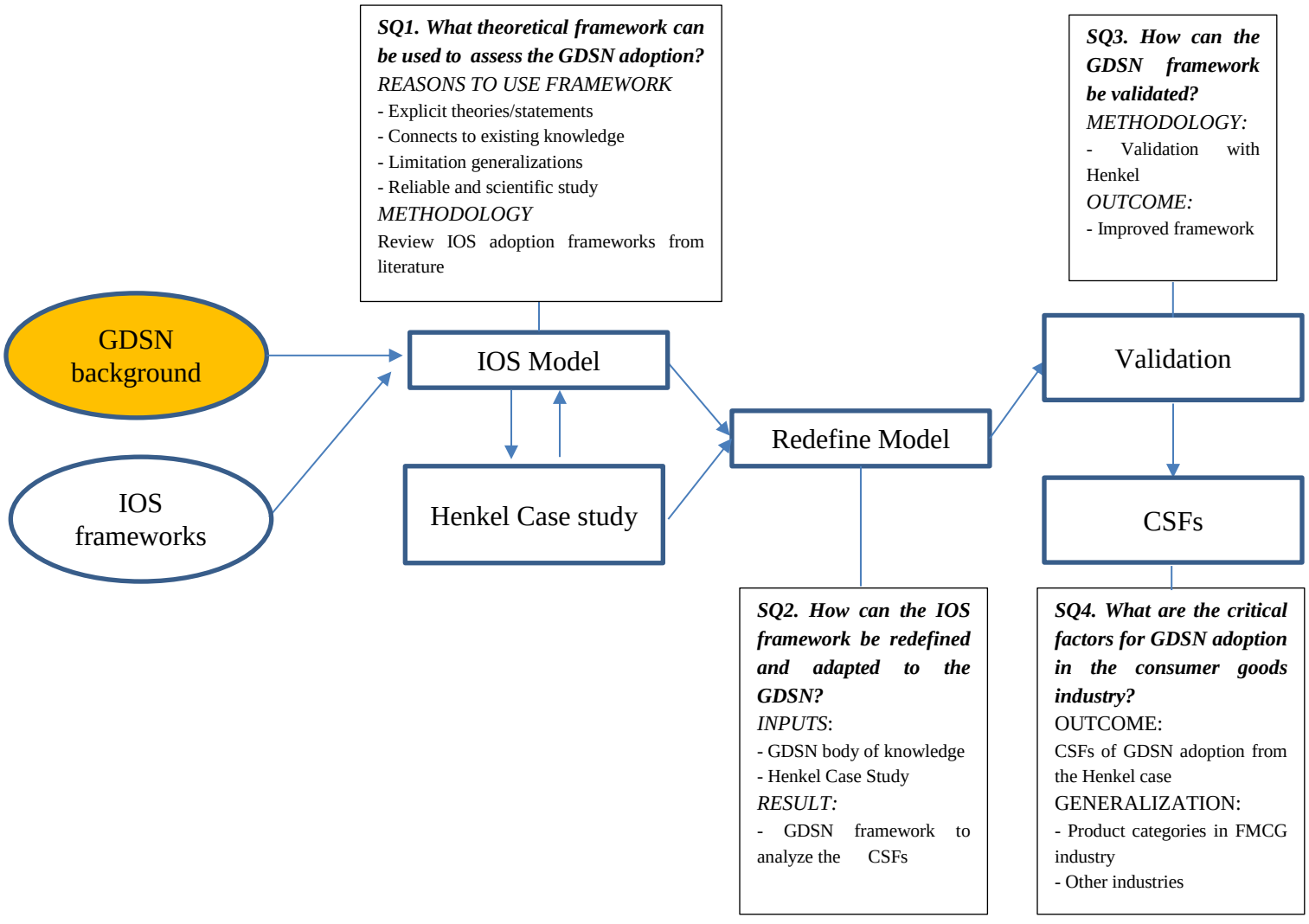
sub-questions were formulated and what they aim at addressing. The research framework will be presented in each section to make the reader familiar with what section is being

Last but not least, theory development and data collection are presented. The sources used for the theory development section were Google Scholar and reports from the most important consulting firms in the world, such as Accenture, Deloitte or AT Kearney. This new knowledge was cross-checked with with Lieven Bode, Benelux Supply Chain Manager at Henkel and Chris Van Daele, Head of the Customer Service and Product Information Management departments at Henkel to get a more practical perspective.

Reliability and validity are also discussed and proven. Reliability refers fundamentally to replicability and trustworthiness. Replicability is assured by standardization and operationalization of the concepts and results derived from this thesis. The framework for the GDSN implementation serves as a standardized tool to assess the implementation process. Trustworthiness is supported by reliable sources of information. Primary sources of include informal and semi-structured interviews with the two managers at Henkel and the questionnaires sent to Henkel's retailers in Belgium and the Netherlands. Validity can be divided into construct, internal and external validity. Construct validity is proven thanks to the multiple sources and concepts used. Internal validity has to do with the linkages between the concepts. This thesis explains and shows the interrelation that exists between collaboration, supply chain visibility and global standards. External validity is proofed through the generalization of the results. This thesis advocated that the results obtained can be generalized to any other supply chain and organization with similar characteristics. Therefore, it can generalized for companies that are in the consumer goods industry and operate in many-to-many supply chains.

3. Theoretical Concepts and Framework

The purpose of this chapter is to make a complete analysis of all the theoretical concepts that are needed to fully understand global standards and the GDSN. The history of the GS1is outlined to understand how global standards were born and the need that existed for them in the FMCG industry. Then, the GDSN is introduced. The GDSN section includes a detailed explanation of what the GDSN is and what it consists of; including its main benefits and elements, and how it works. KPIs to measure GDSN performance are also formulated. The business processes with the GDSN and without it are also compared with each other to highlight the main differences and the non-GDSN business process inefficiencies.



3.1. GS1

Global standards are a comprehensive set of methods and rules that allows a community to be part of the creation and maintenance of globally agreed standards and guidelines (GSMP Manual, 28-04-2017, GS1). The first consistent set of global standards for data interchange was initially established by the Global Commerce Initiative (GCI). The GCI was created in October 1999 by manufacturers, retailers and sponsors to improve the performance of international supply chains through the collaborative development and endorsement of recommended voluntary standards and best practice (Global Commerce Initiative EPC Roadmap, 2003). This group operates through various global working groups. GS1 is the largest and most important organization for global standards. It is a non-profit organization that develops and maintains global standards for business communication. GS1 has nowadays 112 local Member Organizations and 1.5 million user companies (GS1 Annual Report 2016-2017, 28-04-2017, GS1).

The story of GS1 is enshrined in their own website (How we got here GS1, 14-05-2017):

The need for global standards started in 1969 when the retail industry in the US was searching for new ways to accelerate the check-out process in shops. A Committee for a uniform grocery product identification code was established to find a solution.
In 1973, the Universal Product Code (U.P.C) was selected by this group as a single standard for product identification. This barcode is widely used in the United States, Canada, Australia, New Zealand, Europe and some other countries for tracking items in stores. Nowadays it is known as the GS1 barcode. The first barcode product to be scanned was a packet of chewing gum in 1974.

To support the implementation of global standards worldwide, the European Article Numbering (EAN) Association -later called GS1- was established in Brussels in 1977. This association launched an identification system to improve supply chain efficiency.

It was not until 1989 when global standards went beyond barcodes: the first international standard for electronic data interchange is created. Next year, in 1990, the association for global standards in the US, the Uniform Code Council, and the European Article Numbering Association (EAN) come together formally, creating a single organization "GS1" with a presence in 45 countries.

In 1999, the traditional barcode is replaced by the GS1 DataBar. This barcode is smaller and is able to hold more information than the traditional one.

The Global Standards Management Process forum is launched in 2002. The objective of this forum is to give GS1 members one place to discuss about standards and to make them more accessible for organizations.

It was not until 2004 when The Global Data Synchronization Network (GDSN), the internet-based initiative that enables trading partners to efficiently exchange product master data, was launched.

This is the first global standard that enables the interexchange of product master data between supply chain partners. To date, the existing standards were the GS1 barcodes for product identification in stores. Nevertheless, these barcodes did not allow information sharing, only product identification. Master data include all the necessary information to define a product such as composition, dimensions, and even pricing information, among others. A global standard for master data should be the basis of supply chain visibility and this is what the GDSN stands for. The future supply chain needs to counter the increasing uncertainty and complexity in global markets, apart from fulfilling new customer's expectations. Information sharing and information quality are essential and the GDSN is the initiative that aims at improving the quality of information shared between business partners and the end users.

The main role of GS1 standards (What is GS1? GS1, 16-05-2017) is to create rules and guidelines for organizations so that they can apply them to their items to share uniform and accurate data with their trading partners. The result of lacking global standards is that supply chains become more inefficient. This implies costs on extra resources to tackle those errors that eventually are passed on the consumers. Therefore standards play an important role because:

- They are the foundation for clear, understandable exchanges between companies in an increasingly globalized economy.

- They help keep costs down for everyone.

It is important to understand the areas that GS1 serves in addition to the GDSN. Standards are divided in four key product areas (What is GS1? GS1, 14-05-2017):

- GS1 BarCodes: Global standards for automatic identification. They allow a rapid and accurate item, asset and/or location identification.

- GS1 eCom: Global standards for electronic business messaging that allow an automatic, rapid, efficient and accurate business data exchange.

- GDSN: Global Data Synchronization Network. It consists of a repository of information about products and allows business partners to have standardized, reliable and updated item data for effective business transactions.

- EPCglobal: Global standards for RFID-based identification. It is like global standard for automatic identification, the GS1 BarCodes, but uses the Radio-frequency identification technology. RFID uses electromagnetic fields to automatically identify and track tags attached to the items.

This division is based on the technology that is used. The next classification is based on the functionality of each standard (Standards GS1, 14-05-2017):

- Identify: It involves all the global unique keys that enable to identify products. These keys/numbers are used for identifying the items that are captured by the GS1 BarCodes and the RFID technology (EPCglobal).

- Capture: It includes all those elements that can be scanned electronically. These elements have assigned an ID key that allow to identify the item. There are two elements for scanning products: Barcodes and EPC/RFID. Barcodes are symbols that can be scanned electronically using laser or camera-based systems. EPCs have multiple representations, including binary forms suitable for use on Radio Frequency Identification (RFID) tags, and text forms suitable for data sharing among enterprise information systems.

- Share: It includes all the ways to exchange business-critical information. There are many standards in different languages. Three areas are distinguished: Transaction of basic data such as order, deliver and payment; product data sharing and visibility event data. Product data sharing is the most important for supply chain visibility since it allows to interexchange all product information among business partners. Finally, visibility event data enables trading partners to share information about the physical movement and status of products as they travel throughout the supply chain – from business to business and ultimately to consumers. It helps answer the "what, where, when and why to meet consumer and regulatory demands for accurate and detailed product information.

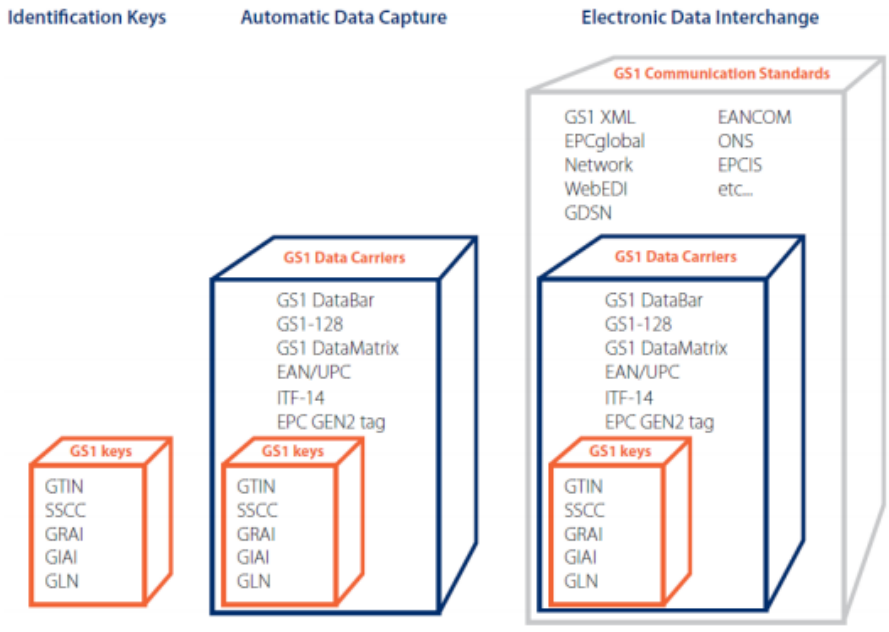


Figure 9. Types of Global Standards (GS1)

3.2. Global Data Synchronization Network (GDSN)

Data synchronization, according to the GS1 website (2017) is the process by which a data source and a data recipient create consistency between the data stored at both locations. This process is preferable executed continuously on a set time interval.

GDSN offers a single point of entry for the synchronization of product sheets. For manufacturers and suppliers, that means "publish once, distribute to all", while for retailers it means "subscribe once, receive from all".

The GS1 Global Data Synchronization Network (GDSN) is a network of interoperable data pools enabling collaborating users to securely synchronize master data based on GS1 standards. GDSN supports accurate, real-time data sharing and trade item updates among subscribed trading partners. (How GDSN works, GS1 14-05-2017). In other words, if one supplier or retailer updates their database, the database of the other partners is similarly updated as a result. This network ensures to have an automatic and efficient exchange of master data. Master data interexchange is one of the most critical operations in supply chains to achieve collaboration and supply chain visibility. The GDSN allows suppliers and retailers to have the same continuously refreshed data.

The main benefits of the GDSN according to the GS1 website are: (How GDSN works, GS1 14-05-2017):

- Allows business partners to access reliable and real-time product information.

- Eliminates manual processes and inefficient ways of sharing information (e-mail, phone calls, excel files).

- Reduce data management time and distribution costs.

- Enables to bring new products to the market more quickly and simply.

Each organization that wants to be part of this Global Data Synchronization Network (GDSN) needs to join a data pool certified and tested by GS1 who connect to the GS1 Global Registry, a central directory which keeps track of connections, guarantees the uniqueness of data and ensures compliance with shared GS1 standards. There are many data pools spread across the world (How GDSN works, GS1 14-05-2017).

The GS1 Global Registry is at the top and connects all data pools. For every product in a data pool the Global Registry stores the item number, the location number and the target market. This guarantees the uniqueness of the catalogue item.

The data pools store the actual information about the articles, like the unique identifier number, unique location number, brand name, description, size, shipping size, etc. There are many different types of data that can be exchanged via GDSN such as:

- Core data: the most basic data that is essential to define the main attributes of the product or set of products. For instance, GTIN, Brand, Subrand, etc.

- Logistical/B2B data: includes more specific data about the product. Products with the same core data but that differ in attributes such as height, width or dept; weights, tax information, hierarchy information, etc.

- Consumer data: data that is relevant to the consumer and that it does not really matter for the partners that comprise the supply chain. For instance, label information such as ingredients, allergens, etc.

- Other data: for instance, digital assets such as images, videos, manuals, SDS sheets…

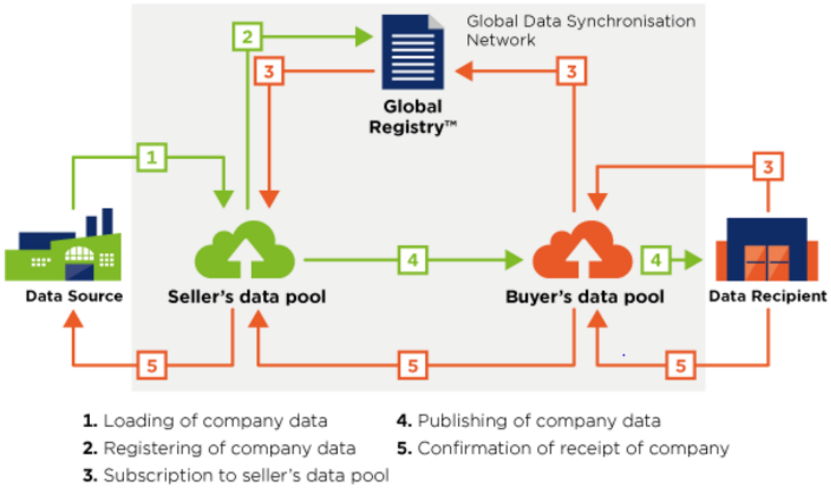


Figure 10. Global Data Synchronization Network (How GDSN works, GS1 14-05-

A data pool can be seen as a centralized database which can be accessed by multiple trading partners and where data is stored in a standardized way. The Global Registry assures this standardization. A Data Pool does not necessarily have to be part of the GDSN. Nevertheless, to become a GDSN-certified data pool there are several criteria in which the data pool must comply. These criteria can be found in the GS1 GDSN Certification Criteria Document. These criteria can be divided as follows (GDSN Certification criteria document, GS1, 01-06-2017):

- *Technical Performance*: Where a data pool offers optional functionality, the optional functionality must also pass the GS1 GDSN Interoperability Tests as contained in the GDSN Certification Event process. This testing is currently administered by the Drummond Group. Each certified data pool must maintain production-level connections to all other certified data pools, post certification.

This will help ensure a fully interoperable GDSN landscape to meet business needs of retailers and manufacturers globally.

- *Operational Performance*: The data pool must show Demonstrated Capability through active use of the network. Demonstrated Capability will be defined as, and measured by, the "the number of trading partner relationships which the data pool enables through the exchange of information in the network". A minimum threshold of 50 trading partner relationships is set for the metric. (Example – If a source data pool has 2 suppliers that have registered their GLNs and GTINs at the GS1 Global Registry and each of those suppliers have 5 retailers that have subscribed to those GTINs, then that source data pool would be supporting 10 trading partner relationships). If a data pool is serving as both source and recipient and the sync is taking place through the Global Registry, then this requirement is met for that single data pool. If a data pool total customer base is not large enough to achieve the operational performance threshold (e.g. 30 suppliers or retailers), then the data pool will not be held accountable to this measure until their customer base reaches this capacity.
- *Implementation Performance*: The data pool must demonstrate commitment to driving community adoption of the GDSN. Demonstrated Commitment is defined as, and measured by, "the ratio of the number of trading partners contracted with a Certified Data Pool versus the number of those contracted trading partners that are subscribing to, or registering items in, the GS1 Global Registry via that data pool." A minimum threshold for this ratio is 25 percent. (Example – if a data pool has 1,000 trading partners contracted for data pool services, 250 of them need to be subscribing to, or registering items in the GR.

- *Data Pool Service Level Compliance*: The data pool must demonstrate cooperation within the GDSN from the perspective of notifying other data pools of DP software upgrades; responding to issues/trouble tickets in a timely manner; and transfer of trading partners from one DP to the next (See DP to DP Service Level and Escalation Document in Appendix A for details).

- *Security Performance:* The data pool must pass a security review performed by an independent third party security audit firm. The audit may be performed by a local audit company selected by the data pool. Certification must be scalable so that it considers security and auditing of sensitive relationship dependent data. Once that review is completed and the data pool has passed, documentation must be shared with GS1 Data Excellence. Data Pools must demonstrate meeting minimum security requirements as defined in the GDSN Audit Requirements Document by successfully completing an independent third party audit at a minimum of every 24 months. Security Guideline and Recommended Audit Requirement documents can be accessed at the following link.

3.2.1. GDSN elements

3.2.1.1. Data Pool

An example of a GDSN-certified data pool is the 1SYNC data pool. 1SYNC is the largest data pool according to a GS1 Global Registry Statistics report (November 03, 2017).

According to the statistic document the total number of trading partners participating in the GDSN is 45,732 (see figure 6). The number of registered items across all data pools is almost 25 million. 14,5 million of these registered items were registered via the 1SYNC data pool, which represents 58.3% of the total of items registered. According to Schemm & Legner (2007), 1SYNC would be a "Mega Pool", because those items that are registered are present in multiple continents and sectors. A Data Pool that only contains items from a geographically bounded area is called a "Local Specialist", because the customer range reached is low compared to "Mega Pools". Moreover, they tend to focus on one sector or product group.

	TOTALS
Active Data Pools	36
Trading Partner GLNs	45,732
Data Recipients	1,738
Data Sources	43,994
Subscriptions Sent	2,229,234
Subscriptions Matched	1,808,082
Subscriptions Matched by Item	103,215,827
Recipient DP Subscription Matches	103,215,827
Registered Items (GTINs)	24,988,568
GTINs Coded with GPC	22,900,208

Figure 11. 1 SYNC trading information (GS1 Global Registry Statistics Report)

3.2.1.2. Product attributes

A product can be described in terms of its specific attributes. A data attribute describes the physical, compositional or structural properties of the item. GS1 and industry leaders decided together which attributes should be standardized. There are two types of standards: *mandatory attributes* and *extra attributes*. Mandatory attributes is the set of standards that need to be filled in for every product. Extra attributes are not mandatory but can be added to describe the product in more detail. These attributes are explained in more detail in the next sections:

- *Global Trade Item Number (GTIN*) (GS1, GTIN, 18-05-2017): it is the most important attribute. It is a globally unique GS1 identification number which identifies the trade items. Unique identification of trade items is critical to maintaining operational efficiencies that business partners rely on to exchange information about products in consistent ways, as well as ensuring the smooth operations of global supply chains. Additionally, the unique identification of trade items is crucial when complying with various regulations across the globe. A GTIN can exist of 8, 12, 13 or 14 digits and it is made of a company prefix, an item reference and a check digit as figure shows below:

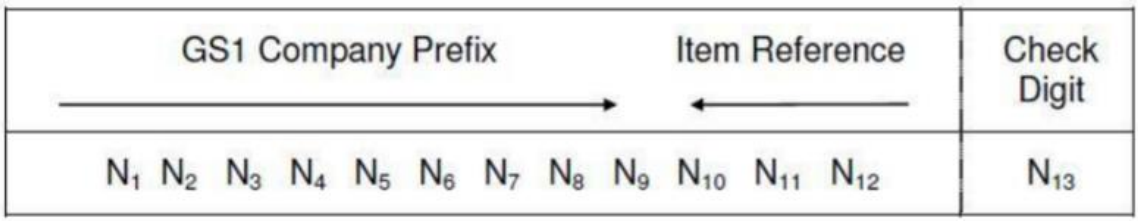


Figure 12. GTIN Identification keys (GS1 System of standards, GS1)

The GS1 Global Office assigns a prefix to a GS1 member organization. The item reference is assigned by the company itself and does not hold any specific information. The item reference is sequential and starts with 000, 001, 002, etc. The check digit is the final digit and is calculated from the other digits. This can be used in the scanning of the barcode to check if the number is correct.

Different packaging (figure 8) has different product attributes, although these different types of packaging contains the same product. However, the pack levels are linked to each other with the use of child-GTIN and parent-GTIN attributes. The brand owner decides which exact packaging levels are assigned with a GTIN.

Figure 13. Packaging attributes (GS1 System of standards, GS1)

It is possible that a product changes during its products life cycle. In these cases, the GTIN of the product could be new depending on the type of change. For instance, if they are minor changes that concern to the packaging material, the same GTIN can be used. Other situations require new GTIN. For example when the product is launched in another country and the language on the material is different or when the number of cases on a pallet changes.

- *Global location number (GLN) (GS1, Global Location Numbers (GLN), 18-05-2017):* provides a standardized way to identify locations and legal entities and automatically process this address information of senders and recipients. Location can be a physical place, such as warehouse or office, or even specific shelf within a store. Legal entity can be a company or its division. It consists of a 13 digit number

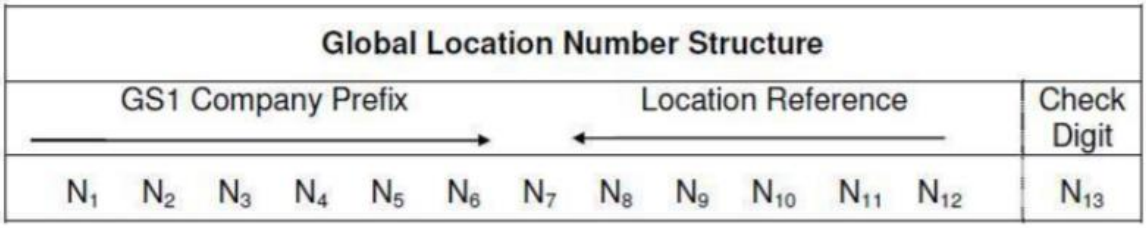


Figure 14. GLN Identification keys (GS1 System of standards, GS1)

These product attributes are encoded into physical solutions, which are either barcodes or RFID tags.

A data carrier is decided according to the amount and type of information that needs to be kept and level of label implementation (item/carton/pallet). The most widely used data carriers are shown in figure 10

Data carrier	Encoded information	Level of implementation	Description
 EAN-13	GTIN	item, carton	*EAN-13* is used to identify the FMCG at the cashiers (point of sale – POS) and in logistics processes. EAN-13 contains 13 digits and can be reduced in size to EAN-8 in order to fit onto a smaller package
 ITF-14	GTIN	carton	*ITF-14* barcode (GS1's interpretation of interleaved two of five barcode) contains 14 digits and is mainly used on a carton level and cannot be used at the POS
 GS1 Databar	GTIN, serial numbers, lot numbers of expiry dates	item	*GS1-DataBar* is a smaller 14 numeric barcode, which is used at the POS on a smaller items
 GS1 Datamatrix	GTIN, batch and serial numbers, expiration date	item	*GS1 DataMatrix* is a two-dimensional barcode, which can include up to 3116 digits of capacity. It can be placed on small space and on the metal surface. It requires the camera-based scanner for data capturing, and that is not intended to be used at the POS
 GS1-128	all GS1 identification keys (GTIN, GLN, SSCC, etc.) best-before date, etc.	pallet	*GS1-128* is implemented at pallet level for logistics processes and consequently includes more information (up to 48 alphanumeric digits). GS1-128 cannot be used to identify items at the POS
 RFID/EPC	EPC (Electronic Product Code) which contains all GS1 identification keys	item, carton, pallet	*RFID tag* is a microchip that stores much larger amount of data comparing to barcode and provides significant time-saving advantage since it does not require manual scanning

Figure 15. GLN Identification keys (GS1 General Specification, GS1)

3.2.2. Synchronization Process

The information about the synchronization process was collected in different implementation guidelines offered by GS1.

As first step, the supplier uploads the information for the required fields of their products in their data pool. This step is called "*on-boarding*". This product data is checked by the GDSN-certified data pool to ensure that it complies with GS1 standards. If the data is accepted, the GS1 Global Registry automatically registers the mandatory attributes described in the previous section. The process is depicted in the next image:

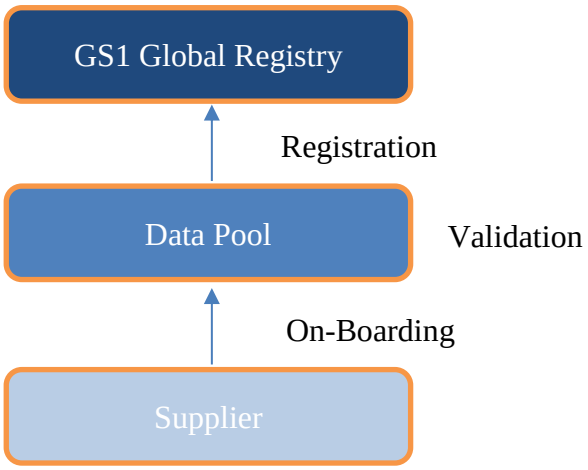


Figure 16. Synchronization Process 1

Product information is ready for distribution when it is in the data pool and stored in the GS1 Global Registry. The next step comes from the retailer. The retailer needs to send a subscription request to receive the data from the supplier. The data is received in the retailer's data pool only after supplier's approval. This process is shown in the next image

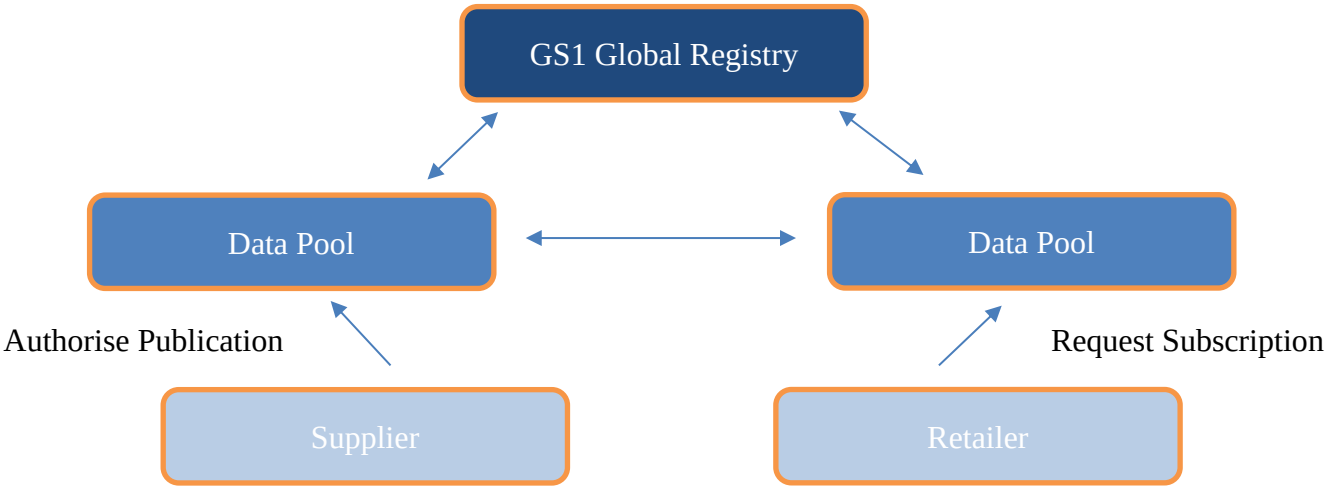


Figure 17. Synchronization Process 2

The GS1 Global Registry is at the top of the GDSN, it regulates all data uploaded and connects all GDSN-certified data pools with each other across the globe. The data pools offer a single point of entry to the user from where the users can upload or download data. In the data pools all mandatory GS1 product attributes are registered. The most important product attributes are the GTIN, GLN that are regulated by the GS1. These unique attributes are also used to register the product in the Global Registry. When a product physically changes, the question that needs to be asked is if the new product is interchangeable with the old product. If it is not interchangeable a new GTIN needs to be assigned to the "new" product.

3.2.3. KPIs

Any operational improvement should be measured to have a clear foundation that enables comparisons between the improved and the original situation. Suppliers and retailers need to establish them in order to track the improvements that the GDSN implementation brings along to the organization. Nevertheless, there is no standard KPI on company's performance provided by GS1. They exist but exclusively to measure the technical performance of the GDSN worldwide. Each participant should create and track them individually to be able to provide facts and statistical figures to the success of their implementation.
For the purpose of this thesis, it is interesting to know the performance that the GDSN has on the companies' operations where it has been implemented. They are an important part of the research and they are needed to further continue the analysis on the CSFs for GDSN implementation.

Fortunately, KPIs for the companies could be found out thanks to the collaboration of Lieven Bode and Chris Van Daele from Henkel and some retailer's representatives.

The KPIs that Henkel wants to implement in the future to track improvements based on the GDSN implementation are (Chris Van Daele, Head of the Customer Service Department at Henkel):

- Reduction in time required to process orders
- Reduction in the number of rejected orders
- Reduction in number of inquiries to customer support

If there is any discrepancy between the product data of the order placed by the retailer and the product data held by the supplier, the order will not enter quickly at the entry department and delays will occur. However, the order could also be processed with wrong information. This implies that it would be rejected at a later stage of the process (even when it is already shipped), causing extra costs. The last KPI relates to the reduction of complains (in the form of phone calls, emails, etc) from retailers to customer support or sales representatives about product data.

The GDSN implementation should remarkably improve these three performance indicators, ensuring a better operational performance of both agents in the supply chain. The benefits of the GDSN would ultimately improve the revenues of the supplier. Therefore, the last KPI is also important to measure the success of the GDSN implementation.

Retailers may have different KPIs to measure GDSN performance since they all have different values, strategy and expectations on this synchronization network. According to the outcome of the conversations/interviews held with some retailer's representatives the two most important KPIs they take into account to measure GDSN performance are:

- Reduction in invoice issues related to wrong product information ordered to the supplier
- Reduction on correcting product data

The supplier will contact the retailer if this one invoices products with wrong or obsolete information, causing delays. Then the retailer will be contacted back by the supplier and will need to spend time on figuring out the root cause of the error and on correcting it. The other KPI is the reduction in time spent on updating or adding new product information due to errors. Both KPIs are actually linked with each other since the second one is a consequence of the first one. However, the first one is easier to be tracked by retailers since invoices are always stored. The time a team spends on correcting product data is more difficult to be tracked.
The measurements of these KPIs can show the actual effect of the GDSN on the operational efficiency of logistics processes along the supply chain.

3.2.4. Business Process Modelling/ Change Analysis

3.2.4.1. Process without GDSN

The retailer needs to know all the information of the products that are received from the supplier. Therefore, the supplier needs to send this information somehow. The current process without the GDSN is displayed in figure 13. This is a generalization of how retailer and supplier would exchange data, but in specific cases this process might be slightly different. The purchasing department of the retailer sends an information request to the supplier via e-mail or fax. The customer department of the supplier receives the request and processes it. Then the supplier prepares all the information related to that order and sends it back by e-mail or fax to the purchase department. Finally, the retailer updates its product database with this new information.

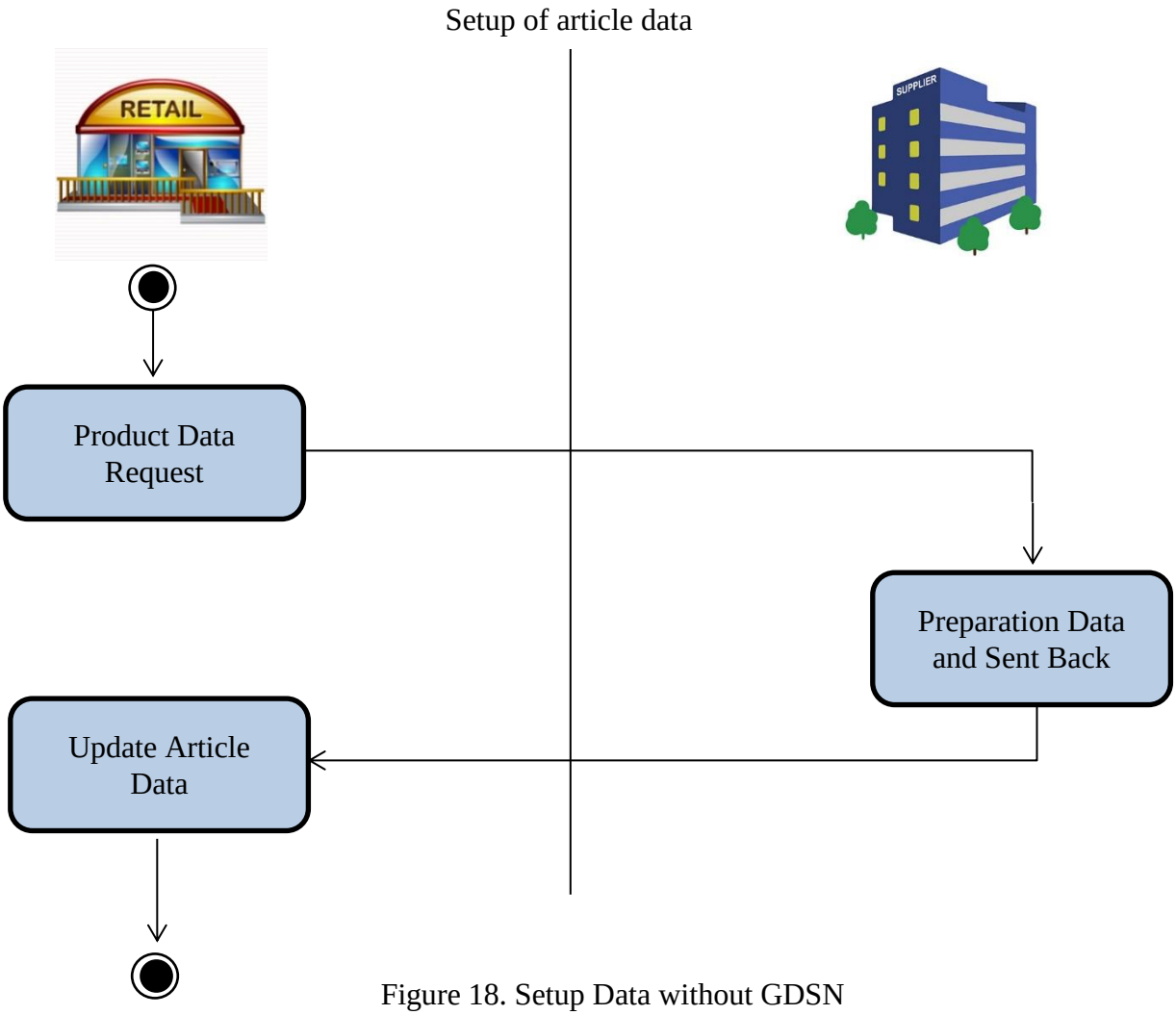


Figure 18. Setup Data without GDSN

Inefficiencies

The non-GDSN setup of article data has some inefficiencies. The first one lies on the request of product data from the retailer. This is done via e-mail or a fax. This request needs to be processed by the supplier customer department. It can take several days before a request is answered, depending on the supplier's response time. Normally, the supplier would like to receive the same format of the data as the format of their database so that they do not need to spend time on converting the received data. An example is when the retailer and the supplier are in regions where the units of measurements are different (Europe vs America). In this case, the retailer will be sending product data to the supplier with different units, which makes the supplier spend time on converting the data before it can be added to the product database. To prevent non-valuable, retailers may send a predefined Excel file to the supplier. In this file predefined fields are constructed, so that the supplier is only capable of filling in the article data according to the customer's format.

A second downside that a manual article data exchange involves is the fact that typographical errors might occur in both sides. The retailer may make errors when sending the data or the supplier may make them when uploading them in their database.

Another problem that may occur is related to the Excel software versions. If different versions and languages are used, changes in the stored data may happen. This is especially dangerous when the purchase departments use automatic conversion programs to upload the product data into their databases. According to Chris Van Daele, Head of the Customer Service Department at Henkel), this issue might seem irrelevant but it occurs more than what people may think of.

The last inefficiency is that the retailer always triggers the product data request but not the other way around. The retailer usually makes this request once or twice a year. However if the supplier updates their product catalogue, the retailer would not be informed about it until the next request.

3.2.4.2. Process with GDSN

The next image depicts the situation using the GDSN. This process has already been explained in section 3.3

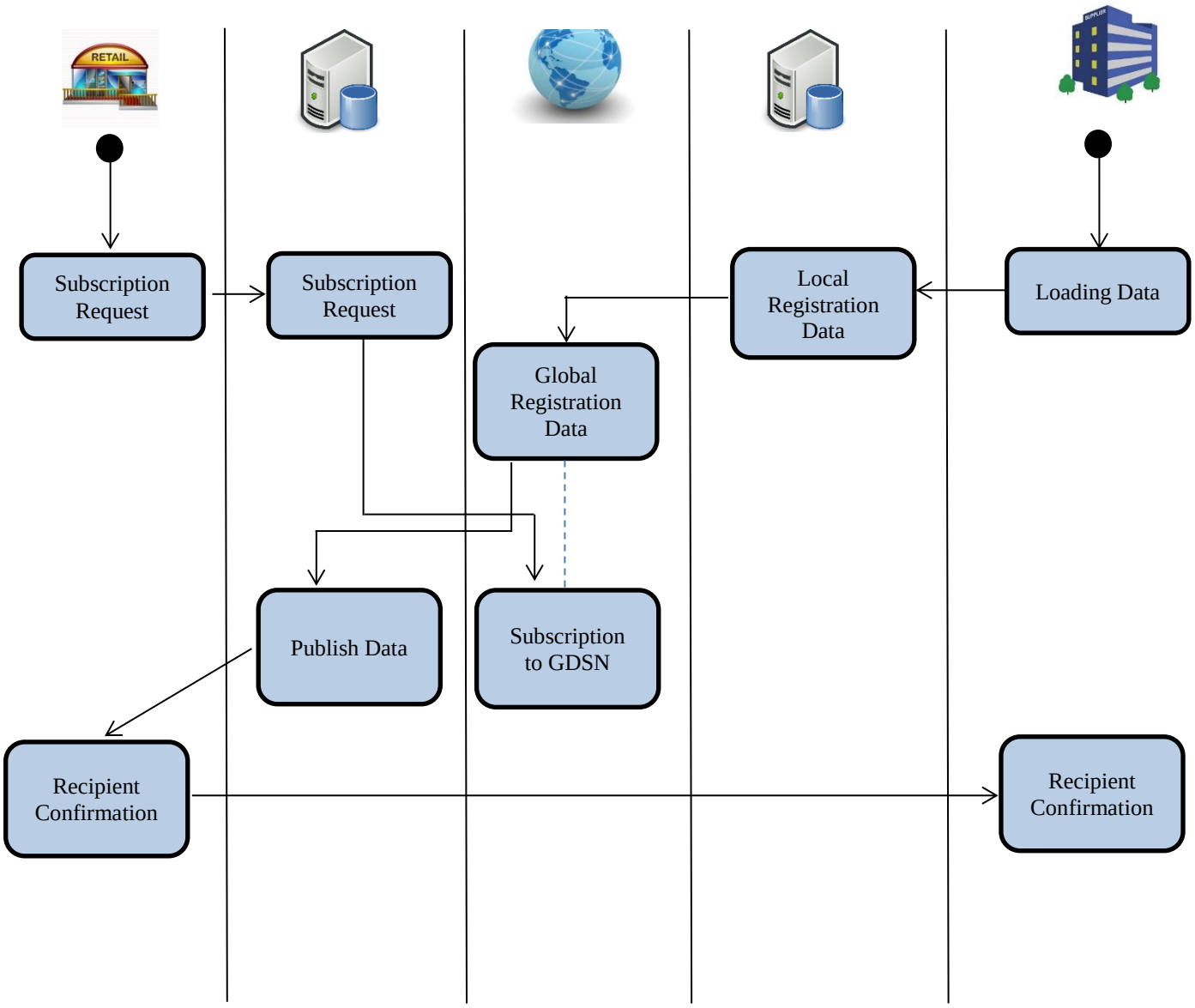


Figure 19. Setup Data with GDSN

In the GDSN-setup of article data, both the retailer and the supplier initiates the setup process. On the one hand, the retailer needs to send a subscription request to obtain the product data, something that is also done in the non-GDSN version.

However, the product data request in the other version is directly sent to the supplier. With the GDSN in place, the retailer uses this request to its own data pool to transfer the request to the supplier. On the other hand, the supplier loads the product data in its own data pool, which is linked to the GS1 Global Registry. It is in this Global Registry where the subscription request and the product data are linked to each other. If the supplier approves the request, then the retailer's data pool retrieves the data and both the retailer and the supplier receives a notification confirming such action.

The inefficiencies explained in the previous section would be inexistent under this new process. Requesting article data is not a time-consuming activity anymore. A request is created by the retailer and approved by the supplier. That's the only inputs that both entities need to provide in order to exchange product information. The retailer creates a request for the wanted information, and if the supplier approves this request both the retailer and the supplier do not need to spend time in extra tasks such as checking and correcting the data with all the business partners they exchange products with, as they would need to do in the non-GDSN version. The data that is exchanged is accurate and reliable because it is created in one single universal format supported by GS1.

3.3. Link between the ERP system and the GDSN network

The Enterprise Resource Planning (ERP) is the integrated management of core business processes, often in real-time and mediated by software and technology. This technology allows to manage all the business processes from an organization (Almajali, et al., 2016).

As product recipes and circumstances constantly change, the product information in the GDSN has to be updated frequently. To do so, many manufacturers manually or semi-automatically upload their data — a cumbersome process when there is thousands of products in various types of packaging. Not to mention the number of data inconsistencies that can and will arise during the manual uploading process. What's more, once the information has been uploaded, soon the process of tracking changes in product formulas, recipes, production processes, new product launches, etc. needs to be restarted.

The objective should be to build a single source of truth to automatize as much as possible this tedious process and reduce the problems associated to it.

One thing is clear: to digitize production information, manufacturers need a central database system to maintain all of their product content. And ideally, there is an automatic connection between this database and the GDSN network.

The challenge is to make a system that:

- No need a high investment
- High quality system
- High productivity (automated upload)

Additional dedicated software packages are often promoted for this purpose. This may be the way to go for large companies, but in many cases, this solution will lead to isolated product information. Even further, you will probably need numerous interfaces within your enterprise resource planning (ERP) system.

Here is a thought on how to tackle this issue. The ERP system already holds a vast chunk of product information. So why do not use ERP as the main and complete product content database system? No extra software needed, and no data duplication due to adding another database system to deal with. Instead, you publish your product info the way it is defined in your core database system.

The solution lies in creating a standard "GS1 cockpit" transaction in the SAP ERP system in which communication is done by communication with GS1 running via SAP Process Orchestration.

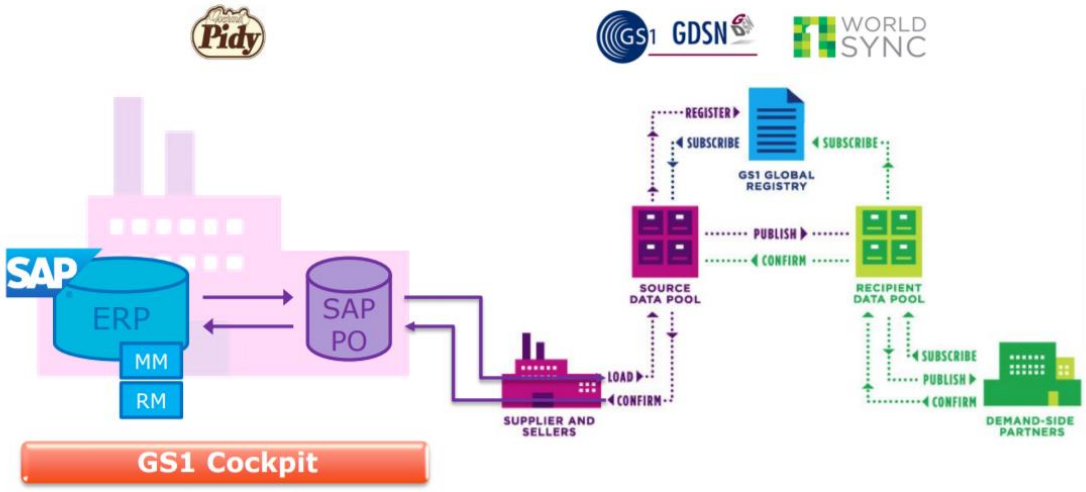


Figure 20. Link ERP and GDSN (GS1)

Figure 15 provides a basic explanation of this system. Figure 15 only shows that the supplier has a data source from where the data is transferred to a data pool before being published in a global registry. Then the retailer is able to download these data in its data pool from the global registry to be able to read it and store appropriately. This is a basic explanation because no concrete IT systems are mentioned. The explanation that is going to be given hereafter includes the IT systems used.

Most of the FMCG organizations use an enterprise resource planning (ERP) for storing master data and other technical information. Therefore, the GDSN needs to be connected

somehow with the ERP of the company since it is the most extensive source of information to obtain the data from.

GS1 standards is not prepared to obtain and classify all the data that will be exchanged with the retailer from the ERP. An intermediate system is needed. Henkel and other FMCG companies use a product data management software. Product data management (PDM) is the process of capturing and managing the electronic information related to a product so it can be reused in business processes such as design, production, distribution and marketing.

It usually involves the use of a dedicated software application and centralized database. PDM typically encompasses multiple products' technical specifications, engineering models, design drawings, bills of materials (BOMs) and related documents. PDM software provides version control and security to ensure that the information stored in the central repository is accurate and up to date, which in turn can reduce data processing and make operations more efficient.

SRC is the company that provides this software to Henkel. The main reason why this software is used is because some of the master data store in the ERP is local, upon agreement between the supplier and the retailer. Therefore, an intermediate step is needed to transform these data in something standardized. It is not only the PDM software that is involved in this process. The GDSN also needs to establish a policy of "embracing the chaos" in which a standardized process for sharing non-standard data is going to be defined and implemented. The tools for enabling this process are:

1. The publication of extended attributes which are visible to all trading partners within the network
2. A defined method for sharing them (this is known as "AVP" or Attribute Value Pair methodology).

These attributes and methods for sharing them can be used in the PDM software but not in the ERP. Therefore, all the data from the ERP can be adequately classified in the PDM. Once the data is classified following the GS1 standards, it can be published in the GS1 data pool. There are thousands of attributes that refer to the each product’s characteristics, such as brand, sub brand, weight, height, nutritional information, etc.

The next picture represent how master data from the FMCG organization is transferred to the GS1 data pool

Figure 21. Master data from the ERP to the GS1 datapool

3.4. Conclusions

This section provides an overview of GS1 and the GDSN background to understand the scope of global standards and what the GDSN consists of. Section 3.1 explains how GS1 was born and the gap that the association aims at fulfilling. GS1 is the organization that is in charge of setting up all the methods and rules that allows the creation and maintenance of globally agreed standards and guidelines. GS1 objective is to improve the performance of international supply chains through the collaborative development and endorsement of recommended voluntary standards and best practices.

The GDSN section includes an overview of what it is, its main benefits and how it works. The GS1 Global Data Synchronization Network (GDSN) is a network of interoperable data pools enabling collaborating users to securely synchronize master data based on GS1 standards. GDSN supports accurate, real-time data sharing and trade item updates among subscribed trading partners. The main benefits are: (1) Allows business partners to access reliable and real-time product information. (2) Eliminates manual processes and inefficient ways of sharing information (e-mail, phone calls, excel files). (3) Reduce data management time and distribution costs. (4) Enables to bring new products to the market more quickly and simply. Then the synchronization process is explained. The GS1 Global Registry and the data pools are the systems that support this process. KPIs to track the improvements that the GDSN bring along have been analyzed. No studies were found on KPIs for the GDSN, however, they are necessary to quantify the benefits of the GDSN. Three were identified from Henkel and two from the retailers. These KPIs are created by each organization because GS1 doesn't provide a fixed set of KPIs to measure the GDSN performance. The product data setup business processes are also compared with and without GDSN. Introducing the GDSN makes the process look more complex. However, the GDSN manages to eliminate some inefficiencies that are present when the GDSN is not used. The main inefficiencies have to do with the way in which product information is requested. E-mails and faxes will have many human errors. In addition, e-mails can take several days to be answered. Excel files are also inefficient as the format used by the supplier must be different compared to the one used by the retailer. This causes more manual work and delay in performing the administrative steps.

Finally, the compatibility of the GDSN with SAP is addressed to show that it is possible to get some data already stored in SAP into the GDSN. This would make easier the data setup process.

In conclusion, this section provides an introduction to the GS1 and the GDSN and then it digs into the technical aspects of the GDSN to understand how it works, it benefits, the product data setup process and the inefficiencies that the GDSN is able to eliminate. This new knowledge is used in the next section as well as in the preparation of the interviews performed at Henkel and the retailers.

4. Inter-Organizational Information System Framework

This section introduces some inter-organizational information system frameworks collected from the literature. They are analyzed taking into account the GDSN background and one of the frameworks is selected to further continue the analysis. This IOS model will be adapted in section 4.3 according to the particular characteristics of the GDSN and the Henkel case study in order to come up with a GDSN adoption framework.

4.1. Introduction

The desire to share information and promote collaborative management and coordination of supply chains (SC) causes firms to turn to inter-organizational information systems (IOS) for SCM (Van Hoek, 2001). During the last decade or so there has been a considerable infusion of information technology (IT) into SCM. They enable integration between trading partners through faster, more efficient and more accurate data exchange, thus offering ample benefits for trading partners (Rahim & Kurnia, 2004). Nevertheless, IOS adoption is a very complex process since more than one organization is involved in the development process. Complexity is much higher when it comes to inter-organizational issues since you have to agree on shared benefits and costs and deal with conflicting interests and power imbalance. The purpose of this thesis is to use an adoption framework of an IOS for SCM to analyze the case study found in Henkel regarding the implementation of the GDSN between Henkel and the retailers. The idea is to use an existing framework or a combination of them and then adapt it to the GDSN case. In addition, the interviews performed at Henkel and the retailers will be used to redefined the model and identify the determinants for adoption and the critical success factors.

4.2. Literature review

Few paper can be found on IOS within SCM. This first ones date back to 1993 when *Grover (1993)* studied the factors that influence the adoption of an IOS. *Premkumar (2000)* focuses on the potential benefits of IOS in supply chains while highlights the management issues that its implementation may face. *Kurnia and Johnston (2000)* use both factor and processual approaches to give a better understanding of IOS adoption. *Rahim et al. (2002) and Johnston et al. (2004),* have examined the adoption of an IOS from both customer and supplier perspectives.

Literature is scarce when it comes to IOS for SCM. IT within SCM has never been one of the most addressed topics in the literature. Giunipero et al., (2008) made an analysis on the subjects that were covered in the literature by SCM between 1997 and 2006. 405 articles from the nine most popular academic journals within the field were analyzed. Findings are presented in the next table:

Topic	Description	Frequency
SCM Strategy	Strategic alignment between the SC and the focal firm	23%
SCM Frameworks, Trends, and Challenges	Categorization of SCM frameworks, trends, and challenges	18%
Relationships	The relationship between the focal firm and its business partners	16%
E-Commerce	The effect of E-commerce and the Internet on the supply chain	8%
Time-Based Strategies	Managing supply chain inventories and enhancing flexibility	6%
Information Technology	The use of information technology or systems in the supply chain	5%
Quality	Product and service quality output in the supply chain	5%
Supplier Development	Supplier Development, Selection and Management	4%
Environmental/Social Responsibility	Ethical, environmental and social responsibility concerns faced by organizations	3%
Outsourcing	Outsourcing the Supply Chain processes	3%
Buyer Behavior	Inter-firm behaviors and activities	3%
International	Globalization of the supply chain	2%
HR Management	The process of establishing necessary reporting relationships between and among firms	2%

Table 1. Literature Review on Supply Chain Management (Giunipero et al., 2008)

However, the interest is not in finding papers that address IOS for SCM but in papers that analyze the adoption process of an IOS. Four papers are found in the literature that either address the adoption process or that introduce a (conceptual) framework for IOS adoption:

1. Rahim & Kurnia (2004) identifies a number of factors that affect the achievement of IOS benefits. This article is useful to study why some organizations have gained many benefits while others have experienced limited benefits from IOS adoption. These factors are divided in three groups: operational benefits, managerial benefits and strategic benefits. However, this paper is very specific in the four case studies that are analyzed and will not be of help to develop a general IOS framework

2. Pang & Bunker (2007) are the authors who developed the first conceptual framework to examine an IOS for SCM. This framework takes into account only the supplier and customer perspectives and supports the framework with four theories, namely resource dependency theory, organizational theory, actor-network theory and negotiated order theory. The framework has been constructed from the literature identifying six major aspects for consideration namely: inter- and intra-

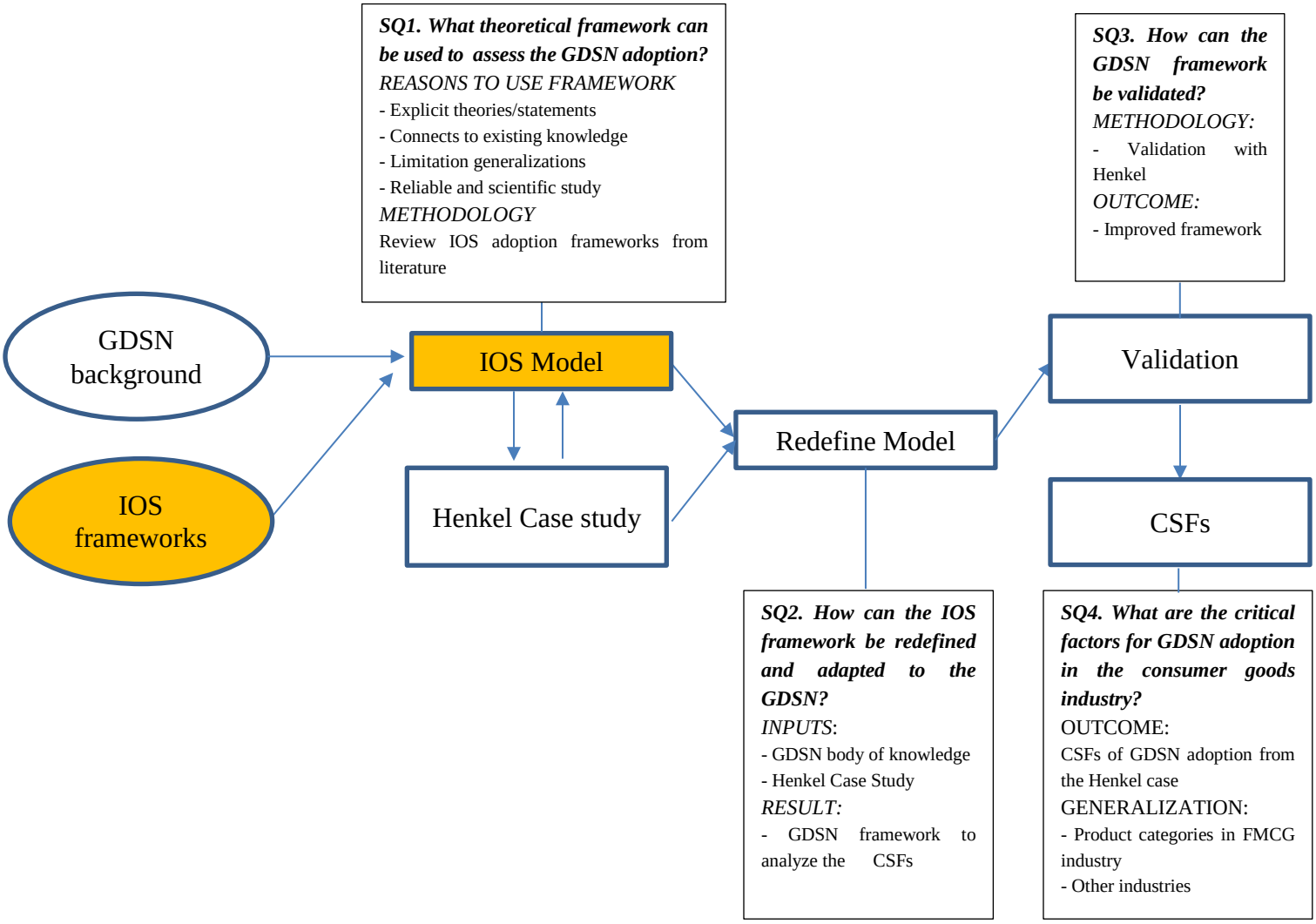
organizational collaboration; strategic management approaches; supply chain design (SCD); business process redesign/ reengineering (BPR); information systems (IS)/information technology (IT) architecture and external environmental factors.

3. Bouchbout & Alimazighi (2008) proposes a theoretical framework to identify important factors for IOS adoption. Five groups of factors are identified: 1) interorganizational context, 2) organizational context, 3) technological context, 4) perceived costs, and 5) perceived benefits. This one is similar to the Pang & Bunker model. However, these aspects are more general and less applicable than the Pang & Bunker model.

4. Kauremaa & Tanskanen (2017) propose a conceptual framework more focused on the design of an IOS for SCM to increase the understanding on the essential managerial and technical decisions. However, this framework is very specific on certain aspects that are more useful out of the scope of the GDSN.

Therefore, the most appropriate model is the Pang & Bunker one as it is the one that take more factors into account. It is based on sounded theories (resource dependency theory, organizational theory, actor-network theory and negotiated order theory) and it is very well-structured.

4.3. IOS adoption framework



The framework developed by *Pang & Bunker (2007)* is the model chosen as starting point to formulate a GDSN framework. The main reason is that is a general conceptual framework that is applicable for any IOS in the SCM field. In addition, it is well-founded in the literature and considers six major aspects to examine the IOS adoption in SCM. According to the GDSN background and the information collected in interviews, these six aspects address the main issues concerning the GDSN implementation process.

The six major aspects are: (1) inter and intra organizational collaboration, (2) supply chain design, (3) strategic management approaches, (4) business process reengineering, (5) IT architecture and (6) external environmental factors.

The four theories upon which the implementation framework is based are:

- *Resource dependency theory*: RDT characterizes the corporation as an open system, dependent on contingencies in the external environment (Pfeffer & Salancik, 1978). "*to understand the behavior of an organization you must understand the context of that behavior—that is, the ecology of the organization*." RDT needs to be reformulated based on the SCM concept and taking into account that the GDSN is an IOS used only between two agents, the supplier and retailer. Ratnasingham and Kumar (2000), p.547 provides a definition within the SCM context: "*a holistic approach with explicit recognition of economic and socio-political dimensions of trading partner relationships*". The GDSN is an IOS that enables a standardized exchange of information between the supplier and the retailer. However, supply and demand of resources can lead to the dominance of a buyer or supplier in a supply chain network (Cox 2001). Therefore, an imbalance in the relationship between suppliers and retailers may occur. For the case study purposed, this theory suggests that resource dependency and power relationships influence management's decision in the adoption of an IOS for SCM.

- *Organizational Theory:* This theory has been used not only to study organizations extensively but also to study the relationship between two or more organizations. Literature on organizational theory addresses structural characteristics (e.g. centralization, formalization and complexity) and behavioral process characteristics (e.g. power and conflict) (Bensaou and Venkatraman 1996). This theory is taken into consideration in the implementation framework of an IOS because both structural and behavioral characteristics of managers influence its adoption for SCM (Lambert et al. 1998). The problem with this theory is that researchers have simply extended the within-organization level to the across-organization level to consider two or more organizations without articulation of any distinct role in the new level of analysis (Bensaou and Venkatraman 1996, p.85). Actor-Network Theory covers this aspect and it will be used instead.

- *Actor-Network Theory (ANT):* ANT focuses on the interaction between actors within an organization. In the context of IOS for SCM, this theory aims at examining the interaction between managers within an organization and in a supplier-customer relationship. One advantage of this theory is that both people and technologies are considered as actors and are examined together as a social-technical network: "modern affiliations among individuals, groups, and organizations entail the use of ICTs to varying degrees; therefore, all networks can be viewed as heterogeneous socio-technical actor-networks" (Lamb and Kling 2003, p.202). ANT "seeks to position itself firmly in the middle of the spectrum between technological and social determinism" (Rose et al. 2005, p.139)

- *Negotiated Order Theory:* This theory advocates that organizations negotiate the terms under which they will interact with one another in the future (Nathan and Mitroff 1991, p.165). It is theory most extensively used to study inter organizational collaboration "negotiated order theory thus focuses on the symbolic and perceptual aspects of interorganizational relationships, particularly on the evolution of shared understandings among stakeholders of the domain's structures and processes, limits and possibilities" (Gray and Wood 1991, p.10). Therefore, this theory is applied to examine the interactions between involved stakeholders in the adoption of an IOS for SCM.

These theories will be used as the background to form the adoption framework of an IOS for SCM.

This thesis advocates that managerial decisions have the greatest influence on the adoption of an IOS. The framework will be used to explain how managers collaborate with their partners when it comes to making decisions in four areas:

- Propose and execute a strategy
- Redesign the supply chain
- Reengineer business processes
- Develop IOSs

Both Supplier and Customer have a certain degree of control and (conflicting) interests over these four areas. External factors may also be important and should be added to it.

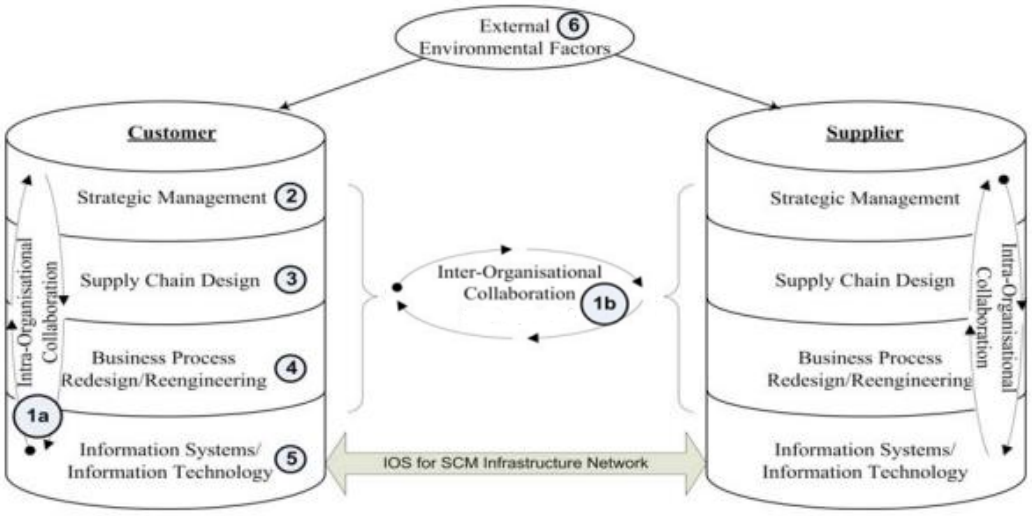


Figure 22. IOS for SCM adoption framework (Pang & Bunker, 2007)

To ensure a successful implementation of an IOS for SCM, not only the alignment of partners' business strategies is important; the redesign of internal control systems and performance measures to ensure the correct performance of the IOS is as essential as the inter organizational relationships. Figure 1 depicts the common aspects regarding the adoption of an IOS for SCM.

1. Collaboration ((a) intra- and (b) inter-organizational)
2. Strategic Management
3. Supply Chain Design
4. Business Process Reengineering (BPR)
5. Inter organizational Information Systems (IOS)
6. External Environmental Factors

These 6 aspects can be classified as follows:

1b & 2: Strategic Collaboration
1b, 3 & 4: Process Collaboration
1b & 5: Technical Collaboration
6: Uncontrollable Factor.

4.3.1. Collaboration

Supplier and Customers have to collaborate to (re)design their supply chain, business processes and IT systems. Therefore, it is one of the aspects that is present in all the others

Collaboration is a very broad term and different perspectives on the meaning of "collaboration" are considered. An Oxford paper simply defines collaboration as: "the action of working with someone to produce something" (Oxford 2004). The definition proposed by Oxford is very simple but enough to clearly understand the meaning of collaboration when it comes to the adoption of an IOS in SCM. Collaboration is a term that involves linkages organizations, resources and people to produce something. In this case, to "produce" the implementation of an IOS for its SCM.

Even though collaboration can be simply defined and understood, it can be something very difficult to accomplish, especially when you have to collaborate with organizations with different strategies and interests.

SCM is a particular field where collaboration is highly needed to ensure benefits among business partners. Collaboration in SCM should imply closer relationships, integrating processes, and the sharing of information, knowledge, risk, benefits and profits between organizations (Barratt 2004).). It has been demonstrated, however, that to collaborate between organizations in a supply chain network is not an easy task (Barratt 2004).

Collaboration is classified as shown in Figure 21 (1a) intra- and (1b) inter-organizational collaboration.

1a. Intra-Organizational Collaboration

Intra-organizational collaboration entails the communication and interaction activities between actors in an organization. In the context of the adoption of an IOS in the SCM, we have the intra-organizational collaboration on the customer side (retailer) and on the supplier side. Actors within each organization include the top management and the employees working in the different departments. Actors will have different roles in the adoption process of an IOS in SCM. Actors may:

- Directly influence in the implementation process
- Indirectly influence in the collaboration process (e.g. inputs from cost-benefit analysis)
- Indirectly influence the actions taken by managers from other departments within an organization

IOS adoption requires managers from different departments to work together (Reich and Benbasat 2000). Findings from research that are useful for this thesis is that all the means have to be used in order to ensure that managers from different departments come together to work on cross-functional task forces and cross-functional project teams. Problems that hinder this intra-organizational collaboration includes lack of communication, understanding and reluctance to share information between departments

1b. Inter-Organizational Collaboration

Inter-organizational collaboration involves the external communication and interaction between actors from different organizations.

Inter- and intra-organizational collaborations are not isolated but are continuous processes within and between organizations. Moreover, both collaborations influence each other on the outcomes of both processes.

A prior strong relationship among partners will have an important influence on inter-organizational collaboration

Intra- and Inter-Organizational Collaboration Analysis

Intra-organizational collaboration is not classified in any of the 4 classifications used at the beginning of this section (strategic, process, technical and environmental factors). The reason is that that classification is used to include both the supplier and the customer interactions. However, intra-organizational collaboration only includes the within-the-organization dimension. Organizational theory and ANT can be used to enlighten how the managers interact and influence each other within an organization.

The outcome after considering both theories is that interaction and influence result in an agreement between managers within an organization on an inter-organizational collaborative strategy that can be executed by both parties. Finally, Negotiated Order Theory is used to study the interaction between the managers as part of the negotiation process.

Inter-organizational collaboration was classified as strategic, process and technical. This classification depends on who are involved in each facet. The three levels of inter-organizational collaboration are detailed as:

a. Strategic Collaboration (1b-2): This is the collaboration between top and senior management from both parties. They negotiate and develop a collaborative inter-organizational strategy that both parties are satisfied with and that can accept.

b. Process Collaboration (1b-3-4): This is the level where both parties have to collaborate to redesign/reengineer the supply chain network and the business processes. For working on these tasks, managers from SC and IT departments need to come together to facilitate the redesign of the supply chain network and business processes though intra-organizational collaboration. Therefore, in process collaboration, intra- and inter-organizational collaboration is happening at the same time since not only SC and IT departments within the organization (within supplier and retailer organizations) collaborate together but also across organizations (in this case SC and IT departments of both organizations work together)

c. Technical Collaboration (1b-5): This is the technical collaboration to develop an IOS infrastructure between the IT departments from both parties. Intra-organizational collaboration from other departments is needed to develop the systems.

The three-level classification help understand how inter-organizational collaboration works and what department needs to be involved in the each facet.

4.3.2. Strategic Management

Suppliers and Retailers need to have a strategy to effectively adopt an IOS for SCM. This thesis will now examine in detail this aspect in order to identify the main factors that have to be taken into account and that affect the development of a strategy.

This section will identify the factors that influence the strategy as well as the application of the four theories.

Porter (1996, p.68) defines strategy as “the creation of a unique and valuable position, involving a different set of activities”, and argues the essence of strategy is differentiation and choosing different sets of activities to achieve different values (Porter 1996).

The problem we come across when analyzing a strategy for the adoption of IOS in SCM is that no strategy is suggested in the literature. Therefore, an analysis of the factors have to be performed in order to study the strategy regarding the implementation of an IOS for SCM. There is a systemic approach to study any strategy that was suggested by Whittington (1993). This approach suggests that the factors in the next fields need to be studied in order to understand how each of these factors lead to a successful adoption of an IOS for SCM.

a. Financial Benefits
b. Needs and Motivations
c. Resource Dependency
d. Power Relationships
e. Inter-Organizational Relationships
f. Trust
g. Selectin a Partner
Adoption factors need to be examined from both the supplier and customer perspectives.

a. Financial Benefits

Organizations that have most of the gains from SCM will be the most motivated to develop a collaborative strategy. Operating costs, reduced inventories and processing errors are examples behind the drivers of adopting an IOS (Frohlich and Westbrook 2001).

b. Needs and Motivation

An organisation must have interests, needs and motivation to collaborate with their partners to adopt an IOS for SCM (Pang and Bunker 2005).

c. Resource Dependency
Supply and demand of resources can lead to a dependency between a supplier and a customer. However, customers might not want to "lock-in" and depend on one supplier using its IOS because this hampers competition among its suppliers even when there is a clear financial benefit (Clemons and Row 1992). Resource dependency theory can be used to explain the drivers behind the adoption of an IOS and hence organizations with the most to gain are more likely to have these drivers in place.

d. Power Relationships

Resource dependency as discussed in (c) can lead to the dominance of a buyer or supplier in a supply chain network; this can lead to imbalance of power relationships between a supplier and a customer (Cox, 2001)

e. Inter-Organizational Relationships

Oliver (1990) suggests six contingencies to establish an inter-organizational relationship (c). They are (Oliver 1990; Koch 2002, p.69):

- *Necessity*: firms enter relationships to meet necessary legal or regulatory requirements.
- *Asymmetry*: firms enter relationships to exercise power or control over another organizations or its' resources.
- *Reciprocity*: firms enter relationships to pursue common goals.
- *Efficiency*: firms enter relationships to improve their internal input/output ratio.
- *Stability*: firms enter relationships to respond to environmental uncertainty.
- *Legitimacy*: firms enter relationships to appear in agreement with the prevailing norms

f. Trust

It can help decrease uncertainty during IOS adoption

g. Selecting a Partner

Selection of a partner is based on the next criteria: reliance of resources (c), power relationship (d), previous inter-organizational relationship (e); and trust developed between the organizations (f).

Application of Theories to the IOS for SCM framework at the strategic level:
The application of the four proposed theories will be analyzed at a strategic level:

a) Resources Dependency Theory

This theory is used to examine the influence of resources of suppliers and customers in the development of an IOS for SCM. Resource dependency helps understand the "formation of inter organizational linkage which helps an organization acquire resources and manage uncertainty" (Koch 2002).

b) Organizational Theory and ANT

It is normal that two organizations have different strategies that might be not compatible with each other. An organization might start a strategic approach and change it in later stages because it is not compatible with other organization's strategies. ANT helps understand the interaction and influence from different managers when making a strategy. ANT is especially useful when studying the formation of inter-organizational relationships to collaborate to adopt an IOS.

c) Negotiated Order Theory

The power dominance that results from resource dependency will influence the negotiation process between the supplier and the retailer. The negotiation among managers will result in an outcome in inter-organizational collaboration.

It is suggested to at least start the negotiation with ground rules so the power dominance does not affect the negotiation process greatly, e.g. trading terms.

4.3.3. Supply Chain Design (SCD) and Business Process Reengineering/Redesign (BPR)

Organizations need to work collaboratively in to redesign or reengineer business processes to build an operational efficient supply chain. "Competition no longer means one company competing with another company – it means an entire supply chain competing with another supply chain" (El Sawy 2001, p.45).

SCD and BPR are interlinked. SCD is the (re)design of a supply chain by integrating the flow of information, movement of goods and business processes such as production planning, inventory control, distribution and logistics (Beamon 1998).

SCD depends on other aspects of the framework such as the strategy selected, the maturity of IT infrastructure, degree of collaboration, and the level of information sharing between organizations previously agreed.

BPR depend on those business processes that the company is willing to redesign.

The original supply chain design will most likely need to be modified due to unforeseen technological problems or business issues.
The first step upon which SCD depends is the strategy selection. Different strategies are Just-in Time (JIT), Zero Inventory (ZI), Efficient Consumer Response (ECR), Vendor Managed Inventory (VMI).

Once SCD is aligned with the strategy, the business processes must fit the SCD in an IOS environment. BPR is needed to redesign these processes. Hammer & Champy (1993, p.32) introduce the concept of BPR as, "fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed".
An organization has to reengineer its business processes with their partners based on SCD to achieve the IOS functions - this is sometimes also known as "process X-engineering" (Attaran 2004). Not only to achieve the IOS functions but to maximize the benefits of the IOS. An organization should understand its processes well before trying to understand those from their partners (Frankel et al. 2002). Intra- and inter-organizational collaboration will help drive BPR at the organizational level and inter-organizational level.

After SCD and business processes are modelled, the requirements for system and infrastructure development for an IOS need to be developed. SCOR (Supply Chain Operations Reference) is the most extensively used model for both supply chain and process design. Intra- and inter organizational collaboration is the most important aspect for SCD and BPR. Firstly, departments have to agree on SCD and BPR. Secondly, both

have to fit with their business' partner's processes. Finally, the new processes have to fit the new IOS for SCM, and vice versa.

4.3.4. IOS factors

Technical compatibility is the main challenge for organizations. The more systems the new IOS is compatible with the less changes on the redesign of the supply chain network and business processes are needed. However, the new developments of the Internet and web services makes the adoption of an IOS less troublesome than in the past (Attaran 2004).

The physical architecture design of an IOS includes primary technology choice, client/server architecture and the nature of linkages (Premkumar 2000).

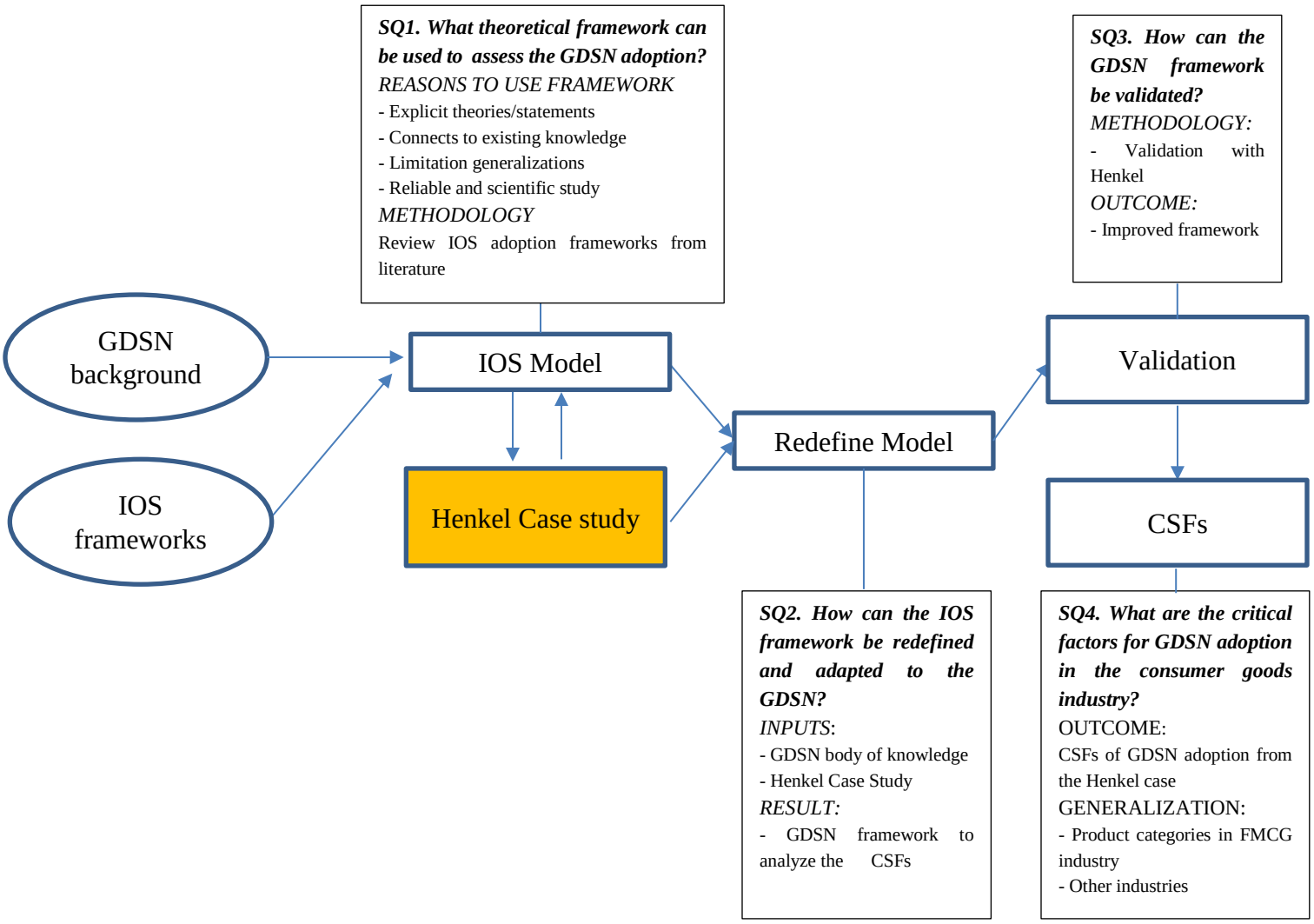
Finally depending on the strategy, the organization will implement the IOS by way of: in-house team, a third party, a purchased or packaged solution, a combination of the last options.

4.3.5. Effects from the external environment

External factors may also affect the adoption of an IOS to a greater or lesser extent. An organization might be pressured by its competitors within its industry. Another external factor might be an industry professional pang suggesting and influencing the organization on the adoption of an IOS. In addition, a government could influence by providing funding and support for the development of the infrastructure.

5. Henkel Case Study

This chapter provides a description of Henkel and its respective retailers. It outlines their current status around the implementation of the GDSN.



5.1. The Supplier: Henkel

5.1.1. Company background

Henkel AG & Company, KGaA, is a consumer goods company headquartered in Düsseldorf, Germany. It is a multinational company active both in the consumer and industrial sector. Founded in 1876, the DAX 30 company is organized into three globally operating business units (laundry & home care, beauty care and adhesive technologies). It is known for brands such as Loctite, Persil, and Fa amongst others.

Henkel is all over the world, however, this thesis will limit the scope to Henkel Benelux. The supply chain structure in Henkel Benelux is similar in the three countries (the Netherlands, Belgium and Luxemburg) as they share some partners. The biggest differences are on the customer´s side. The Netherlands and Belgium have some different retailers.

5.1.2. Supply Chain Structure

The global structure of the company is depicted in the next image:

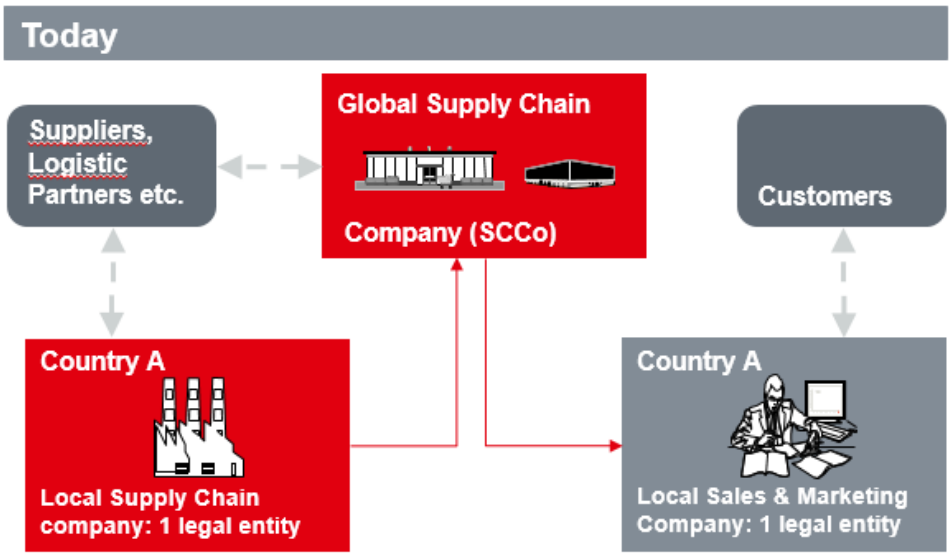


Figure 23. Global structure Henkel

Local production at Henkel Benelux receives raw materials from many different plants in Europe. The next image depicts all the location of all the companies that supply to the Benelux local unit

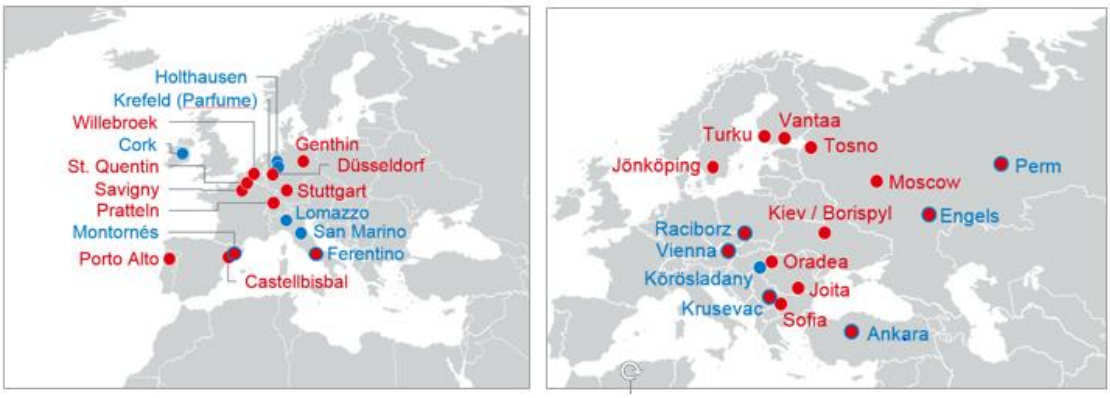


Figure 24. Locations of suppliers for Henkel Benelux

The local supply chain structure is depicted in the next image

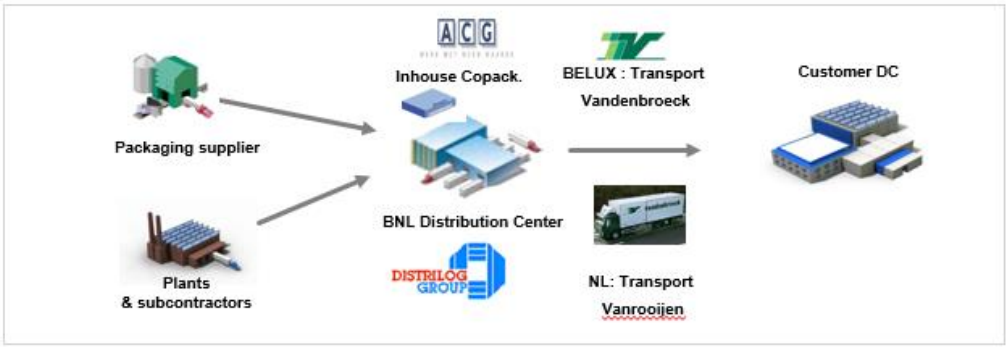


Figure 25. Benelux supply chain

Raw material comes from two different types of companies. From packaging suppliers and from plants and subcontractors. Plants and subcontractors supply all the components that are needed to make the product with the exception of the packaging material that is supplied by a specialized plant. All this raw material arrives in the BNL distribution center. ACG and Distrilog are the two companies that form part of this center. ACG takes care of all the copacking services, while Distrilog is the warehouse where all the stock is stored as well as the production center where individual components are produced.. Therefore, Distrilog is in charge of production of individual goods while ACG is responsible for the copacking all these individual displays into displays, shrinks and manual copackings (boxes).

5.1.3. Business partners: retailers

The scope of the analysis will be the Netherlands and Belgium in order to understand why the implementation of the GDSN was more successful in the first country and not in the second one.

The Netherlands and Belgium share some retailers but they have big differences in regards to the biggest retailers in terms of sales.

The most important retailers in the Netherlands are Ahold Delhaize, Jumbo Group, Kruidvat and the purchasing cooperative between 14 supermarket companies called Superunie. All of these retailers had the GDSN implemented at least from year 2016 (with some of them even before). The last one is Makro which implemented the GDSN in 2017. Even though the implementation of the GDSN happened

In Belgium, the most important retailers are: the Colruyt Group, Carrefour Group, Delhaize and less importantly Metro. All these 3 big retailers (plus Metro) implemented the GDSN in 2017.

5.1.4. GDSN

The GDSN implementation has some differences if the Netherlands and Belgium are compared. First of all, the GS1 subsidiaries are different. The GDSN implementation in Belgium is ruled by GS1 Belgium and Luxembourg, while the implementation in the Netherlands is ruled by GS1 the Netherlands.

GDSN in Belgium

As mentioned earlier in the thesis, Chris Van Daele is the Customer Service Manager in Henkel Benelux and is also the responsible of the GDSN in Belgium. Belgium was able to implement the GDSN in their big three retailers, Colruyt, Carrefour and Delhaize in 2017. The GDSN is a tool that was available in the market way earlier and this section aims at investigating why they could not implement it earlier.

As discussed in the GDSN implementation framework, retailers have more resources and capabilities than the suppliers and also more reasons to implement the GDSN. It is important for retailers to implement the GDSN with their most important suppliers, because otherwise it can create an unequal distribution of competitiveness and different business processes among them, which would create an unstable environment. Retailers could be "lock-in" if only one or a few suppliers want to go ahead with the project. They need to create incentives with their suppliers to "push" them to implement the GDSN.

In Belgium, the GDSN project has been in the pipeline for some time on the retailer's side as they were working on harmonizing this new tool with their ERP. This phase took longer

than expected as other phases of the project. The impact was that the suppliers had to wait on the retailers.

Delhaize was the first one of the big three retailers to launch the project. They started harmonizing data models in 2014 with some suppliers. Then, they started the roll out in 2015. Colruyt was the next one. They started the roll out in 2016. Finally, Carrefour started in 2017. In three to four years' time, the entire Belgian market will have switched to this digital information exchange system."

GDSN in the Netherlands

Lieven Bode, Supply Chain Manager in the Benelux area, was the responsible person for the GDSN implementation in the Netherlands.

The main difference in this case was the role of GS1 the Netherlands, which established deadlines for the roll out of the project that the retailers were able to met. Furthermore, the four retailers implemented a similar organizational structure around the project that ensured the success implementation of the GDSN, meeting all the deadlines that they together with the GS1 the Netherlands set up.

Once retailers were ready to implement it with their suppliers, Lieven Bode supported the implementation phase within Henkel by taking the necessary steps.

All the information collected throughout interviews and questionnaires will be used in the final analysis. This section provides a general overview of the GDSN on the supplier's side. Some information about the retailers had to be included in this section in order to clearly explain the situation around the GDSN in Henkel.

Table 2 summarizes these differences just taking into account the information collected from Henkel

	GDSN Belgium – non-successful case	**GDSN the Netherlands – successful case**
Retailers power	High	Medium
ERP harmonization timing	Bad	Good
Retailers coordination	Unsynchronized	Synchronized
Retailers–Henkel coordination	Bad	Good

Table 2. Differences GDSN Belgium-the Netherlands – Henkel perspective

5.2. Major retailers in Belgium

Henkel supplies to many retailers in Belgium. However, this section will not provide an overview of all of them because only some are relevant for the purpose of the project. None of the retailers had the GDSN implemented in 2016 and only 4 will partially have it implemented at the end of 2017 with Henkel. This fact does not imply that the rest are not working on the GDSN roll out, but that it is not implemented with Henkel yet.

5.2.1. Colruyt Group

Colruyt Group is a Belgian family owned retail corporation that is managing the Colruyt supermarket retail stores active in 4 countries, in Belgium, Luxembourg, France and Hong Kong. Colruyt Group operates in the food and non-food distribution sector in Belgium, France and Luxembourg with approximately 540 own stores and over 600 affiliated stores. The group employs over 29.000 employees and recorded a EUR 9,4 billion revenue in 2016/17 (Colruyt Group annual report, 2011).

Colruyt continuously follows the latest IT trends and technological developments. Its business processes and systems department visits international fairs and works with universities. For instance, they are closely following the future of artificial intelligence, voice technology and Blockchain.

Gudrun Lot (Head of the Purchasing and Product Information Management (PIM) Departments) was the person who was interviewed in regards to the GDSN

Colruyt is one of the retailers that has always devoted attention to robust and high-quality product information. That is the reason why the Product Information Management program was launched in 2014. The GDSN is part of this program. Colruyt knows that the GDSN creates a common language, with rules and definitions known for both parties, which will reduce the risk of errors. As Gudrun Lot recognizes, "*the GDSN leads to efficiency gains for both the suppliers and ourselves, and thus is a school example of a win-win situation*".

Colruyt´s approach was at the supplier level instead of at the product category level. This election was made on the basis of different types of suppliers. The main parameter that was observed was the amount of different types of articles delivered. According to Lot, a supplier offering different categories of products can be more easily rolled out than a supplier offering certain products since the first one can bring more value to the IOS than the second one. The first one will have a similar strategy to Colruyt's than the second one since both the supplier and the retailer would be dealing with multiple product categories.

The GDSN fits in the global strategy of Colruyt around Omnichannel. As Gudrun Lot states: "*Customer experience is more important than ever before. It is the most important factor to retain customers.*

If retailers can offer products at reasonable prices with an excellent customer experience, consumers will always come back and will not go to the competence"

Gudrun also revealed that consumers can currently view all label information on their e-commerce website, which creates a competitive advantage for the e-commerce race. Colruyt's vision is to manage all product data using the GDSN in the future, but, as he states, that depends on the willingness of some major suppliers to change the way of working around product data exchange in a reasonable time and in a synchronized way.
Lot also points out that the main benefit from the GDSN implementation is up-to-date, accurate product information, as the information is maintained in one place by the suppliers, so the right information can be provided to the customers.

Colruyt is currently focusing on the Belgian and Luxembourg markets. Suppliers are in charge of filling in all the attributes of the Belgilux data model. In addition to the usual product data, Colruyt will also include links to photos and certificates.

Lot also explained in detail the actions that are specifically planned to maximize data quality when using the GDSN. The supplier sends a GDSN file into their internal systems that, as a first step, is automatically checked. This data is compared to their internal operational data.
If the data quality is insufficient the supplier is contacted to correct the data package. In addition, GS1 sends reports to check the data that is uploaded in the GDSN to help Colruyt assess and improve supplier data quality.

Gudrun Lot works very closely with GS1. He holds weekly meetings with the organization to solve technical issues, which in addition enables Colruyt to inform GS1 about the progress of the rollout.

5.2.2. Carrefour Group

Carrefour S.A. is a French multinational retailer headquartered in Boulogne Billancourt, France, in the Hauts-de-Seine Department near Paris. As one of the references in food retail. The Carrefour group was the first in Europe to open a hypermarket, a large supermarket and a department store under the same roof. They opened their first hypermarket on 15 June 1963 in Sainte-Geneviève-des-Bois, near Paris in France (History, Carrefour website, 2017) The Group employs more than 384,000 people worldwide and generated total sales of €103.7 billion under its banners in 2016. Carrefour operates nearly 12,000 stores and e-commerce sites in more than 30 countries, in Europe, Latin America, Asia and Africa. It is also one of the largest hypermarket chains in the world (with 1,462 hypermarkets at the end of 2016). France is the country with more stores, with 5670. The rest of Europe includes 3873 stores. Belgium has 708 stores.

Carrefour started with a pilot project about harmonizing EDI messages (Electronic Data Interchange) with suppliers. The O2C pilot project lasted from October 2014 to April 2015.

The O2C project (order to cash) is one of the top-level (context level) business process for receiving and processing customer orders. The context level processes are utilized in a number of ways by businesses such as business process reengineering, aligning enterprise architectures and IT solutions as well as "blueprinting" as part of Enterprise Resource Planning (ERP) system implementations

This project focuses on rolling out the new messages guidelines with suppliers to integrate the EDI messages. The O2C project has included both working groups and internal discussions where the necessary changes have been discussed in detail. The outcome of this pilot project was a theoretical assessment of these necessary conditions and changes that is used to see in practice if the impact to processes and systems is effective as estimated in the working groups. The ambition is to make the EDI integrated with harmonized message guidelines more accessible to smaller suppliers. The investment in integrated EDI ('full EDI') is sometimes an obstacle for smaller suppliers, so they often opt to work through webEDI. WebEDI requires data entry, which is not only time consuming, it also significantly increases the risk of errors. With the integrated system, everything goes faster and less errors occur. With EDI, there's also a margin of error, but it's smaller. Data quality is just a crucial element but still remains an issue for SMEs.

The harmonization of EDI messages was the starting point to establish and develop the GDSN. Carrefour is working not only with master data but also with digital assets such as photos, videos as Colruyt does. Yolande Diaz is the MDM and DAM manager (Master Data Management and Digital Assets Management, respectively). Her teams are making sure that the data provided by the supplier corresponds to what they display across the omni-channel, on e-commerce. Carrefour is currently working on the GDSN major release, to expand this technology to more countries and speed up the non-food products in the countries where it has not yet been implemented. Moreover, this new phase aims at providing a much more flexible data management. Henkel has already joined this major release. The prospections are that the GDSN should be running by the beginning of 2018 (Yolande Diaz, Skype interview).

5.2.3. Ahold Delhaize

Ahold Delhaize was formed in July 2016 from the merger of Ahold and Delhaize Group. (Ahold Delhaize official website, 2017)

Delhaize Group dates back to 1867, when the Delhaize brothers opened a wholesale grocery business in Charleroi, Belgium. Dendooven, Pascal (5 July 2007). As of 31 December 2014, Delhaize Group had a sales network (which includes directly operated, franchised, and affiliated stores) of 3,402 stores and employed approximately 150,000 people (excluding the stores and related associates of divested and discontinued operations).

Store formats are primarily supermarkets, which represent 85% of Delhaize Group's sales network. Delhaize Group's sales network also includes other store formats such as neighborhood stores, convenience stores, and specialty stores. The company is actively engaged with the U.S. Environmental Protection Agency's Energy Star program to manage energy efficiency across its U.S. facilities. (Greenbizm 2017). In 2014, Delhaize Group recorded revenue of €21.4 billion and underlying operating profit of €762 million. Delhaize Group's operations are located primarily in the United States, Food Lion LLC, Hannaford Brothers Company, and Belgium (Delhaize Annual Report, 2017).

Ahold traces its roots back to 1887, when Albert Heijn and his wife opened a first store in the Dutch town of Oostzaan (History, Ahold Website, 2017). The company started in 1887, with the founding of an Albert Heijn grocery store in Oostzaan, Netherlands. The grocery chain expanded through the first half of the 20th century, and went public in 1948. In the mid-1970s, the company began expanding internationally, acquiring companies in Spain and the United States. Under a new leadership team, which for the first time did not include any members of the Heijn family, the company accelerated its growth through acquisitions in the latter half of the 1990s in Latin America, Central Europe, and Asia.

Ahold Delhaize has been streamlining its internal systems and processes by fully integrating global data synchronization.

According to Koen Desmet (Operational Support Manager at Delhaize), the aim is to achieve the clean, accurate and complete product data and comply with universally supported GS1 system standards by synchronizing item information with our trading partners via the Global Data Synchronization Network™ (GDSN®).

In addition to the GDSN, Delhaize decided to invest in SAP for a more efficient and unified back office due to the strong growth of Delhaize over the years that led the organization run against the limits of its internal applications. The switch to SAP was suddenly a momentum for Delhaize to launch GDSN's rollout. GDSN is not yet mature in Belgium. Delhaize also have to do a lot of tests in their SAP system to get the data compilation on track. In that respect, it was an advantage that GDSN was parallel to their SAP implementation.

Delhaize’s main concern is to avoid cost in the value chain and adapt their internal processes to the GDSN and SAP.

According to Desmet, customer need for product information evolves faster than what the group can offer. Carrefour and Colruty are in a more advanced stage than Ahold Delhaize since their IT efforts are less significant. Their ERP system is well implemented and therefore, less IT and business process reengineering is needed.

The experience of Ahold Delhaize with the GDSN can be summarized in the next points:

- IT efforts are significant
- Labor cost for data management drops
- Data quality/completeness goes up from the start
- Long running program to implement (> 3 years)

The group's mission in the upcoming years is:

- Align on the market
    - On boarding approach with other Belgian retailers
    - GDSN data model on Benelux level
    - GS1 data quality program within Benelux market

- Continue to fix the basics
    - Shut Bad Data out of their systems (based on data checker business rules)
    - Automated integration: of pictures coming through GDSN and full tax integration

The group recognizes that due to all recent developments in warehousing, digitization and e-commerce automation, they ran into the limits and limitations of their own systems and processes. Data is so important that a fundamental, standardized solution is needed. Hence, in addition to rolling out a new ERP system, Ahold Delhaize is committed to data flow through the GDSN.

The GDSN eliminates the use of vendor portal for Delhaize's national brands, confirms Desmet. "It is no longer necessary because all of these data are already in the GDSN data model. However, if it appears that suppliers are in violation of data quality or technical connection, the use of vendor portal remains mandatory.

By 2017, Delhaize wants to be ready with a full-fledged alternative to the vendor portal. This provides the suppliers of the home brands and exclusivities with all data specific to Delhaize. "The new vendor portal is complementary to the GDSN standard, so duplicate data delivery is avoided," says Desmet. "Because suppliers also need their approach to provide a better and more efficient process."

5.3. Major retailers in the Netherlands

The data quality program is widely supported by the entire sector. Retailers, suppliers and industry organizations CBD, CBL and FNLI support the program and are active memebers of its rollout. For example, Albert Heijn (Ahold Delhaize), Superunie and Jumbo have personally called on their own suppliers to participate in quality checks.

First time that Henkel joined the GDSN in the Netherlands was in 2010. By that time Henkel Netherlands had about 40% of the invoices not matching and manual investigation was necessary causing extra costs.

The Data Pool that Henkel used was the WWRE (WorldWide Retail Exchange). This Data Pool was used also by one of the suppliers. The other three partners used GS1 DAS as the source Data Pool. Some samples of the products were sent to GS1 Netherlands measurement service to check them against the product data. With the use of a GDSN 90% of all discrepancies were eliminated. The main differences in data was coming from the case dimensions, weight, product description, cases per layer and life span date. The productivity improvement in their data management department was 30% thanks to the GDSN.

5.3.1. Ahold Delhaize

This is the same group that is present in Belgium. Ahold was a Dutch retailer and Delhaize was the Belgian one. They merged in 2016 to create a strong top retailer in Benelux and other parts in the world such as the US and some European Eastern countries. They had similar strategies towards Omnichannel and other technological developments, such as the GDSN. The merger of these two retailers comes from a shared vision about the same sustainable business model.

- Save for customers: buy better, operate smarter and waste less.
- Fund growth in key channels: supermarkets, e-commerce, smaller formats
- Invest in their customer proposition: affordable for all

Therefore, when Ahold implemented the GDSN in the Netherlands, it was not part yet of Delhaize and that's why Ahold Delhaize has fully operation the GDSN in the Netherlands and Ahold Delhaize in Belgium does not have it. As they are merged now. Ahold Delhaize in Belgium can be supported by all the work done in the Netherlands by Ahold.

5.3.2. Jumbo Group

Jumbo is a Dutch chain of supermarkets from Jumbo Groep Holding BV, owned by *Stichting Administratiekantoor Van Eerd Groep* Holding . Between 2005 and 2012, Jumbo expanded, partly due to the acquisition of Super de Boer and C1000 supermarket chains, to the second largest supermarket chain in the Netherlands. The group has about 60,000 employees (including headquarters and distribution centers) by 2017 (Jumbo Official Website, 2017).

Jumbo also joined the purposes of GS1 Netherlands towards the GDSN as its major counterpart did (Ahold Delhaize).

The strong collaboration of GS1 Netherlands, Ahold Delhaize and Jumbo Group made possible the rollout of the GDSN. They synchronized their efforts to *push* their suppliers to implement the GDSN, meeting successfully the deadlines.

5.3.3. Kruidvat

Kruidvat is a Dutch retail, pharmacy and drugstore chain specialised in health and beauty products, which also has branches in Belgium and France. The first Kruidvat was opened in 1975 by Ed During and Dick Siebrand. In addition to Kruidvat itself, Kruidvat Holding also owned ICI Paris XL and Trekpleister (nl) in the Netherlands and Belgium. Kruidvat was supported in the implementation of the GDSN by GS1 The Netherlands and the other major retailers such as Jumbo or Ahold.

5.3.4. Superunie

Superunie is a Dutch wholesale purchasing cooperative between 14 supermarket companies. Henkel supplies to 12 of those supermarkets. Several of these 14 represent multiple supermarket formulas (including brand licensing franchises). In total Superunie supplies about 1800 stores. Superunie has a Dutch marketshare of about 30%. Superunie is part of European Marketing Distribution (EMD), a cooperative that has a European marketshare of about 14.8%

Superunie was also part of the *GDSN flow* that the major retailers and GS1 Netherlands were part of.

5.4. Conclusions

This chapter includes an analysis of all the actors considered in the case study. The differences between the GDSN in Belgium and the Netherlands from the supplier perspective were already outlined in section 5.1.

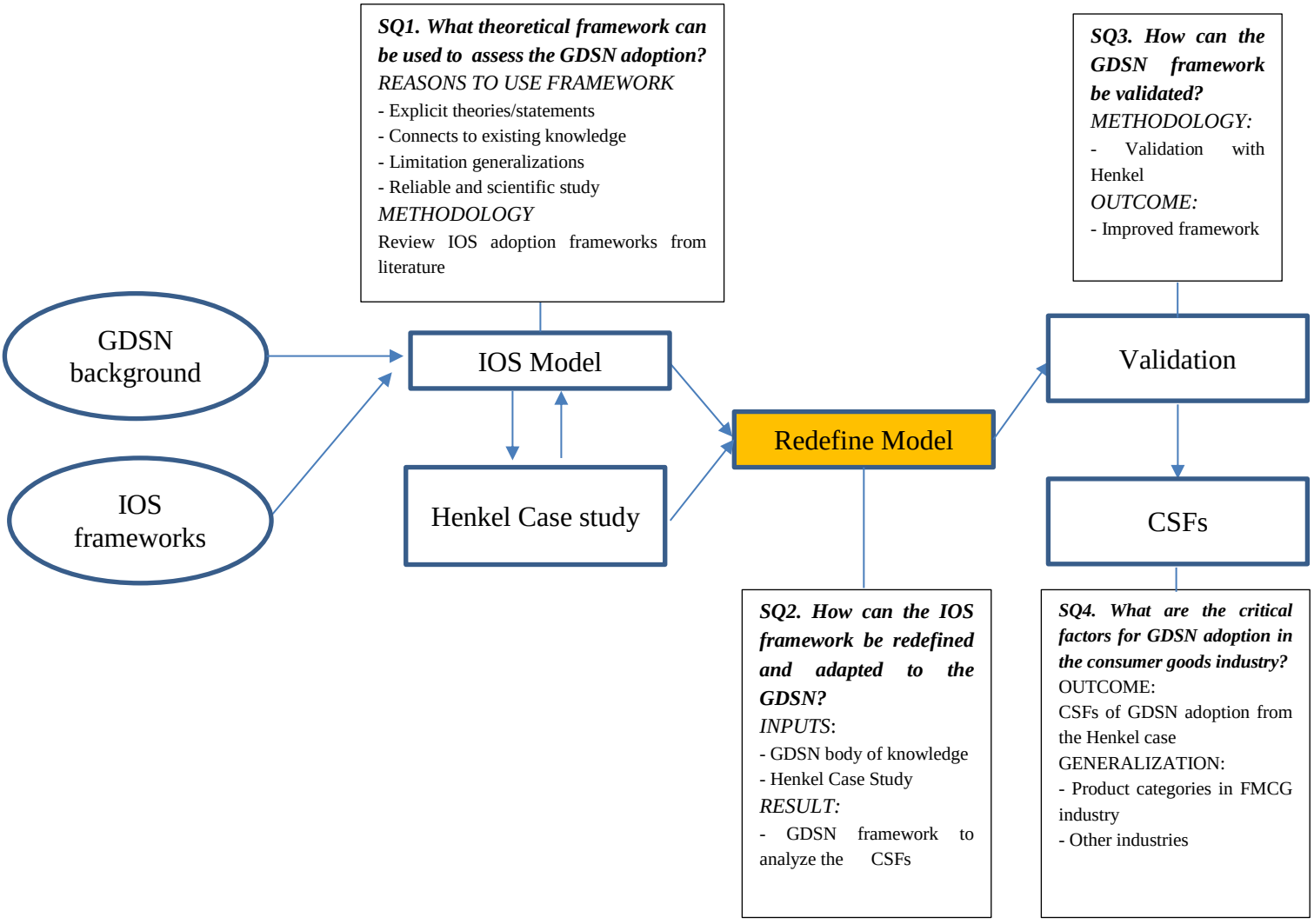
After analyzing the retailers in sections 5.2 and 5.3, some important points can be mentioned, points that will definitely enlighten the subsequent analysis.

1. Retailer's cohesion in the Netherlands among the two main retailers drove the successful adoption of the GDSN. Belgium's market was less concentrated as there was more than two suppliers with similar market share. Jumbo and Ahold Delhaize in the Netherlands had an important part of the market share. Their cooperation with each other and the other stakeholders, mainly GS1 the Netherlands and Henkel, ensured the success.

2. On the one hand, deadlines in the Netherlands were pre-agreed before starting the project. All retailers made sure their ERP systems were aligned to welcome the adoption of the GDSN. In addition, milestones of the projects were made explicit and were fulfilled by all the stakeholders. On the other hand, Belgian retailers did not have any commitment

on adapting their ERP systems simultaneously, what led to poor preconditions to stick to common deadlines for the GDSN rollout

6. GDSN Adoption Frameworks



The framework proposed by Pang and Bunker will be adapted according to the specific characteristics of the GDSN. There is not any GDSN adoption framework existing in the literature. This thesis aims at adapting an existing one so that the GDSN can be analyzed in FMCG organizations using a more specific framework. The IOS framework created by

Pang and Bunker is very general and leave plenty of room for different interpretations if it is directly applied to the GDSN.

The adaptation will be done by redefining the six aspects that Pang and Bunker proposes to analyze the adoption of an IOS.

6.1. Collaboration

Pang and Bunker classifies collaboration in intra-organizational collaboration and inter-organizational collaboration. This is the most important aspect as it influences the other aspects of the framework. Intra-organizational collaboration influences the other aspects at an intra-level and inter-organizational collaboration at an external level with other organizations, in this case retailer or supplier. Therefore, the intra-level will be analyzed (isolating it of the other aspects) to improve the collaboration process of the GDSN project, only internally. Then, the inter-level will actually be broken down in those four aspects, which are actually the ones that will defined the relationship between supplier and retailer.

1. Intra-organizational communication

Intra-organizational collaboration entails the communication and interaction activities between actors in an organization. Cross-functional task forces and cross-functional project teams are essential to ensure a successful collaboration. Actors can either influence directly in the implementation process of an IOS or indirectly in the collaboration process. Organizational theory and ANT are used to enlighten how the managers interact and influence each other within an organization. Even though negotiated order theory is suggested to be used in intra-organizational collaboration, it will not actually be considered as it is a theory that focuses more on the inter-organizational level. In addition, ANT is actually an extension of the organizational theory to consider two or more organizations. Therefore, only the organizational theory will be used and adapted to the GDSN adoption framework.

Organizational theory takes into account structural and behavioral characteristics that have direct or indirect responsibility on the GDSN adoption. This theory can actually be broken down in four theories that enable to address more specifically different dimensions of the organization. They are: rational system perspective, division of labor, bureaucratic theory and contingency theory (Hatch & Cunliffe, 2013).

- Rational system perspective: this perspective focuses on the formal structure of the organization. An organization is seen as a group of people who work together to pursue specific goals. Goal specification provides guidelines for specific tasks to be completed with a regulated way of resources allocation. Formalization is the way to standardize organizational behavior. As a result, there are expectations that creates the rational organizational system. The objective following this line of reasoning is to maximize the amount of output with the least amount of input.

- Division of labor: is the specialization of individual labor roles. According to Adam Smith (1974), the division of labor is efficient due to three reasons: occupational specialization, savings from not changing tasks, and machines taking the place of human labor.

Occupational specialization leads to increased productivity and distinct skill. Also, Smith argued that human and physical capital must be similar or matched; if the skill of workers were matched with technological improvements, there would be a major increase in productivity.

- Bureaucracy theory: Bureaucracy can provide accountability, responsibility, control, and consistency. (Max Weber, 2013).

- Contingency theory*: "The best way to organize depends on the nature of the environment to which the organization must relate"* (Scott, W.R, 1981). This theory claims that there is no best way to organize a corporation or to make decisions. Instead, the optimal course of action is dependent (contingent) on internal and external situations.

The organizational theory provides a good framework to guide the analysis of intra-organizational collaboration in the implementation process of the GDSN. Firstly, both the supplier and the retailer need to establish a suitable structure upon which the project will be carried out. The GDSN project is not very challenging from a technical point of view in comparison to other technologies that, for instance, need more R&D investment (Big Data, Blockchain, etc). Therefore, an adequate structure that boosts a collaborative environment is key to ensure the success of the project. However, before addressing anything related to collaboration, the suppliers and retailers need to:

- *Establish clear and realistic goals, then create the structure and resources allocation to achieve them*. As explained in the rational system perspective, goal specification is the starting point from which the formulation of tasks and resources allocation need to follow. It is important to start with realistic goals so that tasks and resources are formulated and allocated according to what they can actually get to achieve. If goals are deviated once tasks and resources are in place, then they will work towards achieving a different goal, providing unexpected results over the benefits of the GDSN. More details about possible structures and resources allocation of companies working on the GDSN implementation will be provided as the other aspects are analyzed

- *Make a good balance in the specialization of individual labor roles.* The GDSN project will require some specialized roles, something that Adam Smith defends because they lead to increased productivity. However, this project is dynamic and new challenges and directions will emerge during its implementation (even if the same goal is maintained). Therefore, it is important to create specialized roles that can assure continuity in the project, and also flexible positions that can address the dynamic character of this project (cross-functional teams are usually the most efficient solutions to provide this needed flexibility

in the project). This recommendation is supported by the contingency theory that advocates that the course of action is dynamic and dependent on internal and external situations.

These two steps are the first actions that any company needs to do before the implementation phase can even start. Once that is defined, the organizations need to *establish the dynamics of internal trust, collaboration and knowledge sharing fitting the GDSN context.* They need to be properly established to ensure an efficient intra-organizational collaboration. As previously mentioned, collaboration is the foundation that gives support to the other five aspects.
These dynamics will actually be defined by a particular organizational theory. According to the literature, there are two prevailing theories of the firm.

The first one is a *governance-based approach* (reasoning about the efficiency advantages of firms over markets) found in the *transaction cost economics theory (TCE)*. The TCE was developed by Williamson in 1975. In the TCE view, intra-firm power and communication is usually framed as a component of hierarchies. Power within the firm, as well as of the firm, is primarily managerial in that it is invested in those who construct, monitor, and enforce obligations; it is also possessed by those who control factors such as information about costs, performance, and exchange alternatives (Perrow 1986). There are two key assumptions of TCE: bounded rationality and opportunism (Williamson, 1975 cited by Grover and Malhotra, 2003). *Bounded rationality* refers to the limitations of decision-makers to make rational decisions as they can't access to all the possible alternatives. Additional negotiations are needed due to complex or uncertain situations, which turns into higher transaction costs. *Opportunism* indicates when a member of the organization seeks to take advantage of other member as the first has more information. Both assumptions increase the transaction cost, which includes (Clemons et al., 1993):

- Coordination cost: cost of searching information, negotiating cost and monitoring.

- Operational risk: risk that a member of the firm misinterprets or withholds information.

- Opportunism risk: lack of bargaining power resulting from the execution of a relationship, which is influenced by the cost of relationship-specific investments or the loss of resource control.

The key characteristics of transactions in TCE are (Grover and Malhotra, 2003):

-Degree of uncertainty regarding the transaction, which depends on the degree of information asymmetry.

- Degree of asset specificity: refers to relationship-specific investment: if they are high, the switching cost will also by high.

According to TCE theory, the higher each of these characteristics, the more vertical integration is preferred in comparison with market governance structure.

The second theory is a *resource-based approach* found in the *resource-based view (RBV)* that conceives the firm as "bundles of resources" that may create productive competences that are valuable, rare, inimitable, and non-substitutable only if they are configured and employed strategically (Barney 1991). In the RBV view, management controls a strong and integrated culture, which depends upon 'authority (to permit direction), centralized decision making, co-location and common knowledge (to permit communication)' (Grant, 2001).

These two theories of the firm are very general. They analyze firms as a whole, both governance-based and resource-based. However, the interest is to analyze communication at project level. The objective is to discuss intra-organizational communication for the GDSN implementation. The social side of the firm plays a fundamental role that is not truly addressed neither in the TCE nor in the RBV. These theories describe internal operations in abstract and mechanistic terms. In addition, stakeholders are depicted as threats to managerial control. These limitations can be connected with a theory of communication. The aim is to reduce the cost and variability of communication in the interest of efficiency and control at project level. These conceptual shortcomings need to be addressed with a more concrete theory. This theory needs to articulate an already-existential view of the firm suited to the implication of shifting firm-environment boundaries, which is what the GDSN project require. The *communicative approach* developed by Kuhn (2008) will be the starting point to analyze communication at project level

Communication is a process in which actors use symbols and make interpretations to coordinate and control both their own and others' activities to reach an objective. According to this definition, conversations and texts, which are the mean by which actors may exchange symbols, must be examined to understand the process. *Conversation* is to some extent observable and situationally shaped; it can even be seen as coordinated activity distributed across sites (Broekstra 1998). *Texts* are the means upon and through which conversations are maintained. They can be seen as the inputs and outcomes of conversations. They are not the products of the conversational process, but also its raw material. Together, then, conversation and text form a self-organizing loop' (Taylor and Van Every 2000).

Texts are the central instrument to explain the organization to external people and to keep information and knowledge in more expansive and permanent ways within the organization. However, *texts* provide only a partial picture. Texts together with conversations provide the full picture. Texts can be *concrete*, signs and symbols inscribed in some permanent form, or *figurative*, abstract representations of practice sites, communities, and firms.
Therefore, the functions of texts is to: (1) represent the abstracted intentions of the actors (2) mediate conversations.

(3) direct attention and discipline by depicting particular phenomena, forms of knowledge and actions and (4) link disparate practices through a common object by framing conversations.

The persistence of texts is another important topic as texts evolve over time. How can a text remain and be reliably updated across time and space? Retained texts are those that are perceived by actors and to coordinate and control activity 'inside', while enabling beneficial positioning 'outside'. Texts actually do not persist but are updated receiving inputs from other texts encountered. Another important remark so texts persist across space and time is that they must be coherent with the project's progression and that they must build relations with other texts (Czarniawska 1998).
Last but not least, authorship of these texts is an important point that define how these texts will be managed in the organization. As previously discussed, texts are products from multiple conversations that occur in the firm between different stakeholders, therefore, these texts are a way to encourage actors to subordinate personal interests to the collective good. Managers will be the ones "authoring" these texts of course, but the interaction process with subordinates as well as the shared responsibility will improve according to the TCE and RBV.

The theory points out communication as the central problem. The TCE pointed out efficiency, through the creation of a hierarchy and eliminating opportunism, as the central problem. The RBV indicates that the arrangement and control of resources to create valuable competences is the central topic.

This *communicative theory of the firm* is the proposed theory in this thesis to tackle intra-organizational communication in a project such as the GDSN implementation between suppliers and retailers in the consumer goods industry. It will be deemed as the central "philosophy" around which the case study will be analyzed in terms of internal communication. The next table depicts the main foundations of this theory in comparison to the traditional theories of the firm.

	TCE	RBV	Communicative theory
Target	Efficiency through hierarchical authority and purging opportunism	Arrangement and control of resources to create valuable competences	Shaping the trajectory of the firm/project through textually mediated coordination and control
Power	Hierarchies control activities incentivized by management	Integrated culture and shared identity with routines learned over time, engineered by management	Capital attraction through consent shaped by concrete and figurative texts authorized by managers
Interactions	Seek to control stakeholders' influence and build trust	Seek to build positive firm reputation to reduce costs and attract partners	Seek to attract capital through texts and stakeholder dialogue

Table 3. Comparison among TCE, RBV and Communicative Theory (Kuhn, 2008)

2. Inter-organizational communication

Pang and Bunker suggests that inter-organizational communication is broad enough to be broken down in 4 aspects (redesign of strategy, supply chain design, business processes and IT systems). Inter-organizational communication aims at tackling those aspects externally with other with retailers and suppliers.

6.2. Strategic Collaboration

To analyze this aspect, the 7 fields proposed by the Pang and Bunker will be examined in the GDSN context for both the supplier and the retailer

a. Financial Benefits

The GDSN aims at reducing operating costs and processing errors of both suppliers and retailers. Therefore, there are clear financial benefits that this IOS can provide to both types of firms. A cost-benefit analysis is needed. However, this is not really the main focus of the thesis and that is why is added in Appendix C

b. Needs and Motivations

Both entities have to have needs and motivations to implement a new technology in the organization. Something that goes beyond the financial benefits that the technology could bring along. It has more to do with the culture that the industry is shaping for the upcoming years. This sector is undergoing a revolutionary change and the GDSN is part of the future view of retailing.

The retail culture is starting to not easily accepting disruption in their supply chains and here is where technology plays a fundamental role. This new technological revolution in the industry aims at eliminating those disruptions and inefficiencies that still characterizes most of the organizations in the sector.

Therefore, most of the organizations need to keep up with the trends if they want to stay competitive in a market where digitalization and automatization is becoming key.

There are clear needs for both suppliers and retailers to implement not only the GDSN but also other technological breakthroughs that can changer the current paradigm of the retailing industry.

c. Resource dependency

The distribution of resources of the different entities that are part of the project is very important. The relationship formed between the suppliers and the retailers is highly dependent on the resources and capabilities of each of them.

Retailers have more resources and capabilities than the suppliers and also more reasons to implement the GDSN. It is important for retailers to implement the GDSN with their most important suppliers, because otherwise it can create an unequal distribution of competitiveness and different business processes among them, which would create an unstable environment. Retailers could be "lock-in" if only one or a few suppliers want to go ahead with the project. They need to create incentives with their suppliers to *push* them to implement the GDSN so that they do not create a "lock-in" situation.

d. Power relationship

As discussed in section a & c, retailers have more resources and interest in implementing the GDSN. Therefore, they will be the entity driving the implementation process. However, retailers may be "locked-in" if some important suppliers do not desire to implement the GDSN. As said, retailers will have to provide incentives on a case-by-case basis.

e. Inter-Organizational Relationships

Oliver (1990) suggests six contingencies to analyze an inter-organizational relationship

- Necessity: both entity needs to implement the GDSN to keep up with the market trends and because of financial reasons.

- Asymmetry: firms enter relationships to exercise power or control over another organizations or its' resources. In this case, the retailers have more control over resources. However, suppliers can cause retailers to be in a "lock-in" situation. Therefore, they also have power on the negotiation process.

- Reciprocity and Efficiency: firms enter relationships to pursue common goals. Both organizations can benefit financially (more the retailers). In addition, the operational efficiency of the supply chain would considerably improve, a goal that both organizations are continuously seeking.

- Stability: Inefficiencies are greatly reduced by the implementation of the GDSN, something that provides stability.

- Legitimacy: firms enter relationships to appear in agreement with the prevailing norms. Norms will be defined in the negotiation process that both entities will enter. This negotiation process is defined by the resources and capabilities of both entities as well as the power relationship established between them.

f&g. Trust and selection of a partner

Trust and the selection of the partner to implement the GDSN is something that is actually defined based on the criteria already discussed. Setting ground rules from the beginning is essential to ensure trust and a stable negotiation process.

6.3. Process Collaboration

6.3.1. Supply Chain Design

To analyze the implementation of a tool that can standardize the way in which product information is exchanged, it is important to first define the characteristics of retailing supply chains where the adoption process takes place. Supply Chain Design (SCD) is an important concept to be analyzed in this section as it is the foundation upon which the new business processes will be developed.

The traditional definition of SCD is the decision-making process regarding the facility role, facility allocation and capability (Chopra and Meindl, 2010). Nevertheless, the SCD concept used in this thesis will be slightly different. This thesis will use this concept as the way in which the different entities relate to one another. This definition could also be called supply chain configurations. However, this thesis will still maintain the SCD concept to be consistent with the framework developed by Pang & Bunker.

There are three main types of supply chain designs. The many-to-many vs exclusive supply chain type is the most suitable to analyze the GDSN implementation and, therefore, it will be the one used in the analysis.

1. Vertical Integration vs arms-lengths relationships

This type addresses the degree of vertical integration according to the ownership of assets. There are two extreme cases in this type: (Hayes et al., 2005).

- Vertical Integration: when a single organization has full control over the different supply chain functions such as manufacturing and distribution. According to the TCE perspective, the main benefits of this strategy are: (1) reduction of transaction costs (2) elimination of opportunistic behavior (3) communication efficiency.
- Arms-length relationship: when exchange of information is completely standardized (codified and interpreted in an unambiguous way) so that the organizations along the supply chain can have the main benefits of the vertical integration strategy.

This latter type is the best strategy as it has the benefits of the vertical integration strategy in a supply chain that is formed by more than one single organization.

2. Open vs closed supply chains

This type of supply chain has to do with the willingness to share information. Communication and collaboration may not always be sought by the companies that form the supply chain.

On the one hand, closed supply chains are integrated networks that do not want to collaborate with any entity out of the network even though this could be beneficial for them. The main reason for this is that technologies that are applied in one or more organization of the network is (partially) developed by one of the company orchestrating the system. Closed supply chains are more likely to use proprietary standards for security reasons

On the other hand, open supply chains seek better communication and collaboration with partners. This is the type of supply chain that is common in standardized industries such as retailing, automotive, aerospace, etc. In these systems, suppliers are generally encouraged to be the main innovators and sell the same components to a large range of customers. Standardized industries are more likely to use open standards.

3. Many-to-many vs exclusive supply chains

Many-to-many supply chains are those ones where many suppliers interact with many retailers. Exclusive supply chains are the ones that can be many-to-one, one-to-many or one-to-one. This classification explains the logic of the product flow. In many-to-many supply chains, the product is produced by many different suppliers and sold in many different stores, therefore, the retailer distributes multiple brands of products. In exclusive supply chains, the retailer would sell a few or multiple products to dedicated stores.

This type of supply chain is the one that will be considered as the starting point to assess the potential adoption of the GDSN in the retailing industry as it is the broadest type of these three.

Many-to-many supply chains have a low degree of vertical integration as there are many entities involved, which makes impossible to integrate all the functions by one single organization. Moreover, the degree of collaboration is lower than in exclusive supply chains since the more the organizations that work together, the harder it is to collaborate efficiently because the more conflicts may arise. It is also harder to find standardized ways of working when the number of entities is high. It is easier to change the way of working of a few organization rather than many organizations. Regarding the level of supply chain visibility, it is higher in many-to-many supply chains as it is always a more standardized type of supply chain than the exclusive supply chain. Finally, many-to-many supply chains are more flexible as the core competences and skills do not rely on one or few organizations.
Therefore, it is a type of supply chain that is able to adapt quicker to changing environments than exclusive supply chains.

The next table summarizes the main differences of these two supply chain designs.

Characteristics	Many-to-many supply chains	Exclusive supply chains
Vertical Integration	Low	High
Collaboration	Low	High
Visibility	Low	High

Table 4. Many-to-many vs exclusive supply chains

This analysis gives good insights on the need of the GDSN according to the characteristics of these two supply chain designs. Each of these characteristics can be linked to the need of the GDSN.

The higher the vertical integration, the less need of the GDSN as supply chain functions will be controlled by one single organization.

The higher the collaboration, the less need of the GDSN as this is an IT tool to increase collaboration among business partners.

The higher the visibility, the less need of the GDSN as this is an IT tool to also increase visibility among business partners.

Therefore, many-to-many supply chains have more need of GDSN adoption than exclusive supply chains as they are worse on those aspects that the GDSN aims at improving. Exclusive supply chains will not benefit much about this tool as they operate in collaborative and visible environments. The impact of the GDSN will not be as high as it would be in many-to-many supply chains.

6.3.2. Business Process Reengineering

Once SCD is aligned with the strategy, the business processes must fit the SCD in an IOS environment. Business process reengineering (BPR) is *"the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed"* (Hammer & Champy, 1993, p.32).
An organization has to reengineer its business processes with their partners based on the SCD to achieve the expected GDSN functions efficiently
The business processes have to be designed according to the outcome that is expected from the GDSN. Therefore, collaboration elements, strategical elements and the supply chain design need to be taken into account to be able to redesign the process that will enable to reach the desire objective; a successful implementation of the GDSN in the suppliers' and retailers' supply chain operations.

The Supply Chain Operations Reference (SCOR) is the cross-industry process reference model that features supply chain management practices and business process reengineering. It was developed and designed by the Supply-Chain Council (1996). The SCOR model describes high-level business processes associated with all phases of satisfying customer demand (SCC 2000). Even though the interest on the SCOR model in this thesis lies under the business processes that are affected by the GDSN, other higher-level business processes will be analyzed to fully understand the value of the SCOR model.

At the highest level the SCOR model is organized around five business process: *Plan, Source, Make, Deliver* and *Return*

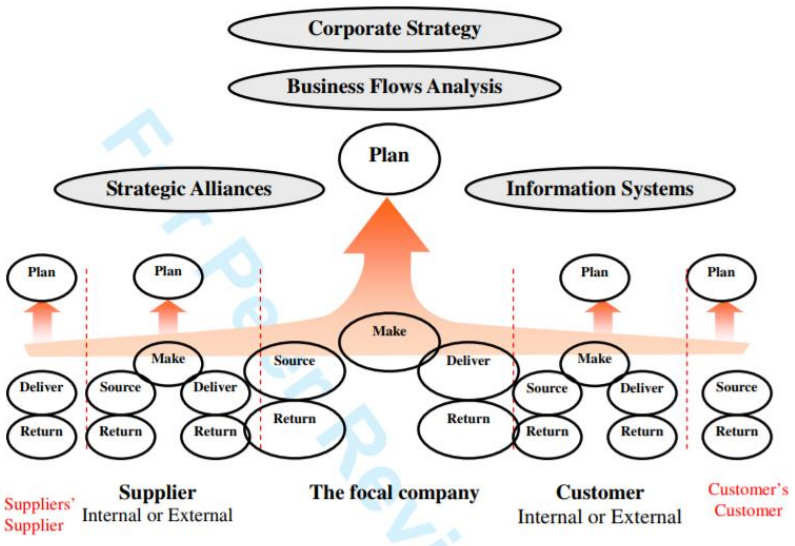


Figure 26. Supply Chain Path in SCOR Terminology (SCC 2000)

The SCOR model has a hierarchical structure that provides a business process framework with standard descriptions and interdependencies among processes at different levels.

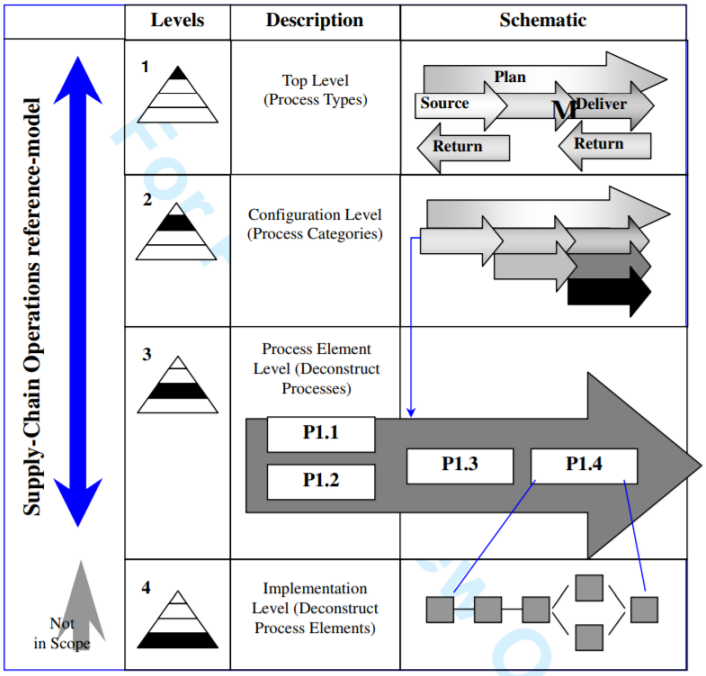


Figure 27. Top-down approach implementing the SCOR model (SCC 2000)

The business process *Plan* is the highest level in this hierarchical structure followed by the other four types *Source, Make, Deliver* and *Return*, which are included in the configuration level. At level 3, the process element level, activity definitions are still generalized, so they still apply to a variety of product, services and information flows. They include the sub activities of the three types. These three top levels form the SCOR model, which provides the framework for analyzing, designing, and implementing actual operational supply chain execution or planning processes. Best-practices and enabling technology indexing/cataloging are also linked to the Process Elements level, and they can be used to guide implementation. Level 4 is for more specific activities that might not be shared between the different entities that are part of the supply chain. The objective of this model is to facilitate horizontal process integration across different business units and players in the value chain. The model offers the benefits of standardization if all value chain participants implementing the SCOR model adhere to the framework.

The model includes standard performance metrics for measuring process performance. These metrics are defined in their specific layered structure. Twelve Level 1 metrics are used to measure five areas of strategic enterprise supply chain performance: reliability, responsiveness, flexibility, cost, and asset management. These metrics decompose into lower level metrics that are linked to one or more process elements in the model (SCC 2000b). The idea is to use widely accepted and meaningful measures at appropriate levels of the organization to support strategic decision-making.

Nevertheless, the SCOR model provides a top-down approach that takes into account the entire operational and strategical models of the firms. The applicability of the SCOR model in BPR when implementing a new tool/technology in the supply chain is limited. The SCOR model assumes that cross-site KPI information is easy to obtain. However, the implementation of new technology such as the GDSN or ERP systems takes time in global firms. The implementation of IT tools together with rapid corporate expansions make difficult to have all material codes unified among all the subsidiaries. In addition, a consultant team supporting the implementation project can lack important information as it might not be kept in computer-based information systems. According to this explanation, the limitations of the SCOR model are:

1. *Geographical limitations*

- SCOR can only present business flow between legal or geographical entities. The model is not able to do so in a matrix organization where computer-based information systems govern the internal operations of the firm as well as those with their respective peers in the supply chain.

- SCOR is limited to one single supply chain while most of the enterprises may be associated with multiple channels of markets (Omnichannel).

2. Gap limitations

- The KPI of the SCOR model is not always available, particularly when it involves cross-site information.

- Even when KPI analysis is available, intangible problems are not part of the model. Cultural conflict can play a major role in the implementation process.

3. Collaborative activities limitation

- Activities of collaborative design and customer relationships management are not defined in the SCOR model.

These limitations reveal that a different approach is needed in order to assess the BPR more effectively when analyzing the implementation process of an IOS.

A bottom-up diagnosis is necessary to identify the problematic processes and their consequences. This is especially useful when KPI information among sites is not available or can be biased by external factors. Problems can be identified via interviews with key managers of the supply chain entities. Then all the problems identified can be grouped in major groups. These problem groups can be categorized depending on the nature of the problem. These problem groups should then be aligned with the supply chain entities and the business processes defined in the SCOR: *Plan, Source, Make, Deliver* and *Return.*

To facilitate the visualization of all these elements and the subsequent analysis, a table like the one presented hereunder can be used

PG Code	Entities / Interview Code	2nd Tier Suppliers	1st Tier Suppliers	Focal Company	1st Tier Customers	2st Tier Cupplier s	PG Cat
PG1	B1, B8	P2	M3, D1	P1,P3, D2, D3			Business Process
PG2	A2, A6, C8, D2	S1		P2, M3,	D3		IT Systems
PG3	A1, A4, B5, B7, C2, D2,		D2	S3, D1, R2			Organization Structure
PG4	C2, D10	M2		D2, R1,	P3,D2		Business Process & IT Systems
PG5	D2, E1, E2, E6			S1, D1	S3, D2		IT Systems

PG6	B2,D3, E4		P2	P1, S2, M3	S2		Organizati on Structure
PG7	A4, A6, B2, B5, C3, D8			P2, S1 R3			IT Systems
…	…	…	…	…	…	…	…

Table 5. Bottom-up approach for BPR

This table includes only the level 2 processes (configuration level-process categories) of the SCOR model. That is the reason why each P, S, M, D and R are linked to a number, which indicates the process category.

Examples of process categories within the top level *Source.* "S", can be Source stocked product (S1), Source Make-to-Order (S2) and Source Engineering-to-Order (S3). Making products to stock is challenging due to unknown demand quantities and procurement of raw materials, while making MTO and ETO products requires accurate demand forecasting and transparent market estimation. Therefore, each of these process categories may present different problems.

This table also includes what interviews the problems were identified from as well as the major problem groups identified as "*PG Code*". Finally, the supply chain entities are on top of the table.

As discussed above, this table provides all the identified problems in a clear and visual manner. They are linked to the problem groups, the business processes identified in the SCOR (only level 1 and 2) and the entities. Furthermore, the category of each of the problem groups has been added in the right column so that every problem group can be related to the area from which it arises. Problems may have to do with organizational structure, certain business processes or IT systems.

Once such visual table has been made, solutions have to be identified as they will be the ones driving the BPR process. Solutions can be formulated according to the information already collected and depicted in the above table. Further interviews with key managers of the supply chain entities and an analysis of potential solutions performed by a consulting team are the main tools to formulate such solutions.

The last step is to prioritize the solutions in order to identify the possible sequence of BPR actions. There are two dimensions that must be considered. The degree of difficulty to implement them and the degree of severity of each problem. The number one priority will be that one with the highest degree of severity and the lowest difficulty of implementation. Scores can be given to each problem group and its respective solution in the two dimensions in order to formulate a priority list. This list will give rise to priority activities that will be performed as part of the BPR.

In conclusion, the SCOR model is not a comprehensive framework when implementing an IOS, as Pang and Bunker suggest in their model, because it serves as a referential tool for assigning business processes and associated factors of performance measures. SCOR model´s weaknesses have been addressed. An alternative bottom-up approach is proposed to drive the BPR in a supply chain context. This approach starts with identification of problems through interviews with key managers. These problems will be grouped and will be linked to the supply chain entities and business processes of the SCOR model. Then, solutions are formulated according to the input obtained from further interview with key managers and the analysis of external parties such as a specialized consulting team. Finally, problems and solutions will be ranked according to the severity of the problem and the difficulty of implementation of the solution. This analysis will provide a list of activities that will drive the BPR method.

6.4. GDSN factors

The more systems the GDSN is compatible with the less changes on the redesign of the supply chain network and business processes are needed.

The physical architecture design of an IOS includes primary technology choice, client/server architecture and nature of linkages (Premkumar 2000).

The GDSN is a network that is already standardized and managed by GS1. The GS1 Global Registry is designed and controlled by GS1. Therefore, all the entities will have the same central database and will not be a factor in the implementation process as it is not managed by neither the retailer nor the supplier. The data pools are more flexible than the GS1 Global Registry as they are not designed by these two entities but by a certified provider. The choice of this provider is a factor instead. The choice of the provider will depend on variables such as the cost and the technical characteristics of the data pool.

Finally depending on the strategy, the organization will implement the IOS by way of: in-house team, a third party, a purchased or packaged solution, a combination of the last options. This GDSN is usually implemented by means of a packaged solution powered bu GS1.

6.5. GDSN framework

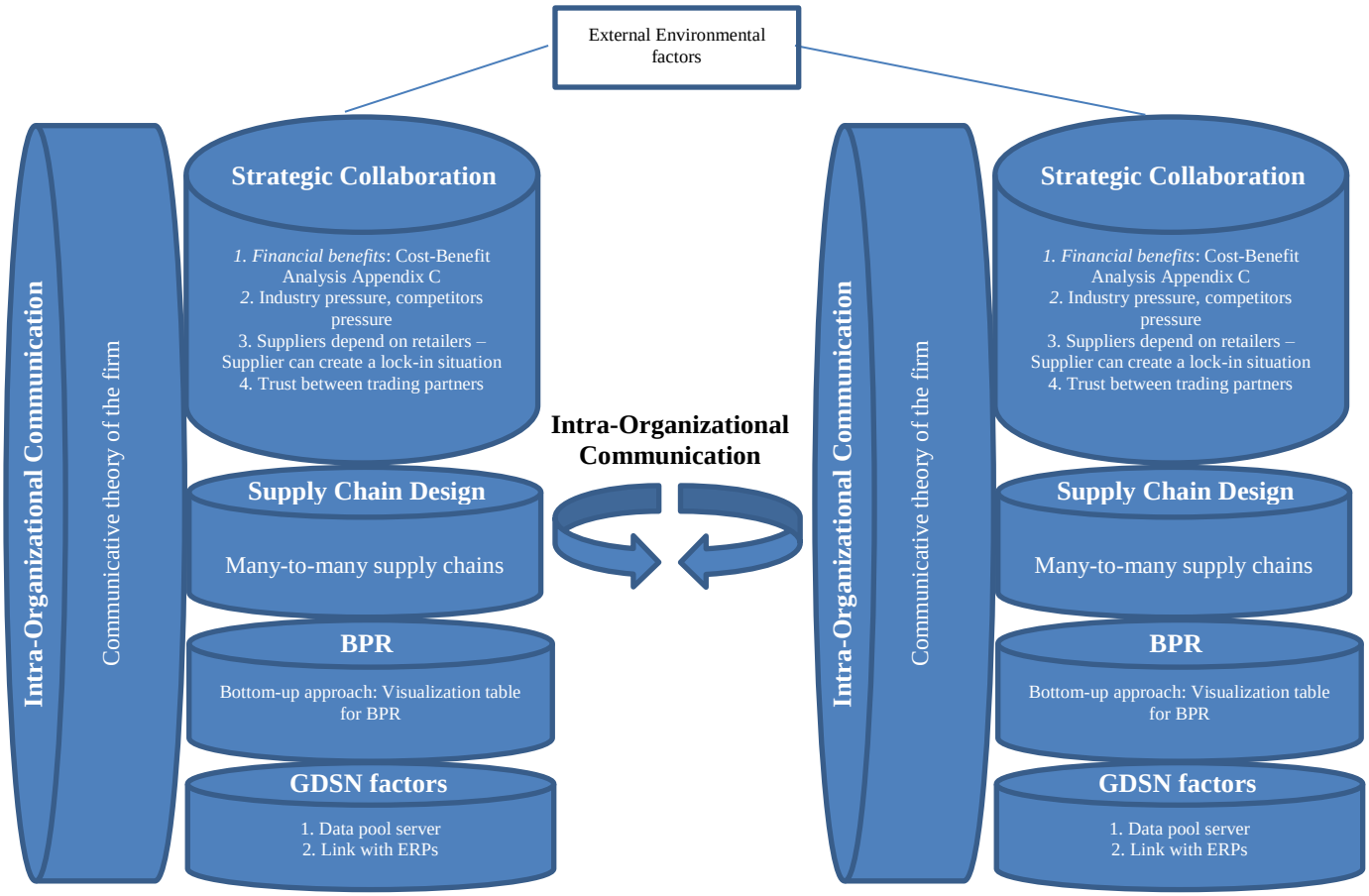


Figure 28. GDSN framework

This GDSN framework keeps the 6 aspects from the IOS framework, but they include specific instruments to evaluate the GDSN adoption.

This GDSN framework is used to identify the CSFs of the GDSN adoption in the next section.

The value creation of the GDSN framework can be summarized in the following points:

1. Intra-organizational collaboration:

A new communicative theory of the firm was formulated to cope with the inefficiencies of the TCE and RBV.

This theory advocates for shaping the trajectory of a project through coordinated texts, authorized by management. They are able to collect abstract knowledge and intentions of actors that otherwise would be lost as they would not be enshrined anywhere. Texts are not permanent. They evolve over time as they receive new inputs from conversations or other existing texts. It is important to link texts with one another to establish a good network of texts, able to show the big picture of the project.

These texts are a way to encourage actors to subordinate personal interests to the collective good. Managers are the ones "authoring" these texts, but the interaction process with subordinates as well as the shared responsibility will improve in relation to the TCE and RBV.

The GDSN is a project that has multiple areas of action. Therefore, texts will play a very important role in transferring the knowledge that is acquired throughout the project to stakeholders or new people that start working in the project and that has little background on the GDSN

2. Strategic collaboration

Strategic collaborations is very broad and different areas need to be addressed to analyze the full concept. The next lines summarize the main findings regarding the GDSN implementation.

Financially, a cost-benefit analysis was performed to understand when the investment on the GDSN will be paid off. On average it takes 2-3 years to pay it off for both suppliers and retailers. In addition, retailers will obtain more financial benefits thanks to the GDSN than suppliers.

The need for the GDSN is also important to shape the strategic collaboration between retailers and suppliers. The GDSN is a tool that is part of the revolutionary change that will shape the retailing industry in the upcoming years. Suppliers and retailers will need to adapt to the new paradigm and the GDSN is one of those tools that become critical to keep evolving in the digital world.

Regarding the power in the relationship, the distribution of resources is more on the retailer's side. In addition, there must be an alignment among retailers to implement the GDSN so that it is profitable for the supplier. Retailers will drive the process and they need to create incentives for the suppliers so that these ones do not create a "lock-in" situation.

Last but not least, the inter-organizational relationship between the two entities should be assed using the six contingencies suggested by Oliver (1990): Necessity, Asymmetry, Reciprocity and Efficiency, Stability & Legitimacy.

3 & 4. Process collaboration (supply chain design and business process reengineering)

Process collaboration has to do with the supply chain design and business process reengineering.

On the one hand, supply chain design is a concept that is at the same level as supply chain visibility and the GDSN. Some different types of supply chains have been analyzed, however the type many-to-many vs exclusive supply chains is the most relevant to analyze the potential benefits of the GDSN. Many-to-many supply chains is the type that can benefit the most of the GDSN. Exclusive supply chains can only have a few benefits but maybe not enough to compensate the costs associated to implementing the GDSN.

On the other hand, business process reengineering (BPR) is *"the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service, and speed"* (Hammer & Champy, 1993, p.32).

Pang & Bunker suggest to use the SCOR model to analyze how business processes can be adapted to the new IOS the company works with. However, it was found that the SCOR model is not the best framework to analyze the GDSN as it provides a top-down approach that takes into account the entire operational and strategical models of the firms. The applicability of the SCOR model in BPR when implementing a new tool/technology in the supply chain is limited. The SCOR model assumes that cross-site KPI information is easy to obtain when it is not the case with an innovative project. The three main limitations of the SCOR model include: (1) Geographical limitations: SCOR limits the analysis to legal or geographical entities, (2) Information limitations: essential information such as KPIs might be not available while the SCOR assumes they are & (3) Limitations in collaborative activities: collaboration among entities has a different meaning in the SCOR model than the meaning that is deemed in this analysis.

A bottom-up diagnosis is necessary to identify the problematic processes and their consequences. This is especially useful when KPI information among sites is not available or can be biased by external factors.

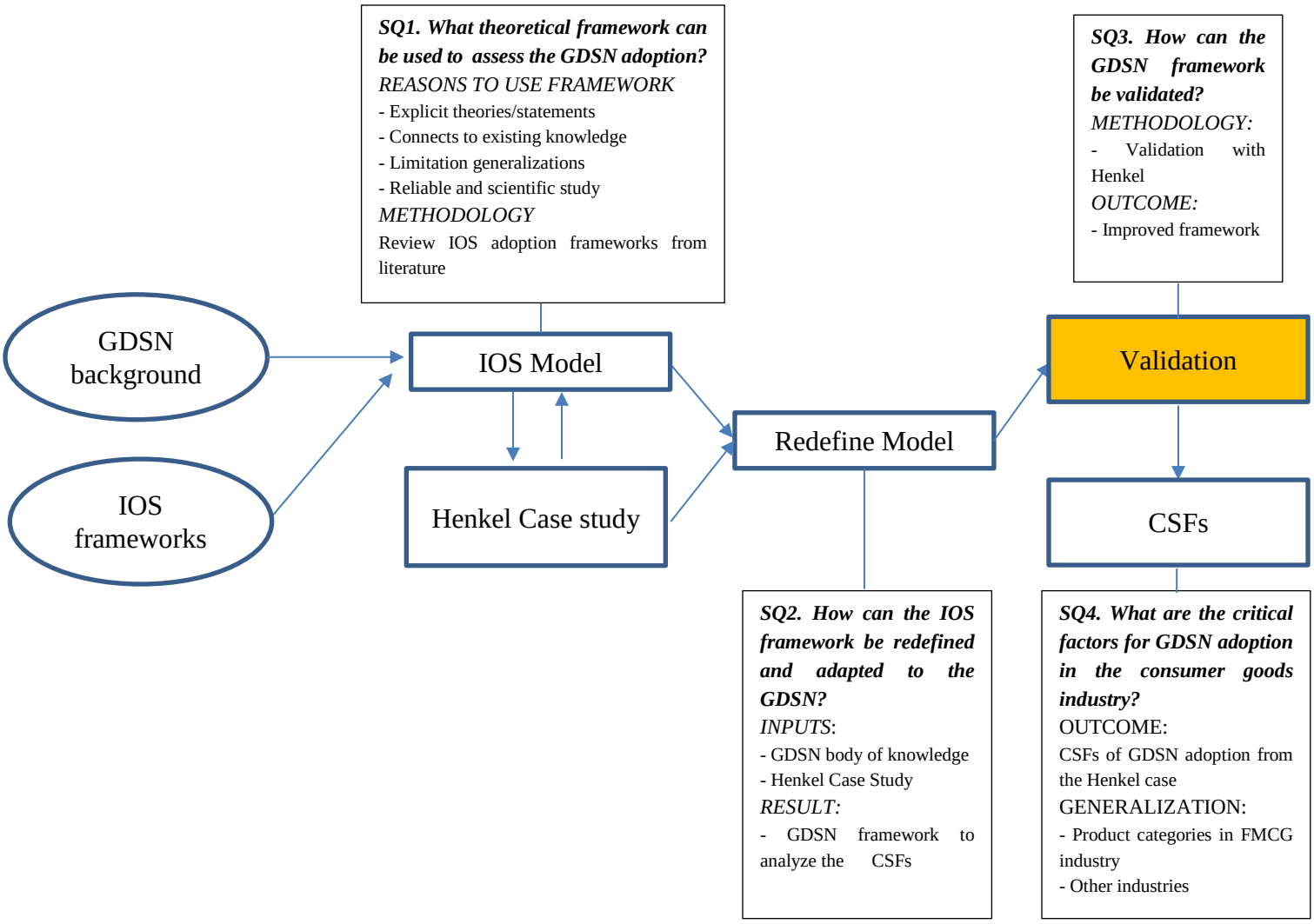
Therefore, an alternative bottom-up approach is proposed to drive the BPR in the GDSN implementation process. This approach starts with identification of problems through interviews with key managers. These problems will be grouped and will be linked to the supply chain entities and business processes of the SCOR model. Then, solutions are formulated according to the input obtained from further interview with key managers and the analysis of external parties such as a specialized consulting team. Finally, problems and solutions will be ranked according to the severity of the problem and the difficulty of implementation of the solution. This analysis would provide a list of activities that will drive the BPR method.

5. IOS factors

The more systems the new GDSN is compatible with the less changes on the redesign of the supply chain network and business processes are needed.

The GDSN is a network that is already standardized and managed by GS1. The GS1 Global Registry is designed and controlled by GS1. The data pools are more flexible than the GS1 Global Registry as they are not designed by these two entities but by a certified provider. The choice of this provider is a factor instead. The choice of the provider will depend on variables such as the cost and the technical characteristics of the data pool.

6.6. Validation



This section is entirely dedicated to answering the SQ3. This sub question extension depends on how representative the GDSN framework is from the perspective of Chris Van Daele, Head of the Customer Service and Product Information Management departments.

When I presented the GDSN framework to Chris, his overall impression was really good as he believed that almost all the most important factors and aspects were included in the framework. His two main remarks were:

1. Top management missing: top management plays a very important role in a project like the GDSN. It was clear to me that top management matter a lot but I thought that their impact has more to do with the conception of the project rather than the adoption. However, they also play an important role in the adoption process as they are the responsible people in resources allocation: human and financial resources, and also in the relationships with external parties, namely retailers and the GS1.

2. Continuous improvement: from his perspective and knowledge, the GDSN is the kind of project that requires continuous improvement. There are a lot of issues that occur during its adoption and implementation and risk management becomes essential to ensure the project's success.

These new remarks are included in the GDSN framework to obtain a validated framework. As these two remarks cannot be located in any aspect of the framework, they will added as the two main supporting factors that should be present in all the aspects of the adoption process.

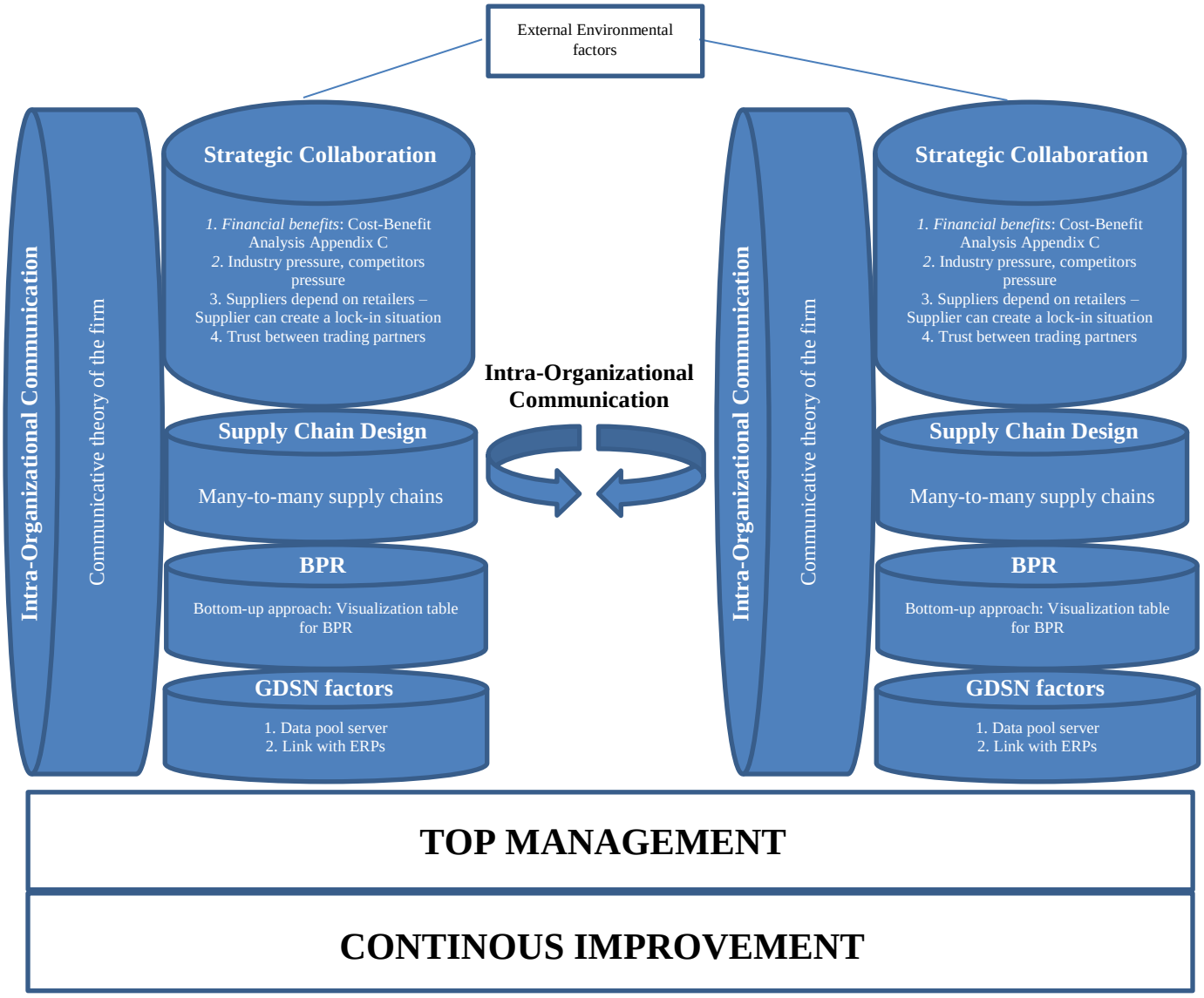


Figure 29. Validated GDSN framework

7. Conclusion

This section aims at analyzing how this research has addressed the research questions that were formulated at the beginning of the work. Finally the critical success factors are presented.

It is important to align whether this work has answered the questions raised, and whether the objective of this thesis has been reached.

The main research question aims at identifying the critical success factors for GDSN adoption in the retailing industry. To answer this question three sub questions were formulated. These three sub questions will be analyzed before the critical success factors for the GDSN adoption are identified.

SQ1. What theoretical framework can be used for assessing the GDSN adoption?

As no theoretical framework existed in the literature, an existing one for IOS adoption was the starting point from which the GDSN framework is formulated.. Rahim & Kurnia (2004), Pang & Bunker (2007), Bouchbout & Alimazighi (2008) & Kauremaa & Tanskanen (2017) were the papers that were analyzed included in this thesis. The Pang & Bunker was the framework chosen because it is the one that take more factors into account. It is based on sounded theories (resource dependency theory, organizational theory, actor-network theory and negotiated order theory) and it is very well-structured and founded in the literature.

All these frameworks advocate that top management factors are the most important for the implementation of an IOS in an organization since top managers have the authority to approve projects, provide financial resources and re-structure the organization if needed. This is something that will be considered when coming up analyzing the critical success factors.

SQ2. How can the IOS framework be redefined and adapted to the GDSN?

The GDSN framework keeps the same six critical aspects that are analyzed in the IOS framework (and the same basic theories that support these aspects). These aspects are adapted to the GDSN project according to the GDSN characteristics (analyzed throughout the thesis) and the input received from the interviews performed at both suppliers and retailers.

Some of the new elements that were included in this framework are: communicative theory, power relationship, a new bottom-up diagnosis for BPR or the different supply chain configurations that can be found. All these new elements will be used for the critical success factors.

SQ3. How can the GDSN framework be validated?

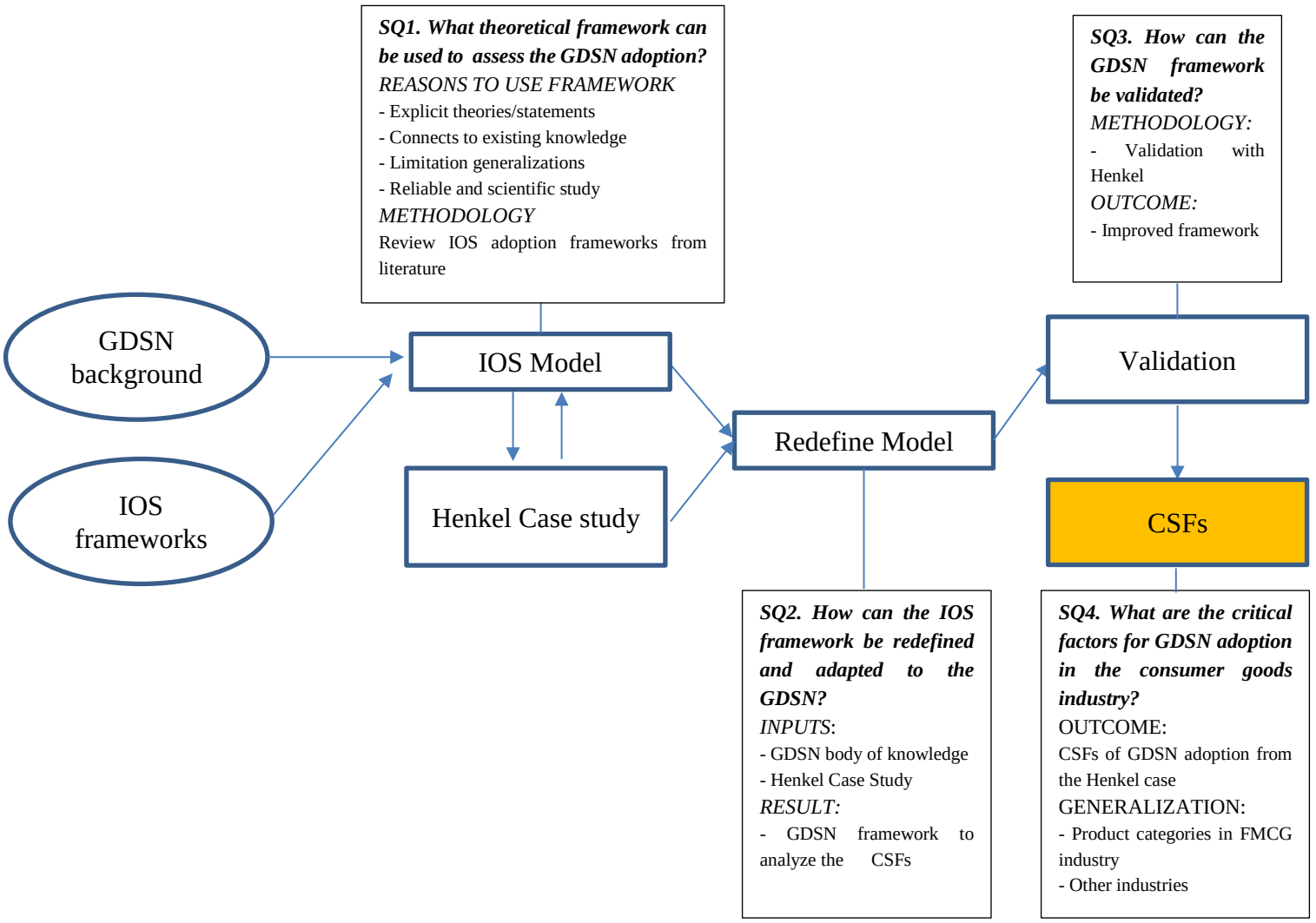
This question addresses an extra step in the analysis that give more rigor and reliability to the research. The results that are obtained in this sub question greatly depend on the person who validates the framework. In this case, the person was Chris Van Daele, as it is the person who has been working the most with the GDSN.

The result of the validation process is a validated GDSN framework that serves to identify the CSFs. The validated framework is like the original GDSN framework, but with only a few remarks in some aspects of the framework, remarks that are considered in the analysis. However, the GDSN framework stays as it was before the validations process.

SQ4. What are the critical factors for GDSN adoption in the consumer goods industry?

This last sub question aims at identifying the CSFs for GDSN adoption in the consumer goods industry. This sub question is actually answered for the specific Henkel case and then the generalization to the consumer goods industry is discussed. The CSFs for the Henkel case are formulated in the next sub chapter.

In addition, the analysis will include a small discussion about the applicability of these results in other industries. This is not part of this research sub question so it will be included in the section reflections.



1. Make sure the GDSN network fits with the culture and needs of your organization

The first thing that has to be assessed is if the GDSN will have a great impact in the future operational performance of the organization and their supply chain partners. Analyzing the connection among the GDSN, supply chain visibility and supply chain design is how this decision could be made effectively

The GDSN is aimed at improving product information visibility throughout the entire chain. The improvement in visibility would lead to a more efficient supply chain: wrong orders would be greatly reduced and the manual work of processing this information in different formats and excel files would be over. The costs associated to these processes would potentially be reduced to zero. In addition, the working environment would considerably improve, which would boost a more collaborative environment among business partners. This might also improve other business areas.

Therefore, if visibility towards product information is something that is not deemed as a major factor, then the GDSN would bring limited benefits as improvements would be subject to the current inefficiencies. The GDSN will be useful towards visibility if the supply chain business partners have a big margin to improve. Otherwise it will be pointless to invest in this tool

Another important variable is the supply chain design (SCD). Different supply chain configurations have different needs. Some supply chain types were analyzed in section 3.6. Many-to-many vs exclusive supply chains seem to be the type that has more to do with the GDSN. Many-to-many supply chains are those ones where many suppliers interact with many retailers. This is the type of supply chain that characterizes this case study. Henkel is a global multinational that sells its products to many retailers all over the world. However, the focus is locally and Henkel has many clients both in Belgium and the Netherlands. On the other side, the retailers have many clients as well as it is expected in multinational retailing firms.

Exclusive supply chains are the ones that can be many-to-one, one-to-many or one-to-one. This classification explains the logic of the product flow. In many-to-many supply chains, the product is produced by many different suppliers and sold in many different stores, therefore, the retailer distributes multiple brands of products. In exclusive supply chains, the retailer would sell a few or multiple products to dedicated stores.

Many-to-many supply chains is the type that can benefit the most of the GDSN. The reason is that both organizations will have many entities working with and product information will be shared in many different ways depending on each of the entities. Therefore, standardization will have the greatest impact on such organizations.

Both supply chain visibility needs and supply chain designs have to fit with the purpose of the GDSN. If the supply chain configuration is close to the many-to many supply chain type and visibility towards product information is an important factor, then the GDSN will have important reasons to be implemented.

2. Establish an agreement between the dominant retailers of the region and the responsible GS1 organization about the rollout of the GDSN

The GDSN is not a tool that can be implemented if just two organizations want to. The GDSN is implemented only if the most important retailers and suppliers of a region agree on using it. The project has to be regulated by GS1. This organization has to make sure these retailers communicate effectively with one another in order to achieve the desired results. Milestones, deadlines and resources are the three main elements that they have to agree on to have a successful start on the project.

3. Collaborate with each supplier and offer them incentives in order to avoid a "lock-in" situation

Retailers are the driving force in this process as they have most of the resources and capabilities needed to implement it successfully. Even though, retailers are the driving entities, suppliers could cause a "lock-in" situation if the most important ones do not want to implement it. Retailers should offer incentives, apart from the financial benefits that they will have. Some incentives could include the offering of technical assistance, consultants or financial assistant in the initial phase.

4. Implement the philosophy of the *communicative theory* in each involved organization in order to ensure excellent intra-organizational communication at project level

The communicative theory was introduced in the GDSN framework as a new theory to ensure that intra-organization communication has the necessary level to help the project be successful. This theory advocates for shaping the trajectory of a project through coordinated texts, authorized by top management. This is the way to keep essential information of a complex project over time. Information that could arise in informal talks could still be reflected in these texts. Complex IT projects like these ones need to record every single piece of information that might be useful. Text must be updated regularly as the project will also receive new inputs every day. Stakeholders and future employees will be able to catch up with the project thanks to having all the information that has arisen during the project enshrined in texts.

5. Use regularly the six contingencies suggested by Oliver (1990) to evaluate the strategy positions of all the entities during the project

Positions throughout the implementation process might change. A resource dependency can lead to the dominance of a buyer or supplier in a supply chain network; this can lead to imbalance of power relationships between a supplier and a customer. It is essential to avoid this situation especially because it is an IT system that is implemented among several organizations. If an imbalance situation is created, some entities could quit or delay the pre-agreed deadlines. The six contingencies can be used to assess the strategic positions in a pragmatic way.

6. Use the bottom-up approach suggested in this thesis in section 3.6 to prioritize the process that will be reengineered as part of the BPR

This bottom-up diagnosis starts addressing the. problematic processes and their consequences. Unlike the SCOR model, the method starts from the bottom as not information is available to identify the problems from the top

The identification of problems is through interviews with key managers. These problems will be grouped and will be linked to the supply chain entities and business processes of the SCOR model. Then, solutions are formulated according to the input obtained from

further interview with key managers and the analysis of external parties such as a specialized consulting team. Finally, problems and solutions will be ranked according to the severity of the problem and the difficulty of implementation of the solution. This analysis would provide a list of activities that will drive the BPR method.

7. The entire project has to be supported by top management and a continuous improvement environment.

The GDSN rollout requires top management of all involved organizations to step up in order to provide support and commitment to the project during its life cycle. Resources have to be allocated fairly in order to ensure success. In addition, top management and responsible people at team level have to boost a continuous improvement environment, as this is the type of project where many errors arise; errors that will drive the learning culture throughout the project.

8. Discussion

This section includes recommendation and implications for managers that are involved in the implementation process of the GDSN. In addition, the contribution to science is addressed. Finally, limitations and future research areas are discussed.

8.1. Personal reflection

This research thesis can be situated in the field of technology as a corporate resource. We live in an age where technology is shaping the traditional way in which corporate operations are carried out. Corporations aim at eliminating waste and inefficiencies of their operations not only to become more cost efficient and competitive, but also to offer a better customer experience. Industries such as the financial industry and the retailing industry are probably among the ones that will be shaped the most by breakthrough technology. Therefore, this research goes along the digitalization trend that organizations seem to be interested in.

However, digitalization does not cover all technologies similarly. There exist two mainstreams that can divide the different digital technologies:

- Developed technology, whose main difficulty relies on its implementation
- Innovative technologies that are in R&D phase

The GDSN can be placed in the first mainstream. This type of technology is already developed but organizations may encounter many difficulties in the implementation process. This is what this research topic is about. The outcome of this thesis is oriented to give more insights to those stakeholders that are willing to start the adoption and implementation process of the GDSN.

Technologies such as control towers, IoT, Big Data, Logistics BPaaS or blockchain are still under the R&D phase. Firstly, these technologies need to find a potential growing market to know the scope of their future implementation.

In addition, I found out that adoption and implementation processes are more intricate when the network of stakeholders is more complex. I personally believe that the GDSN network is very complex in comparison to other digital platforms. Therefore, its adoption process can be trickier than in other cases where the network is simpler.

My last reflection about this work is about the lack of strategic vision of large companies. I think that in many cases, large organizations request consulting services to solve problems that could perfectly be solved by a more professional top management.

Top management need to collaborate more proactively in this types of projects to ensure success without needing external services.

8.2. Managerial implications

Supply chain managers and logistics professionals can have these CSFs into account, specially when (1) assessing the feasibility of the project & (2) shaping the progress of the project, collaborating with all the involved entities, to ensure its success.

The current state of supply chain visibility in relation to product information is still improvable. Digital channels are taking over the market and accurate exchange of product information is needed to be able to compete effectively in these new channels and give the customer what they request. This thesis recommends to meet reasonable deadlines to gain a competitive advantage over those organizations that have delays. A framework and critical success factors are presented to help companies achieve a successful implementation. These CSFs were obtained based on the Henkel case study and could be slightly different in other companies and industries. The generalization of these CSFs is addressed in the next section.

Last but not least, the adoption of the GDSN is part of the overall supply chain strategy, so it should be aligned with the overall digitalization strategy of the firm.

8.3. Generalization

This study focuses on the consumer goods industry and takes its particular characteristics into consideration when it comes to the assessment of the GDSN implementation process. The Henkel case study is representative of the consumer goods industry but some remarks have to be taken into account. Any supply chain network in the industry can benefit greatly from the results as long as they have a similar supply chain visibility strategies and degree of many-to-many supply chain as Henkel (see figure 3). The closer a network is to the Henkel case the more applicable the outcome of this thesis is.

In relation to the generalization to other industries, the answer is similar to the one above. The CSFs are more applicable as long as the specific case study is close to the Henkel one in regards to supply chain visibility and design.

The focus of the research is on a dyadic relationships between the manufacturer and the retailer. Many researches pinpoint the investigation of information sharing at the buyer-supplier level as too simplified (Kaipia and Hartiala, 2006b). However, in this research, the investigation of dyadic relationships is justified, because the main goal of the GDSN is to successfully exchange product information between these two types of organizations, which is where most of the benefits that the GDSN brings along can be obtained from.

Even though this thesis focuses on the GDSN, the results could be generalized to other types of global standards as they would also imply a dyadic relationship between the manufacturer and the supplier.

Finally, the lack of some data collected from the company because of confidentiality reasons is an important limitation. Further information from the Henkel case study could have led to slightly different results, a good example is the financial figures used in the cost-benefit analysis. They are approximate, as the original ones were confidential.

8.4. Theoretical contribution

The objective of this paper was to identify the CSFs for the GDSN implementation. Therefore, the main contribution has been the identification of CSFs and the operationalization of a framework for the implementation process of the GDSN. There was no framework existing in the literature. The GDSN framework was formulated from an existing IOS framework.

Existing well-known theories such as the RBV, TCE or ANT are the foundation of this framework. Other theories such as the communicative theory or the bottom-up approach used to analyze the BPR are more innovative theories that take into account certain areas that can help obtain better results when using them in real projects. This GDSN framework is a good contribution to the literature. The framework can be used in more case studies to identify CSFs. It can also be used to test and further improve it so that it includes insights from multiple case studies and not only from one.

The essential link between the GDSN, logistics and IT systems was made explicit in section 5.1. This is also a good contribution to the literature, as shows the two main concepts by where the GDSN is involved.

8.5. Future research areas

This theory has different objectives, apart from the main one, which is the identification of the critical success factors. Therefore, the area of further research is broad and can be tackled from multiple dimensions.

This research is based on a case study and represents the first step in an investigation that is aimed at linking different concepts.

Testing the critical success factors and the GDSN framework is needed in order to validate them. They were formulated based on the GDSN characteristics and a single case study conclusions by means of interviews and questionnaires. However, they still need to be tested. The GDSN can be generalized to other companies and industries. However, the critical success factors are more applicable in the Henkel case study and could be not applicable in other cases.

One of the delimitations of the study is a focus on the retailing industry. The applicability of the study in other industries is also interesting. Even though the design of this research is for the retailing industry the research could be extended to other industries with similar characteristics.
The aspect of strategic collaboration could be further investigated. An area of further investigation and study would be how companies perceive information as a tool to optimize the overall supply chain processes, and as a tool used to develop and support a competitive advantage. Information asymmetry is followed also by the important concept of power balance within the supply chain – there is always a supply chain actor, which owns more information than others, and can somehow influence the processes of adoption.

We have assumed that supply chain visibility creates the availability of information in the supply chain, which companies act upon. Does supply chain visibility always provide a base for collaboration? Therefore, the bond between supply chain visibility and collaboration also deserves further investigation.

Two innovations introduced in the GDSN framework are the communicative theory and the bottom-up approach for BPR. Empirical results about these two methodologies are still missing and therefore becomes an area of future research.

8.6 Relationship with Management of Technology

This last section intends to link the research thesis with the Master's degree in Management of Technology.

The objective of the MOT programme is to analyze innovation and technology from a business perspective. Technology is seen as a corporate resource capable of driving innovation to support firm's most important challenges. The programme relies on scientific methods and techniques to analyze technology and innovation.

This thesis studies a technology as a corporate resource to improve operations' efficiency of a supply chain network. Some of the scientific methods and techniques taught during the program were used, showing the relationship between this paper and MOT.

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Appendix A

Interview Questions

1. General Questions

1. When did you start to implement GDSN standards?
2. Who was the initiator in adopting GDSN standards? What was the reason for it (lack of information or its poor quality or anything else)? Was it a desperate need or a forward looking step?
3. What was the scope of implementation?
4. Were there other FMCG organizations in NL that were implementing GDSN standards at that time?
5. How would you define visibility? SC visibility (SCV)? Have you achieved SCV since GDSN standards implementation? If so to what degree from 1 to 10?
7. What IT systems do you use to support the implementation of GDSN standards?
8. Which standards and IT systems did you use before? (Any proprietary standards?)
9. Have you ever had confusion with implementation of data identification standards before GDSN standards implementation? Did they diminish after?
10. How did the process of GDSN implementation go? (employee resistance, top management support, IT related investments, technological challenges)
11. When is the investment going to pay off? Could you please provide us with some financial numbers?
12. Do you have a way to measure the specific impact of the GDSN on SPC aside from the KPIs that are usually used for measuring supply chain performance? Any new KPI introduced because of the GDSN implementation? Are the KPIs that were used before implementing the GDSN getting better?

2. Questions about the GDSN in Belgium and the Netherlands

1. What are the main reasons why the GDSN was implemented in the Netherlands and not in Belgium? (financial, operations, IT systems, retailers, management, lack of other resources)?
2. Who decided to start the strategy for implementing it by 2018?
3. Is the implementation following the same procedure as in the Netherlands?
4. What would the main differences be between the Netherlands and Belgium when it comes to the implementation of the GDSN?
5. Is the expected result similar to the result obtained in the Netherlands?
6. What was the start of rolling out GDSN at (retailer)?
7. What timing has been set for this rollout?
8. Why did you opt for that approach?
9. How long has the project already taken for you at the technical level? How did you handle that?
10. How does GDSN / trustbox fit in the global strategy of (retailer) around omnichannel? Is it going to get all data from the GDSN in the future?

11. What benefits does (retailer) expect from the GDSN implementation?
12. What product data should a supplier fill in the GDSN?
13. What actions are specifically planned to ensure data quality and follow closely?
14. How do you see the cooperation with GS1 in this project? What role do they play in the onboarding of suppliers, data quality?

Appendix B

GS1 GDSN Certification Criteria Document

GDSN Service Level Compliance Proposed by Certified Data Pools

When a GDSN Certified Data Pool is notified of an issue that requires follow-up by another GDSN member (e.g. Data Pool or GS1 Global Registry), the Data Pool will contact the organization that is engaged during point of failure. In certain scenarios, it may be difficult to identify the point of failure as multiple entities may be involved (e.g. GS1 GR and another Data Pool). If this is the case, the Data Pool should follow-up with the GS1 GR first until it is determined the issue is not with the GS1 GR. The following steps will be followed to address the issue: 1. Requesting party (i.e., the party experiencing the issue) to place a call and email to the customer support team of the receiving party (i.e., the recipient of the support request). The required contact information should be maintained in a central location that is easily accessible to all GDSN data pools and the GS1 GR. 2. Receiving party's customer support team to follow-up with a response. A response is defined as 1) notification of a ticket number for tracking purposes and 2) acknowledgement that the issue is being researched and status if available. Escalation timing begins once the requesting party receives the notification of a ticket number. 3. The following escalation process will be used only for Critical and Major faults (Severity 1 and Severity 2 issues) in the Production environment. A Critical Fault is defined as a service interruption for any Data Pool on GDSN. Message synchronization not accessible with no apparent work-around. A Major Fault is defined as a system fault for a Data Pool on GDSN with a defined workaround (i.e. degraded system or functional performance). There will be a single escalation point of contact for each data pool, and the escalation process will require that the follow-up be between the corresponding escalation points. a. If no response is received within 8 business hours, the requesting party will initiate a follow-up email or call into the customer support team of the receiving party. b. If no response is received within 16 business hours, the escalation process will involve the appropriate technical support manager from the requesting party contacting his/her counterpart at the receiving party. Escalation contacts will be maintained in a central location that is easily accessible to all GDSN data pools and the GS1 GR. c. If still no response after 24 business hours, escalation will involve the appropriate senior manager from the requesting party contacting his/her counterpart at the receiving party. d. The final escalation point will be Susie McIntosh-Hinson / Malcolm Bowden at GS1 Data Excellence Inc. Review and final decision will be made by GS1 Data Excellence, Inc.. Per the GS1 Global Registry Access and License Agreement and the Acceptable Use Policy, the GS1 GR and certified data pools reserve

the right to request information of each other that is pertinent to the resolution of issues. Such information includes communications configurations such as retry sequences, timeouts, and general message choreography. It also includes actual data transmitted (e.g., MDNs, subscriptions, CINs, CICs, synch list reports). All GDSN Data Pools are expected to provide this information in a timely manner to facilitate the troubleshooting of issues. GDSN members should provide the requested information within 8 business hours of acknowledgement and response to the original request, after which the escalation process defined above, will be followed. Per the GS1 Global Registry Access and License Agreement and Acceptable Use Policy, Data Pools must provide around the clock (24X7) technical contact services. It is the Data Pool's responsibility to provide regular updates to their direct connect customers that are impacted by the issue at hand. Each data pool will determine the frequency of updates that are provided to their customers. Production Level Connection Establishment: A certified data pool must guarantee a maximum time of 10 business days to provide a production level connection and functionality to another DP which requests connectivity. A required production level connection consists only of in-network message sets with only in-network code lists and no optional extensions. The time limit starts after the AS2 set-up information (e.g. AS2 identifier, digital certificate, GLN, and URL) has been provided. This information must be included in the official request for connectivity. The clock stops at the point that the SDP gets either an EANUCC Response or a GDSN Exception back from the RDP. More time will be allowed if AS2 connectivity issues occur.

Appendix C

Cost-Benefit Analysis GDSN

Costs retailers and suppliers: The first cost that both entities incur in is the connection to be made between their IT systems and this data pool, which is by means of a PDM software. It was quite difficult to obtain precise costs about this software as it is highly dependent on the type of information system that the organizations have in place. The only source from which this cost could be obtained was from a report of the company Lansa, which estimates that this cost is between **€5,000** and **€100,000**. As said, the range is so wide because there is no standard solution. The training of the employees is not considered in the calculations because it is deemed as very low in comparison to the price of the software.

In adittion, the organization has to pay an annual fee for the subscription to the data pool. The fee depends on the the annual turnover of the company and if it is the retailer or the supplier. The fee is the 0.003% of this turnover if the GS1 DAS data pool is used by Henkel (the data pool from GS1 Netherlands, which is actually powered by 1WorldSync). In the Netherlands, the annual turnover of Henkel in 2016 was €80 million. Therefore, Henkel has to pay 0.001% * €80millions = **€800**. The fee for retailers to connect to this database is 0.00002%. If the annual turnover for Colruyt (the retailer used in this analysis) is 8.652 billion, then they have to pay 0.0002% * €8.652 billions = **€17,304**

Then the organization would have to pay a yearly fee of €2,400 to continue to be connected to the data pool.

The benefits can be direct or indirect. On the one hand, all direct benefits involve the reduction of the labor (time is saved because of reduction of handing inaccurate data). On the other hand, indirect benefits are related to new opportunities that arise due to trustworthy data.

Direct benefits retailers: the questionnaires performed in some big retailers revealed that between 1% and 5% of the orders received by Henkel are wrong because of wrong article numbers. In these cases, the retailers need to contact Henkel to solve the problem. The estimation time to solve it according to some GDSN managers in retailers is about 15/30 minutes.

Indirect benefits retailers: there are several benefits that are not quantifiable. Some of them have already been mentioned in the sections that explain the GDSN in depth.

1. All data come in the same format from a single point of entry, the data pool
2. Possibility to create an automated reorder process
3. More automatized stock management, something that is currently done manually by retailers' employees

All these fields have actually consequences in other variables that could be quantified and tracked by the implementation of KPIs. KPIs such as inventory reduction, out of stock %, logistics costs, receiving time, speed to market (A.T Kearney). However, no data on these KPIs are currently tracked by any of the retailers interviewed and cannot be included in the cost-benefit analysis.

Last but not least, according to the research performed by A.T. Kearney, there is a price error on 60% of the invoices. Prices are not currently synchronized with the GDSN, but GS1 is working on it. If these errors can eventually be reduced to zero, then the benefits of the GDSN will even be greater.
Direct benefits suppliers: Between 1% and 5% of the incoming orders are wrong as stated by the retailers. To fix the problem, the supplier takes less time than the retailer as the retailer has to investigate the problem and then contact the supplier, steps that the supplier does not have to undergo. The estimation time to solve it according to Chris Van Daele, Head of the Customer Service and Product Information Management departments is very little, around 10min.

Indirect benefits suppliers: Some of them are the same as for retailers but not all of them:

1. Product information uploaded once for all the retailers in a single point of entry.
2. New products continuously synchronized. The supplier does not have to send the data to the retailers every time a new product is introduced or an old one changes drastically.

Cost-benefit analysis for retailers: Colruyt is the retailer selected to perform this cost analysis. The reason is because it is the one from which more real data about orders could be obtained. Colruyt had to process more than 120,000 orders in 2016. If there is a 2% of errors when processing orders and the average time is 23 minutes to solve them, then the savings in working time are: 2%*80,000 *23 minutes = 613 hours/year

The average employee in Belgium and the Netherlands works 40 hours a week. In one month this is (40 * 4) = 160 hours/month. If the estimation in productivity is 0.7 of those 40 hours (Strategic Labour Market Intelligence Report, 2016), then the working time is (0.7 * 160) = 112 work hours per month.

Therefore, the months that the organization would save is (613 hours/year / 112 hours/month) = 5.5 months.

If the gross salary of an employee in the purchasingth department is around €3,000 in both countries and the real costs of an employee is 2.7 times higher than the gross salary according to Hadzima (2010) (extra costs include extra benefits, office equipment and other indirect costs), then the monthly cost per employee is (€3,000 * 2.7) = €8,100/ employee*month.

Finally, the total amount saved would be (€8,100/ employee*month * 5.5 months) = **€44,550**

€44,550 would be the total amount of money saved on employee costs by the retailer. If prices would also be synchronized, the savings would even be higher. However, since Colruyt has to pay a yearly fee of €17,304 to be connected to the data pool, the actual savings are (€44,550 - €17,304) = **€27,246.**

The implementation costs have to be considered now to calculate the time that Colruyt would pay off the investment on the GDSN. The Best case scenario is that implementation costs are only €5,000. In addition to this cost, the yearly fee of subscription has to be added just once, since it has to be paid the first time that the connection is made even though there are no benefits. In such case:

Best case scenario: (€5,000 (implementation) + €17,304 (one-time fee)) / €27,246 = **0.82 years**

If the implementation costs would be €100,000, then

Worst case scenario: (€100,000 (implementation) + €17,304 (one-time fee)) / €27,246 = **4.3 years**

Cost-benefit analysis for suppliers: the procedure is the same as the one developed for retailers. Only the data is different. Henkel had to process 6000 orders and the time to solve a problem is only 5 minutes. Therefore the time that Henkel would save every months thanks to the GDSN is 2%*12,000 *10 minutes = 40 hours/year.

Therefore, the months that the organization would save is (40 hours/year / 112 hours/month) = 0.36 months

The total amount saved would be (€8,100/ employee*month * 0.36 months) = **€2,916.** If the yearly rate is paid then the total savings would be (€2,916-€800) **= €2,116.**

In this case, the only implementation considered will be €5,000 because it is assumed that the suppliers will have to pay the lowest possible, otherwise, it would not be beneficial for them:
(€5,000 (implementation) + €800 (one-time fee)) / €2,116 = **2.74 years**

The conclusion is that the investment on the GDSN implementation will be paid off in about an average of 2-3 years for both the retailer and the supplier. The financial benefits of the GDSN were made explicit throughout the thesis. However, this section provides a quantification on these financial benefits that will be of help in the analysis. For example, this cost-benefit analysis reveals that the entity which will drive the implementation process of the GDSN will be the retailer as it is the one that can save the most in general terms without taking into account the revenues.