



Data Synchronisation in Dutch Healthcare

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Abstract

Product data of healthcare products is not yet effectively and efficiently transferred from the data source to the data recipient in the Dutch healthcare sector. This causes errors in the supply chain. These errors could be prevented by participating in the Global Data Synchronisation Network (GDSN). In this thesis we research the impact of the GDSN on the Dutch healthcare supply chain. First the development of data synchronisation in the healthcare sector is studied. Then a link between the healthcare sector and the retail sectors is made, where the GDSN already has been used for years. We look at the logistic healthcare processes concerned with product data, and we determine the inefficiencies. Finally the costs and benefits of the GDSN implementation will be analyzed. Several interviews with relevant persons were conducted to acquire useful data.

The results show that the GDSN can be used profitably in the healthcare sector. The supply chain partners using the GDSN will work more efficiently, because of accurate and up-to-date data. The largest direct benefit is the elimination of product number errors on invoices. This benefit will save the hospitals as well as the suppliers a lot of corrective work. The largest indirect benefit will be the standardized barcode on every medical product in the GDSN. With the use of standardized data provided by the GDSN more efficiency projects could be started, like an automated recall process or an automated ordering process. The efficiency projects that use the accurate data are recommended for future research.

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I hope you will enjoy reading this paper.

Maarten Paalman
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Abbreviations

DAS	Data Alignment Service
DoD	Department of Defense
EAG	Early Adoption Group
EAN	European Article Numbering Association
EPC	Electronic Product Code
ERP	Enterprise Resource Planning
FTE	Fulltime-equivalent
GDSN	Global Data Synchronisation Network
GHX	Global Healthcare Exchange
GLN	Global Location Number
GPC	Global Product Classification
GPO	Group Purchasing Organization
GS1	Global Standards One
GTIN	Global Trade Item Number
HIBC	Health Industry Bar Code
HIBCC	Health Industry Bar Code Council
IT	Information Technology
KPI	Key Performance Indicator
UCC	Uniform Code Council
UK	United Kingdom
UML	Unified Modeling Language
UoM	Unit of Measure
UPC	Universal Product Number
US	United States
WWRE	WorldWide Retail Exchange

1. Introduction

1.1 Thesis Introduction

When a hospital orders a medical implant, a nurse triggers an order process that reaches the supplier. The supplier sends the implant to the hospital, and the doctors implement it in the patient. This order process is based on data from locally situated databases at the hospital and at the supplier. Now imagine that the supplier changes one of its products, and updates the product information in its own database. He sends a notice of the changed product data by fax or e-mail to all their hospital clients. The logistic departments of the hospitals need to update their own database manually.

Let's assume for example that in 1% of the manual updates something goes wrong. For example the fax is not sent to all hospitals, or while updating the hospitals database a typographical error occurs. This typographical error could be a small one, for example if the width of the package is one millimetre off. However the typographical error can be huge, for example if the identification number is incorrect, or the size of the implant itself is different. If an order is placed at the manufacturer with wrong identification numbers the manufacturer might notice this and spend time on contacting the hospital to correct the order. However if because of inaccurate information the wrong product is ordered by the hospital it needs to be handled differently, the right product needs to be ordered quickly and the cause of the mistake needs to be found. This takes extra time and costs money.

According to Hospitals Worldwide (2009) there are over 15.000 hospitals and health clinics in the world. Multiply this with the thousands of medical implants ordered, and that assumed small 1% of wrong product data updates is a major inefficiency.

When product information is changed by the supplier, he wants this information to be correctly and instantly changed at every hospital's database. For example when a product from a manufacturer changes from 10 pills inside a pack to 20 pills, the hospitals need to be informed about this update as soon as possible, preventing wrong orders to be sent.

To achieve this accurate and up-to-date data synchronisation a Global Data Synchronisation Network can be used. This network will be explained in the next chapter.

This master thesis is based on an internship at the Erasmus MC at the healthcare logistics department. The thesis is the final part of the researcher's master program Economics & Informatics at the Erasmus University Rotterdam.

1.2 Scope

There are several ways to synchronise data. To synchronise item article information the Global Data Synchronisation Network can be used. According to testimonials on the GS1 website (2009) some big retail companies have stated that the Global Data Synchronisation Network has proven to be useful and valuable. In this paper the synchronisation process will be researched by focussing on the Global Data Synchronisation Network.

The Global Data Synchronisation Network is used successfully in different sectors. However the healthcare sector falls behind with the adoption of data synchronisation. The sector on which this paper is based will be the healthcare sector. The healthcare sector is selected because there has been little research on data synchronisation. In view of this I did my research during an internship at the Erasmus MC, which is the main hospital in Rotterdam.

The healthcare supply chain exists of multiple parts. For the healthcare side the paper will only focus on the hospitals. Private clinics or other medical centres will not be included. Group purchasing organizations and distributors also play a role in the healthcare supply chain but are not included in this research. Only Dutch hospitals and suppliers are in the scope as trading partners in the healthcare supply chain.

There are many different products purchased by the hospitals. This ranges from computers to gloves and from orange juice to scissors. For this research paper the data synchronisation will focus on medical products. Since there are tens of thousands medical products the scope will be limited to medical implants.

The processes viewed in this thesis will be limited to the logistic processes concerning the ordering of products and the synchronisation of product data.

1.3 Research questions

The Erasmus MC is looking at the possibility of data synchronisation for medical implant product data. When this functions successfully it is likely that more product data will be synchronised. This thesis will look at different perspectives of data synchronisation combined with the logistic processes for medical implants at the Erasmus MC.

The main research question is:

“What is the influence of a data synchronisation implementation at a Dutch hospital’s supply chain?”

To answer the main question we will divide it into sub-questions. These sub-questions will be answered in the chapters in this thesis. The first sub-question will clarify what data synchronisation is.

- *What is data synchronisation?*

Because the main question aims at hospitals the second sub-question will be about the developments of data synchronisation in the healthcare sector.

- *What are the developments of data synchronisation in the healthcare field?*

To get a better understanding of what a data synchronisation implementation can accomplish, the third sub-question is about the results of data synchronisation in other markets.

- *What are the results of data synchronisation implementations in other markets?*

The next sub-questions will be aimed at answering the part about the influence in the main research question. The influence of the data synchronisation implementation on the logistic processes needs to be researched. The sub-questions concerning this issue will be the following:

- *Which logistic hospital processes will be influenced by data synchronisation?*
- *Which logistic supplier processes will be influenced by data synchronisation?*
- *On what side of the supply chain will data synchronisation have the biggest impact?*

The final sub-questions are about the financial influences of the data synchronisation implementation for the hospitals and for the suppliers.

- *What are the costs and benefits of a data synchronisation implementation for a hospital?*
- *What are the costs and benefits of a data synchronisation implementation for a supplier?*

1.4 Methodology

To answer the main and sub-questions certain methodologies will be applied, which include a literature study, interviews, process analysis and a cost-benefit analysis. We will now describe which methodologies will be used.

Literature Study:

To get a good understanding what data synchronisation is and how this technology is developing in the healthcare and other sectors, a literature study will be performed. The literature study will be executed by following the steps explained in the course Methodology of E&I (FEB33007). Data synchronisation is a new technique for the healthcare sector. In this literature study only some scientific papers were found regarding this subject. Other non-scientific sources will also be used to answer the sub-questions.

Interviews:

To enrich this thesis with empirical information qualitative interviews will be conducted with key personnel. The method for qualitative interviewing is described in “The Practice of Social Research” by Babbie (2004). The information gained from the interviews will be used in the process analysis and the cost-benefit analysis. The list of interviewed persons can be found in the appendix.

Process Analysis:

The process analysis explains how a process works by showing the chronological sequence of steps that occur (TCC, 2004). For this analysis we will first define the relevant medical supply chain processes. For each of the supply chain processes we will create a visual representation with the use of Unified Modelling Language. Next we will identify and discuss the inefficiencies and explain what happens to them when the processes are changed due to the GDSN implementation.

Cost-Benefit Analysis:

For the cost-benefit analysis we will use the methodology described in the book “Applied cost-benefit analysis”, written by Brent (2006). In this book is written how to select the right costs and benefits for the analysis, and what ratio's and calculations are relevant. When the costs and benefits have been discussed we will create a cost-benefit analysis for the Erasmus MC. The information about costs and benefits is gathered through interviews, literature studies and the process analysis.

2. Data Synchronisation – A Literature Study

2.1 Introduction

In this chapter we will answer the first sub-question with the use of a literature study. This sub-question is “What is data synchronisation?”. First we give a short introduction into data synchronisation. After this we will explain what the global data synchronisation network is. The focus of this thesis will be about this network. In the next sections in this chapter we will go further into this data synchronisation network by explaining the different parts of the physique of the network and how the data synchronisation process actually functions. We will also look into what kind of data will need to be synchronised.

2.2 Global Data Synchronisation Network (GDSN)

Data synchronisation, according to the GS1 website (2009), is the process where a data source and a data recipient are creating a consistency between the data stored at both locations. This process is preferable executed continuously on a set time interval.

The supply chain in healthcare, from the supply side to the demand side, exists of Manufacturers, Distributors, Group Purchasing Organizations (GPO) and Hospitals. In this paper we focus on the hospitals and the suppliers (manufacturers). It is normal for the supply chain partners to use their own database in the order process. When the manufacturer changes some of its item information in its own database, the databases on the receiving end are not up-to-date anymore. This leads to a decrease of data accuracy. The accuracy of data is important for all companies to operate their business processes. Without accurate data wrong decisions might be made. The ability to make right decisions based on accurate data is even more important at a hospital, because human lives are at stake. To make sure every supply chain partner is working with the same information, each partner should use the same data set. This can be achieved by using a Global Data Synchronisation Network (figure 2.1). This network exists of globally accessible data pools to which suppliers upload correct and changed up-to-date data. Hospitals and other supply chain partners can subscribe to retrieve this data. In this thesis we will only focus on the GDSN for data synchronisation.

The GDSN exists of multiple parts, which are displayed below in figure 2.1. The GS1 Global Registry is at the top and connects all Data Pools. This registry will be explained in the next section. It can be seen as the yellow pages of the network, because it stores the location of every supply chain partner,

which products it has published and which data pool he uses. 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. A hospital can subscribe to the desired product information and retrieve the data from its own data pool. This is because all data pools are interconnected (GS1 Healthcare US, 2008). In figure 2.1 the distributor and the GPO (group purchasing organization) are also displayed. They will be ignored in this research. Figure 2.1 is a healthcare specific representation of the GDSN. However the GDSN is used in many markets. There is only one GS1 GDSN in the world in which all companies can participate. In the following chapters the parts of the GDSN will be explained.

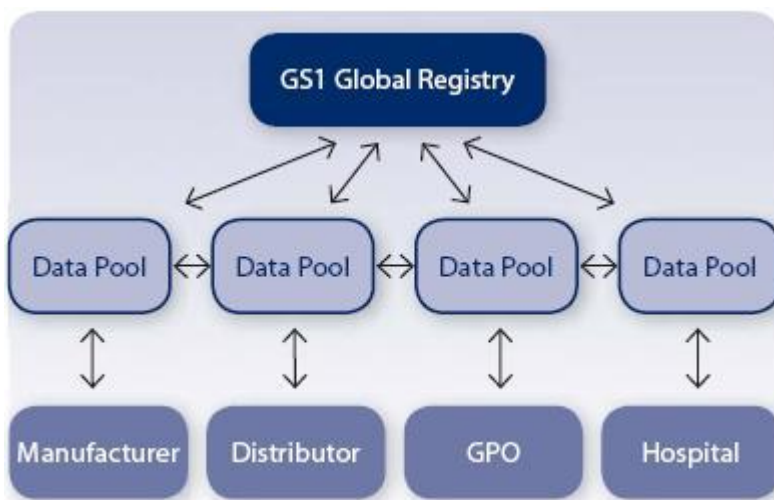


Figure 2.1, Global Data Synchronisation Network, (GS1)

2.3 GS1 and the Global Registry

GS1 is a global organization which aims to improve efficiency of supply chains across sectors. According to the historic overview of the GDSN from a participant’s website (Edgenet), EAN International (European Article Number) was formed in 1977, which became GS1 in 2003. GS1 stands for Global Standards 1. The GS1 code system is a globally accepted system to uniquely identify products. The GS1 website (GS1 symbols) states that they developed the following well-known codes: EAN-8, EAN-13, GS1-128, GS1 DataBar, DataMatrix and GS1 EPCglobal. Together with industry leaders GS1 came up with a set of product attributes to be synchronised through the GDSN. These product attributes are relevant to the logistic and internal processes for the supply chain partners. For each sector different attributes might be important. The GS1 healthcare group has defined healthcare specific attributes, for example an attribute called “contains blood” which is a Boolean (yes/no). More detailed information about the healthcare attributes will be given later on in this paper.

As said before the GS1 Global Registry can be seen as the yellow pages. 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. Without this registry the global interoperability of the data pools would not be possible. When we write in this paper about the “GDSN”, we mean the GS1 GDSN®.

2.4 Data Pools

According to Wikipedia (2009) 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 GDSN is a voluntary industry initiative. Every data pool is free to decide if it wants to be part of the GDSN. According to a data pool list on the GS1 website (2010) there were 28 data pools with a GDSN-certification in 2010. There is no clear information available on the total number of non-certified data pools in the world. 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 GDSN certification criteria document (2010) and can be downloaded from the GS1 website. These criteria are the following:

Technical Performance: The data pool must successfully take the GS1 GDSN Interoperability Test (Drummond Group 2006). This is a test administered by the Drummond Group to make sure the connections between the data pools are working correctly.

Operational Performance: The data pool is required to show Demonstrated Capability. This means that the data pool must be able to support a minimum of 50 trading partner relationships. For example if a data pool has 4 suppliers who have registered their product at the Global registry, and 20 retailers that have subscribed to this data, then the data pool is supporting (4x20) 80 trading partner relationships.

Implementation Performance: The data pool is required to demonstrate commitment towards community adoption of the GDSN. This means that the data pool must have at least a minimum of 25% of trading partners participating in the GDSN. For example when a data pool has 100 trading partners using its services, at least 25 should be registering or subscribing to items in the Global Registry.

Service Level Compliance: The data pool must notify other data pools of software upgrades and respond timely to issues.

Security Performance: The data pool must be submitted once a year to a security audit performed by an independent third party security audit firm. If the data pool has passed the review, the documentation must be shared with GS1. The data pool must comply with the minimum security requirements which are stated in the GDSN Audit Requirements Document (2007).

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 13, 2009). It has over 3.4 million registered items. These items were registered by a total of 7,677 suppliers and used by 102 retailers. According to the same statistic document the total number of trading partners participating in the GDSN is 21,771 (see figure 2.2). The number of registered items across all data pools is over 4.3 million. This shows that 79% of all items were registered via the 1SYNC data pool. Examples of these items are alcoholic-, automotive-, home improvement- or grocery products. Schemm & Legner (2007) calls this a “Mega Pool”, because it is actively present in multiply continents and sectors. According to them a data pool that only services a geographically bounded area is called a “local specialist”, because of reaching a lower number of customers they tend to focus on one sector or product group.

	TOTALS
Active Data Pools	21
Trading Partner GLNs	21,771
Retailers	218
Suppliers	21,553
Subscriptions Sent	718,503
Subscriptions Matched	598,761
Subscriptions Matched by Item	10,289,538
Recipient DP Subscription Matches	10,289,538
Registered Items (GTINs)	4,339,317
GTINs Coded with GPC	3,177,909

Figure 2.2, Total numbers of GDSN activity

2.5 GDSN 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. Industry leaders and GS1 together decided which product attributes should become the standard to use in logistic processes. There is a standard set of mandatory attributes which need be filled in for every product. Beside this set there are extra attributes to describe the product in more detail. These are not mandatory and this list of extra attributes differs per market and is too long to describe here. All attributes names are in English to be able to work globally. However certain data for the attributes, like description, might be written in the local language. In the following paragraphs the mandatory attributes will be explained.

2.5.1 Global Trade Item Number (GTIN)

The GTIN is the most important product attribute. It is a globally unique GS1 identification number which identifies the trade items. The information in this section comes from the GS1 Healthcare GTIN Allocation Rules (2007). On a barcode the first number is most likely the GTIN. A GTIN can exist of 8, 12, 13 or 14 digits and is build up from a company prefix, the item reference and a check digit (see figure 2.3).

The GS1 company prefix exists of a GS1 prefix and a company number. The GS1 Global Office assigns a prefix to a GS1 member organization. That member organization assigns the company number.

The item reference is assigned by the company itself and does not hold any specific information. Usually the item reference is sequential and is assigned 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.

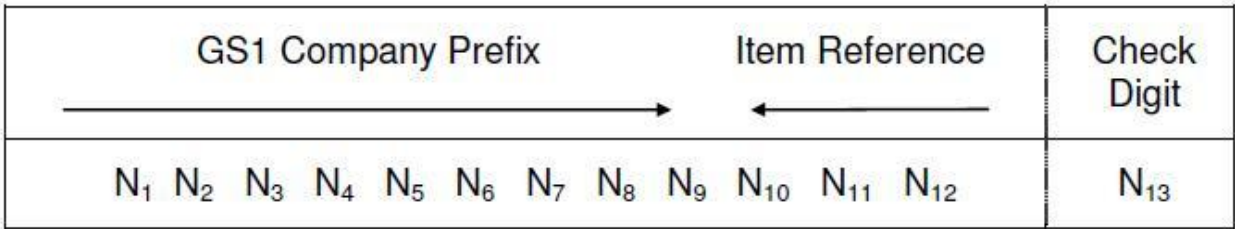


Figure 2.3, Example of a GTIN-13

As you can see in figure 2.4 the three different pack levels have different attribute information. A pack level defines how the product is packed. For example if the product is on a pallet or in a box. A uniquely registered GTIN cannot contain multiple data on the same attribute. This means that the different pack levels require different GTINs. When for example the barcode on the Inner Pack is scanned the employee knows it is not a consumer unit. 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. Typically any level that is to be priced, ordered or invoiced sometime in the supply chain receives a unique GTIN.



Figure 2.4, Different pack levels

During a products life cycle it is possible that a product changes. It depends on the type of change if a new GTIN should be assigned. For example in figure 2.5 the number of tablets changes. In this case a “new” product has been created which could cause confusion if it is not given another GTIN than the “old” product. The creation of new GTINs will be explained later.

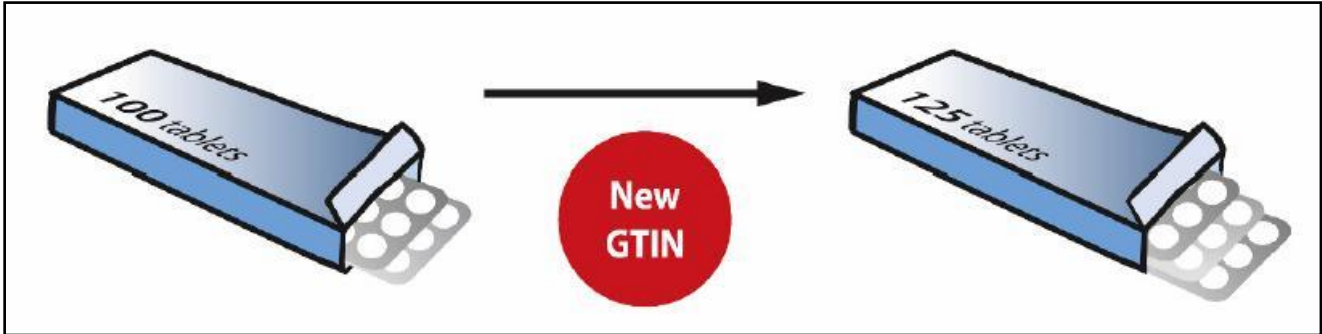


Figure 2.5, New GTIN when the Net content is changed

There are other instances where new GTINs are required. For example when the product is launched in another country and the language on the material is changed. Another example is when the number of cases on a pallet changes, for example from 6 cases to 10 cases.

When the change concerns minor changes in the packaging materials like in figure 2.6, the same GTIN can be used. This is because the product is still the same and hospitals would not get confused when the changed product arrives. The same GTIN can also be used when an additional language is added onto the packaging. When an alteration to the product is made the question should be asked if the “new” product is fully interchangeable with the “old” product. If this is not the case a new GTIN should be assigned. If the supplier does not do this, problems might occur when clients receive other products than ordered.

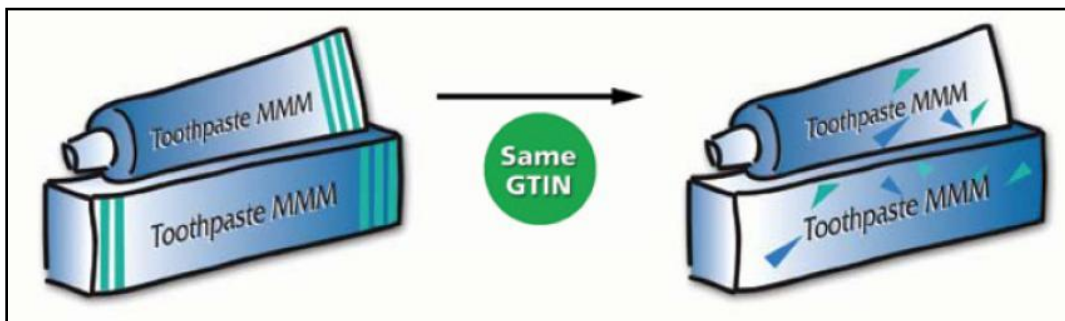


Figure 2.6 Minor change in packaging materials

2.5.2 Global Location Number (GLN)

According to the GS1 Identification Key Series GLN report (2008), the GLN is a GS1 identification key that exists of 13 digits. It is used to identify any location. This can be a physical location like a delivery address, a specific warehouse or a storage cabinet. It can also identify a legal entity like a bank or a whole company. It is also possible to identify a function within a legal entity like a buying department at a retailer, or the invoicing department at a hospital. In figure 2.7 the composition of the GLN is displayed. The GS1 company prefix from the GTIN is also used for the first digits in the GLN. The company can assign their own location reference digits. They are free to assign just one GLN for the whole business, or one for every location they want to identify. When a company assigns a GLN they define a standardized set of data about the location which is then uploaded to a database so all trade partners can use it. The check digit is used to ensure the integrity of the data.

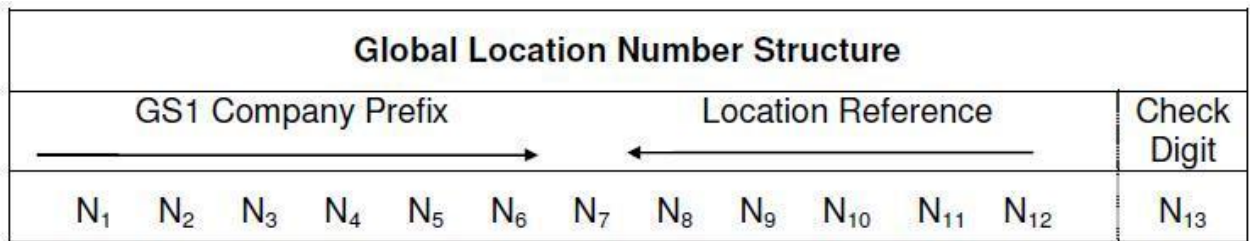


Figure 2.7, GLN

2.5.3 Mandatory attributes required for Global Registry

To register a product at the Global Registry several attributes are mandatory, according to the GS1 report Synchronizing Product Data in Healthcare (2008):

- *GLN of Source Data Pool*, which is the location of the data pool that serves as an entry point into the GDSN.
- *GLN of Data Source*, which is the location of the entity which provides the GDSN with master data.
- *GTIN*, which is the unique number of the registering item.
- *Target Market Country Code*, which states the country in which the product will be sold.
- *GPC*, which stands for Global Product Classification and identifies the category of the product. There are hundreds of different categories, for example: breakfast product, chicken, toy, cloth, etc.
- *State*, which is used to describe if the product is Registered, Cancelled, In Progress or Discontinued.
- *Date*, which is used to store the date on which the product was registered. Also the cancel or discontinued date can be stored. The “last changed date” is created automatically by the Global Registry.

2.5.4 Other mandatory GDSN attributes

In the same source from section 2.5.3 the following 17 attributes are also mentioned as mandatory attributes to operate in the GDSN. However these are only registered in the Data Pools and not in the Global Registry. They are the following: *Information Provider, Hierarchy Level, Brand Name, Functional Name, Base Unit y/n, Consumer Unit y/n, Dispatch Unit y/n, Invoice Unit y/n, Orderable Unit y/n, Variable Measure y/n, Returnable Packaging y/n, Batch/Lot Number y/n, Non-sold Item*

Returnable y/n, Marked Recyclable y/n, Height & Unit of Measure (UoM), Width & UoM, Depth & UoM. Next to these mandatory attributes there are hundreds of extra attributes which are not mandatory, but can be useful to help describe the product. In the next chapter these extra attributes will be given for healthcare products.

2.6 Synchronisation Process

When the supplier has defined all information for the required data fields for his products, the information needs to be uploaded to his data pool. According to the GS1 Synchronizing Product Data in Healthcare (2008) this process is also called on-boarding. The product data will be checked by the GDSN-certified data pool to ensure the data complies with the GS1 standards. If it does not comply the data will be rejected and the supplier will need to change his data and try again. When the uploaded data set is validated by the Data Pool, the mandatory attributes mentioned at 2.5.3 need to be registered at the GS1 Global Registry. This will be done automatically by the data pool. This process is showed in figure 2.8.



Figure 2.8, Storing Information in the GDSN

After the information is stored in the data pool it is available for distribution. For this event to happen the data receiver, in this case the hospital, needs to send a subscription request. The supplier needs to authorize this request. Only after authorization the supplier's data pool publishes the requested information to the hospital. The data pools manage all subscriptions for their users and exchange the information among the other data pools with the use of the Global Registry to obtain the data pool locations. This process is displayed in figure 2.9.

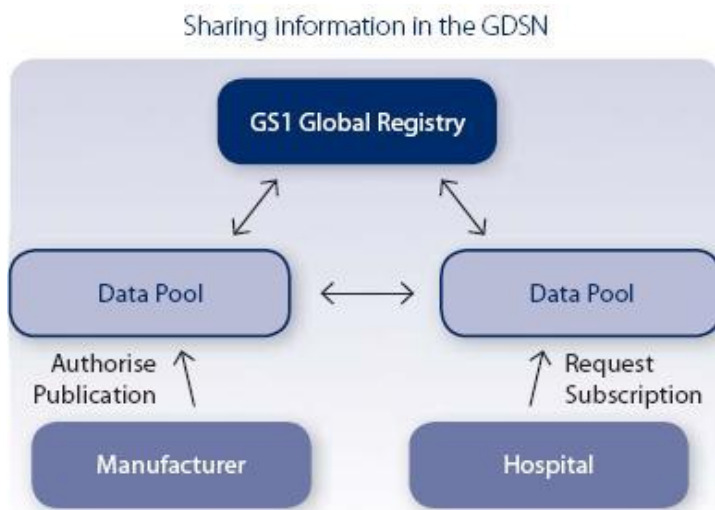


Figure 2.9, Sharing Information in the GDSN

When a supplier changes or adds product information he needs to upload the revised or new data to his data pool. His data pool will validate this new information and if it is correct they publish it to all authorized supply chain partners who subscribed to it.

2.7 Conclusion

In this chapter the Global Data Synchronisation Network was explained. The GS1 Global Registry is at the top of the GDSN, which 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 and target market which is a unique combination. 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. Developments in the healthcare GDSN field – A Literature Study

3.1 Introduction

To answer the main question “What is the influence of a data synchronisation implementation at a Dutch hospitals supply chain?” it is useful to look at the recent history of data synchronisation and standardization in the healthcare field. According to the GS1 Healthcare Reference Book (2009/2010) the healthcare system lacks a standardized way to identify medical products. This has a negative impact on the healthcare supply chain. After years of studies, pilots and debate, the healthcare industry is now making steps forward towards the implementation of a standardized set of supply chain data standards.

In this chapter we will look at several healthcare related data synchronisation developments. The first section is about the GDSN pilots that are or have been executed in the healthcare sector. After this the presumed advantages of the GDSN for the healthcare partners will be the topic. The next section will be about the most used barcodes in the healthcare sector. Finally some statistics gathered from healthcare supply chain partners about the readiness of GS1 standards will be discussed.

3.2 Pilots

In the logistic healthcare field the GDSN has not yet been adopted. However several pilots have been executed. In this chapter four pilots on the GDSN in the healthcare sector will be discussed. A pilot was executed in 2003 by the US Department of Defence (DoD). This pilot showed it was possible for the GDSN to operate in the healthcare market. When that pilot was completed successfully a subgroup from the DoD pilot continued to participate in the GS1 Healthcare Global GDSN Pilot. This showed the interoperability of the GDSN. After this pilot the GDSN Early Adoption Group was formed which started using the GDSN in a live production environment.

These pilots were performed in the US and Australia. Because of the success of the pilots, other countries also became aware of the possibilities for efficiency in the healthcare supply chain. For example in the Netherlands a group of hospitals and suppliers is working on setting up a pilot of their own, supported by GS1 Netherlands.

3.2.1 Department of Defence (DoD)

The information in this chapter was retrieved from the DoD/VA Data Synchronisation Program (2007). In 2003 the DoD launched a product data synchronisation program to look at their healthcare supply chain. The target was to reduce costs, improve the supply chain and to better support the soldiers. The department of Veterans Affairs (VA) joined these synchronisation efforts. In 2006 the DoD and VA started a GDSN pilot. The product data synchronisation program had shown that significant savings could be reached by the alignment of trading partner item files. The DoD launched the GDSN pilot because it believed that the sharing of manufacturer product information electronically between all the partners in the supply chain would provide significant efficiencies to all. In this pilot they used information about 10 products from 2 manufacturers. The goal for this pilot was to see if the GDSN can be implemented in the healthcare industry and if it can reach the same benefits as it reaches in other markets. This pilot made use of one data pool, called 1SYNC. All participants were located in the United States. The conclusions of this pilot were the following:

- GDSN is capable of meeting the data needs of US healthcare
 - Most of the fields required for healthcare are already in GDSN
 - Industry specific fields can be added, like “Contains Blood” and “Latex Free”
 - The methodology for managing the GDSN schema is mature and scalable
- Data loading is manageable by manufacturers
 - Manufacturers found it easier to gather GDSN data than they originally thought
 - Manufacturer systems contained nearly all the required data fields
- GDSN data could be implemented today using existing business systems
 - Today’s hospital Information systems require minimal fields to add new items
 - GPO systems could intake GDSN data today with minimal development effort
 - Technology partners already exist to assist participants in the GDSN process
- GDSN may satisfy global requirements
 - Global manufacturers are facing mandates from international customers for supplying standardized product information
 - Manufacturers desire a product data utility solution that is global in nature in order to reduce data sharing requirements and redundancy

- Although global functionality was not tested in this pilot, the GS1 GDSN global vision appears to meet international requirements
- The current method for gathering and managing product data is cumbersome
 - All parties in the supply chain struggle with data standards
 - All parties agree that consistent and synchronised data would bring benefit to them as individual entities as well as to healthcare overall

The results of the DoD/VA pilot are positive. However this pilot only worked with a small number of items. To get a better idea of the impact a GDSN can realize additional items and participants will be necessary to test the scalability.

3.2.2 Global GDSN Healthcare Pilot

After the DoD Pilot turned out to be successful and being aware of the possible supply chain efficiencies, a sub-group of the DoD project decided to start a new pilot which would focus on international interoperability by also using a data pool in Australia. Another target of this pilot was to provide additional information on how the GDSN is supporting Healthcare product data needs, like the flow of data, data standards, data accuracy and product and location identification.

The results given in the Global GDSN Healthcare Pilot Report (2008) are positive, however not described in detail. It states that the pilot clearly demonstrated that the GDSN provides the infrastructure to exchange data and messages between data pools across international borders. The previous pilot only used 10 products in one country, this pilot had registered over 2500 items and the participants came from two countries (see figure 3.1).

Loading & Registering Data



Figure 3.1, Loading and Registering Data

Other key findings from the pilot were practical issues. For example the GTINs for each pack level needs to be registered into the GS1 Global Registry. If for example the case and the pack have been registered, but the GTIN for the base unit is left out the publication is stopped.

Another issues appeared because of the Beta system used in this pilot. Normally the GTINS are registered by an automated process. However the Beta system in this pilot could not process them automatically so it had to be done manually. Because of this some GTINs did not end up being registered because of human errors. This caused that some GTINs were not published accurately. This shows that by eliminating human intervention with the use of automated data synchronisation, the data accuracy will increase.

3.2.3 Early Adoption Group

In 2008 a group of US healthcare stakeholders decided it was time to implement the GDSN in a live production environment. This would increase the knowledge on GDSN for the healthcare sector which could then be used worldwide. GS1 Healthcare US decided to establish the GDSN Early Adoption Group (EAG) to support their effort. This EAG included members from all major roles in the healthcare supply chain in the US. They exist of 4 healthcare providers, 3 GPO's, 6 manufacturers and 1 distributor. The data pool used is 1SYNC. The EAG had set themselves **four objectives**.

1. Establish an agreed-upon set of GDSN attributes for healthcare in the US
2. Exchange data via the GDSN
3. Develop a set of meaningful metrics to measure success of the GDSN as full implementation and integration with back-end systems progresses.
4. Articulate recommendations and insights to promote industry adoption of the GDSN and publish findings.

All four objectives were achieved and are described in their report called GDSN in Healthcare: Experiences of Early Adopters in the United States (2010).

1) For the first objective a specific set of 40 attributes for healthcare products was agreed-upon. These include the mandatory attributes mentioned in the previous sections 2.5.3 and 2.5.4. According to GS1 GTIN Attributes for Healthcare Spreadsheet (2009) the healthcare specific attributes are the following:

Contains Blood: Indicates if the product contains blood as an ingredient

Implantable: Indicates if the product can be partly or totally inserted into the body

Contents of Concern: Indicates if the product has specific health concerns

Reusability Types: Indicates if the product is for single use or can be used multiple times

Brand of Generic Flag: Indicates if the product is a brand name or generic

Does Product Contain Latex: Indicates if the product is made from or contains latex

The full set of attributes can be found in Appendix A. A link to the spreadsheet containing extra information about all attributes can be found in the references.

2) The manufacturers published their information. The data recipients subscribed to the information through their GDSN-certified data pool. When the data was received the data recipients reviewed the data and sent an acknowledgement to the manufacturer. These acknowledgements can be “synchronise”, “accept”, “reject” or “review”. The data exchange through the GDSN worked correctly which means that the **second objective** was accomplished.

3) For the **third objective** the group established **key performance indicators** (KPI) which can be used to measure the success of the GDSN implementation. They felt strongly that the development of these KPI’s would promote the adoption of GDSN throughout the healthcare sector. These KPI’s should be tracked by the participants individually to be able to provide statistics on the success of their implementation. GDSN is a new concept for the healthcare sector. This means there are no statistical facts available yet on the benefits of the GDSN. One can only make assumptions so far.

According to the early adopters group report (2010) the KPI’s are divided into two sections: KPI’s for the data source (supplier) and KPI’s for the data recipient (hospital).

The most important KPI’s for the supplier are the following:

- Reduction in time required to process orders
- Reduction in the number of rejected orders
- Reduction in transportation costs
- Increased revenue, because of clients having visibility to new products quickly

- Reduction in number of inquiries to customer support

When the hospitals always use the correct product data in their orders, the order entry department at the supplier can enter the orders quickly without having to sort out the order discrepancies. This will also mean that no orders will be rejected because of incorrect order information. The reduction in transportation costs is gained when no wrong orders are sent to the hospitals. Wrong orders also need to be returned which of course costs extra. Also suppliers could use the correct unit of measures to plan their distribution optimally. The increased revenue is also a key performance indicator. What can be measured is the increase in sales because hospitals have better visibility on new products. The last KPI to be measured can be the reduction in phone calls from hospitals to customer support or sales representatives about product data.

The most important KPI's for the hospital are the following:

- Reduction in invoice issues related to wrong or obsolete codes being ordered
- Reduction in time spent on adding or updating of product information

For the hospital there are two KPI's which are expected to show the efficiency the GDSN can bring. The first one is the reduction of errors in invoices. When wrong product codes or obsolete products are ordered, the supplier will most likely notice this mistake and contact the hospital. The hospital then needs to spend time to figure out the errors and correct them. The other KPI is the reduction in time spent on updating or adding new product information. The manual "touches" from the point the data is received until the product master data is updated will be reduced if all data is retrieved correctly with the GDSN.

The measurement of these KPI's for suppliers and hospitals can show what effect the GDSN has on the efficiency of the logistic processes. The participating companies in the early adopters group have not published results of their measurements on the KPI's.

4) The fourth objective was to promote healthcare industry adoptions of the GDSN. The Early Adopters Group created a plan with six different phases to adopt the GDSN. This plan can be of great help for supply chain partners who want to participate in the GDSN. The phases are shortly described below. More detailed information can be found in the early adopters group report (2010) mentioned before in section 3.2.3

- Phase One: Commit. The company must create internal awareness of the GDSN and its benefits. Management and the departments in the organization must understand how the GLN and GTIN work.
- Phase Two: Assess. A gap analysis of GTIN attributes must be performed to determine what work flow changes are required to comply with the GS1 standards.
- Phase Three: Select. The company must select a GDSN-certified data pool to subscribe too.
- Phase Four: Implement. Prepare data by updating the internal system to close the gaps which were identified in phase two. Coordinate with your supply chain partners and confirm the attributes to be synchronised. Educate your employees about the GDSN. Create data governance procedures and then start with the data synchronisation.
- Phase Five: Transact. Develop a data integrity plan. Start transacting with the use of the GDSN and reassess business processes to meet the set goals.
- Phase Six: Maintain. New product information and product updates must be synchronised. Evaluate if new attributes are necessary and measure return on investment.

3.2.4 Dutch GDSN pilot

The previously mentioned pilots did not involve any countries in Europe. However with these developments in the US, the European healthcare supply chain becomes aware of the efficiency advantages to be gained.

In the Netherlands a group of healthcare partners came to the conclusion that the GDSN is a perfect opportunity to reduce supply chain costs and increase data accuracy which can be used throughout other hospital processes. They formed a GDSN workgroup which aims at the creation of a GDSN pilot. The group exist of four hospitals and two suppliers. Two data pools are available for the pilot, which are the GHX and GS1 DAS data pool. GHX is an international company providing logistic services to the healthcare and GS1 DAS is a Dutch GS1 data pool where DAS stands for Data Alignment Service.

They created four possible scenarios which can be tested in the pilot. For their pilot they must choose at least one of these scenarios. The scenarios are described below and displayed in figure 3.2, which was extracted from an internal document of the Dutch GDSN pilot group.

- The supplier publishes data to GS1 DAS where the hospital subscribes too.
- The supplier publishes data to GHX where the hospital subscribes too.

- The supplier publishes data to GS1 DAS. GS1 DAS synchronises with GHX where the hospital subscribes too.
- The supplier publishes data to GHX. GHX synchronises with GS1 DAS where the hospital subscribes too.

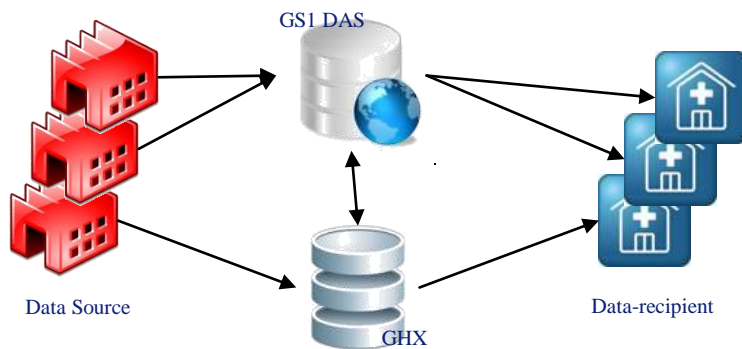


Figure 3.2, Possible scenarios for the Dutch GDSN pilot group

The participating hospitals first need to decide which GDSN-certified data pool will be their point of entry into the GDSN: GHX or GS1 DAS. The pilot is expected to start in 2010. Their goal is to get a working GDSN environment which will be used to persuade other healthcare companies to participate in this network. The preferable future scenario is that every healthcare supply chain partner in the Netherlands uses the GDSN.

3.3 Anticipated Advantages

The reason companies might adopt the GDSN is to create a more efficient supply chain. The group of early GDSN healthcare adopters created a list with anticipated advantages for supply chain partners who participate in the GDSN. These advantages are given in this section, and will be used in the interviews to gather information for the cost and benefits chapter.

The early adopters group anticipates the following benefits that apply to the suppliers if they would participate in the GDSN:

- Improved data quality for both internal and external processes
- Faster loading of new items into customer ordering systems
- Elimination of manual touch points for item set-up and maintenance
- Fewer customer inquiries on new or existing products
- Faster and more accurate maintenance of customer contracts

- Streamlined processing of rebates

The early adopters group also anticipated what the advantages for the hospitals would be if they would participate in the GDSN:

- Reduced time and manual effort to add and maintain products in the item master
- Reliable, accurate and up-to-date product information
- Elimination of unit of measure errors

The list of advantages for the supplier is longer than the list for the hospital. However one advantage for the hospital is not listed by the early adopters group. This is the advantage of proper barcodes. This will be explained in the next section.

3.4 Barcodes

In the healthcare sector there currently is not one type of barcode used by all suppliers. You might say there is a barcode “chaos” out there. Hammond (2005) stated that “*The grocery market had little problem in agreeing on a single barcode for labelling the products they sold; we need to make similar decisions in creating standards for health IT*”. For example there are medical implants in the hospitals with several different types of barcodes on the package. It so happens that the different supply chain partners might put their own internal barcodes on the package. These internal barcodes hold no value for other supply chain partners, but they stay on the package as it travels down the supply chain. It would be much easier and more efficient if all supply chain partners used the same barcode; the one created by the supplier according to the GS1 standard. This will happen if the supplier participates in the GDSN. When the barcodes on all products are **standardized** it would be easier for the hospitals to scan them. This data could then be used to optimize other hospital processes like implants registration, recalls, stock optimization, automatic reordering, etc.

A barcode is build up of black lines and white spaces with different widths. Each set of black lines represent a number, a letter or a machine readable character. The barcode scanner sends the string of symbols directly as input to the computer. This way typographical errors caused by humans are eliminated. According to Maffetone (1990) when humans enter data via a keyboard the average error rates is 1 in 300 keystrokes. With the use of a barcode scanner the error rate is virtually zero. Also the speed of which the data is registered into the computer is many times faster. In the healthcare sector two types of standardized barcodes are used. These are the Health Industry Bar Code and the GS1

barcode. Other types of barcodes are still used by a small group. However they are all expected to switch to the GS1 standard in the near future.

3.4.1 Health Industry Barcode

In 1983 the healthcare sector became interested in bar codes. This interest was brought on by third-party payers who wanted cost containment measures. According to a paper called “The basics of barcode technology” (Schmaus, 1991) the American Hospital Association teamed up with representatives from the Health Industry Manufacturers Association, the Health Industry Distributors Association, The National Wholesale Druggists’ Association and the Pharmaceutical Manufacturers Association to form the Health Industry Bar Code Council (HIBCC). They developed a standard for barcodes in 1984 in the healthcare industry: the Health Industry Bar Code (HIBC). The HIBC uses a unique number that is assigned by the HIBCC. The HIBC starts and ends with an asterisk (*). The first character is a plus sign (+), which indicates the barcode as a supplier label using the HIBC standard. An example of the HIBC barcode is displayed in figure 3.3.



Figure 3.3, Example of a HIBC supplier barcode

The first following digits are the labeller identification code, which is unique for each manufacturer. Other information like lot number, serial number or expiration date might also be included in the barcode. The last digit is a validity check.

3.4.2 GS1 Barcode

According to the GS1 Timeline, found on the GS1 website, the American grocery industry used the Universal Product Code (U.P.C.) in 1973 to scan its items and is administered by the Uniform Code Council (UCC). In 1977 the European Article Numbering Association (EAN) was formed by twelve European organisations. Their EAN-13 code was designed to be compatible with the U.P.C. In 1990 the UCC signed a cooperative agreement with the EAN to co-manage global standards. According to a white paper called “Integrating the Electronic Product Code and the Global Trade Item Number” (Brock, 2001) this led to several different UCC/EAN barcode types, for example UCC/EAN-13, UCC/EAN-14, UCC/EAN-128.

The UCC/EAN-13 code is a 13-digit code where the digits represent in order: the country code, the numbering organization prefix, the item number and the check character. The UCC/EAN-14 code is a 14 digit code where the digits represent in order: packaging number, management number, manufacturer ID number, item number and the check character.

In 2003 UCC/EAN changed its name to GS1. The UCC/EAN-128 code became known as the GS1-128 code and is the most wanted barcode because of its structure. The barcode is build up from a start character, the encoded data, a check character and a stop character. According to the GS1 128 barcode graphics website (2010) the encoded data can entail all 128 ASCII characters. This is because the code actually exists of thee sub codes which can all be used inside one barcode. These sub codes are called 128A, 128B and 128C⁶⁵:

- 128A - ASCII characters 00 to 95 (0-9, A-Z and control codes) and special characters
- 128B - ASCII characters 32 to 127 (0-9, A-Z, a-z) and special characters
- 128C - 00-99 (double density encoding of numeric only data) and FNC1

The encoded data uses application identifiers, which makes this a popular code. An application identifier is a predefined identifier used to display additional information in the barcode. There are approximately 100 different application identifiers, all with a different prefix. For example the prefix for the GTIN is 01. When the prefix is displayed in text under the barcode it will be surrounded by parenthesis. An article with the item number 54321 will be displayed as (01) 54321. Multiple prefixes can be printed into one barcode.

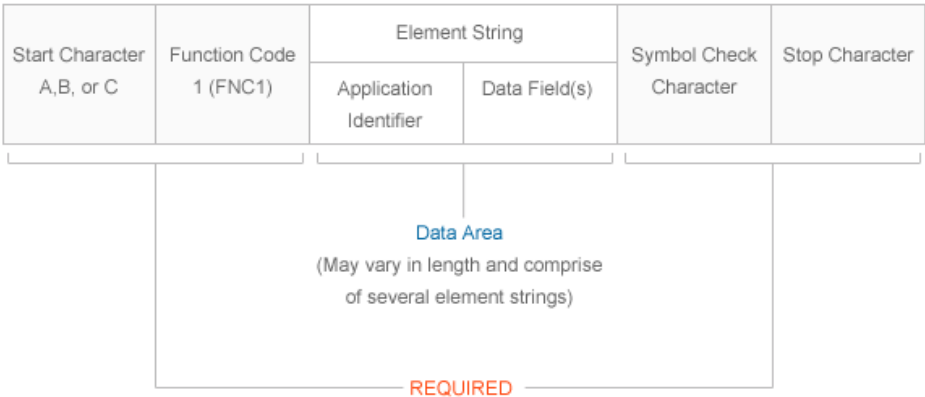


Figure 3.4, GS1-128 barcode structure

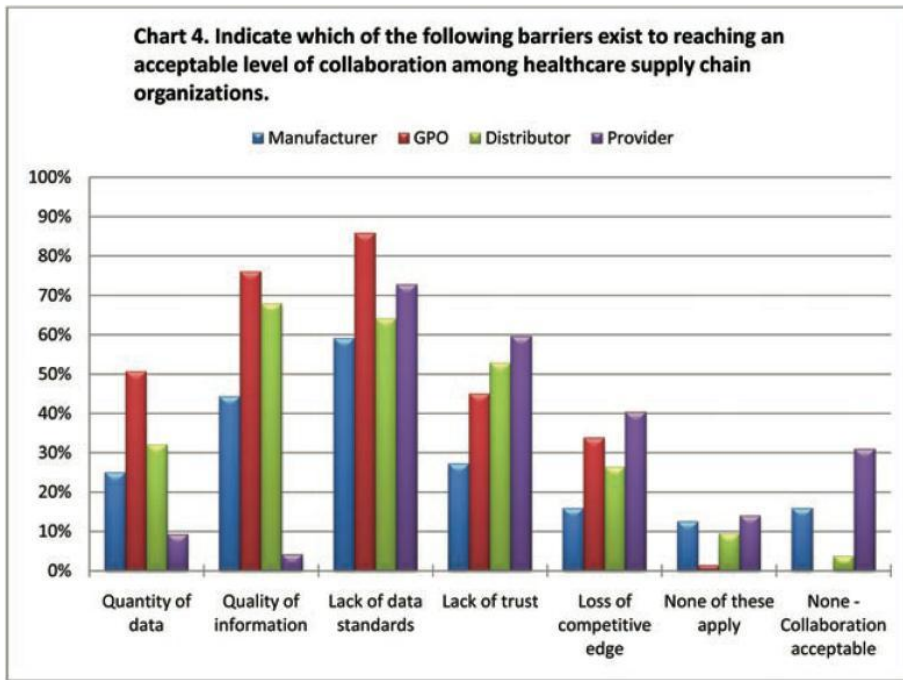
On medical implants the GS1 barcode usually contains the GTIN (01), the Batch Number (10) and the Expiry Date (17). These three information parts are the most important for medical implants. When scanning the barcode you register what it is, when it was produced and when it expires. This is important for patient safety. For other medical products other combinations of application identifiers

might deliver the best result for information gathering. Forty-five application identifiers contain information about trade item attributes, like expiration date, net weight and variable count. Twenty-eight application identifiers store information about logistic unit attributes, like gross weight and routing code. One application identifier is used for the GLN, to point out a physical location. The whole list of application identifiers can be found in appendix B.

3.5 Healthcare sector readiness

To get a good view of the current state of the healthcare supply chain a survey was conducted in 2009 by the University of Kansas. The information and charts in this section come from the results of that survey, published in the paper “The State of Healthcare Logistics” (Nachtmann & Pohl, 2009). 1381 healthcare supply chain professionals were asked to provide input on data standardization and the supply chain. The participants in the survey also include the group purchase organizations and distributors, which are not included in this research. The providers mentioned in the charts are the hospitals. The manufacturers can be seen as the suppliers. Although it is not mentioned in this survey, it seems all participants are from the US.

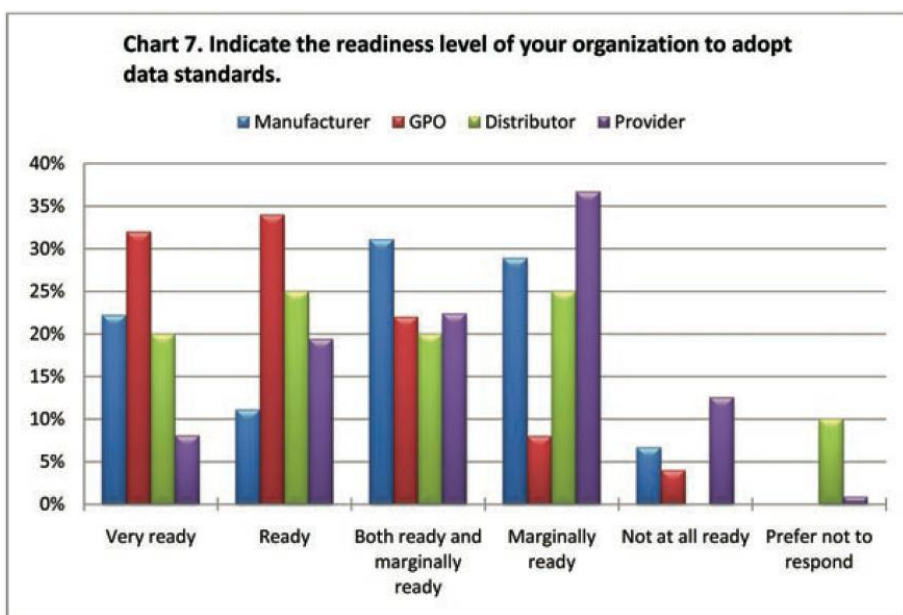
In figure 3.5 the existing barriers for reaching an acceptable level of collaboration in the supply chain are displayed. It shows that lack of data standards is the biggest barrier blocking the collaboration in the healthcare supply chain. A surprising fact is that the hospitals do not see the quality of information as a problem, while the other trading partners see this as the second largest barrier. Apparently most hospitals are satisfied with the current quality of data. The lack of trust is also a big barrier, but more important for the hospital than for the supplier. Around 30% of the participating hospitals do not see any barriers in the supply chain.



Sample size = 1267; Source: 2009, Nachtmann and Pohl

Figure 3.5, Barriers for collaboration in the healthcare supply chain

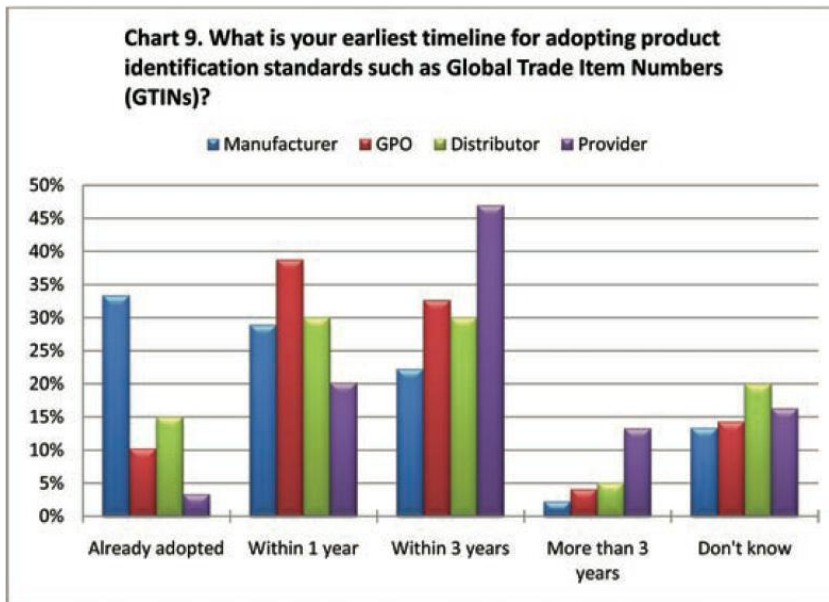
In figure 3.6 the readiness of supply chain partners to adopt data standards is displayed. Between the suppliers and the hospitals it seems that the hospitals are the least ready to adopt standardized data. This seems a little strange, because in the figure 3.5 the biggest barrier for hospitals to collaborate with supply chain partners is a lack of data standards. This indicates that hospitals acknowledge the fact of a lack of standards but are not actively pursuing the adoption of standards. This can be explained by the fact that hospitals are primarily focusing on providing healthcare services, and do not focus enough yet on supply chain efficiency.



Sample size = 450; Source: 2009, Nachtmann and Pohl

Figure 3.6, Level of readiness to adopt data standards

In figure 3.7 the healthcare partners indicated how far along they are with the adoption of identification standards, such as GTINs. Manufacturers are the largest group that already has adopted GTINs. The hospitals are the group that scores the lowest. This is probably because giving care to patients is their top priority, whereas the other supply chain partners are more striving towards profits and thus looking for options to reduce costs.



Sample size = 446; Source: 2009, Nachtmann and Pohl

Figure 3.7, Timeline for adopting product identification standards

GS1 healthcare US has posted on their website (2009) that the healthcare industry has set the GTIN sunrise date for the end of 2012. This means that by December 2012 GTINs should be assigned to all healthcare products and used in business transactions. This survey dates from 2009 and most of the partners have already adopted or will adopt GTINs within 1 or 3 years, so it seems that most healthcare partners will be ready to process GTINs at the sunrise date.

This survey has showed the readiness to adopt data standards in the healthcare sector. The hospitals and suppliers both see the lack of standards as the biggest barrier for better collaboration in the supply chain. However it turned out that the suppliers are more ready to adopt these data standards than the hospitals. This can be explained by the fact that it is relatively easier for one supplier to adopt the GS1 standards, than for one hospital that has connections to hundreds of suppliers, and that hospitals need to deal with the suppliers who operate conform GS1 standards but also with suppliers that do not. This will cause extra work for the hospitals that have to deal with different data formats. When in the future all suppliers have adopted the GS1 standards it will be easier for the hospitals to follow the standards adoption.

3.6 Conclusion

In this chapter we looked into the developments of data standardization and synchronisation in the healthcare. The developments of the synchronisation mainly concern the GDSN pilots being executed recently, which showed that the GDSN is ready to be implemented in healthcare and will bring efficiencies in the supply chain. An early adopters group was created which helped define anticipated advantages and key performance indicators. A short description of the two most used barcodes in the healthcare was given and explained that there currently is a barcode “chaos” on medical products. The readiness of the healthcare sector to adopt data standards was the last topic. This showed that suppliers are more ready than hospitals to adopt data standards in the logistic processes.

4. GDSN in Other Markets – A Literature Study

4.1 Introduction

To come to a better understanding what the GDSN actually has to offer to the Dutch healthcare, it is useful to look at companies which already participate in the GDSN. Because the GDSN is new in the healthcare sector we have to look at other sectors to get data. In this chapter we will have a look at what happened when the GDSN first went live. Results from a study performed in 2004 will be discussed, in where retailers mention their current inefficiencies which are related to inaccurate data. After this, examples of retailers are given who have implemented the GDSN and have shared their findings. All of these publications seem to be success stories. There was no information available on companies where the GDSN implementation went wrong. Because of this it is unclear if there are companies that were disappointed with their GDSN participation.

4.2 GDSN adoption

As explained before, the Global Registry holds all data about the registered GTIN's and GLN's. The popularity of the GDSN can be seen in figure 4.1. It shows the timeline since the start of the global registry in 2004 with the amount of GTINs registered. One year after the start in 2005, 200 companies had signed up.

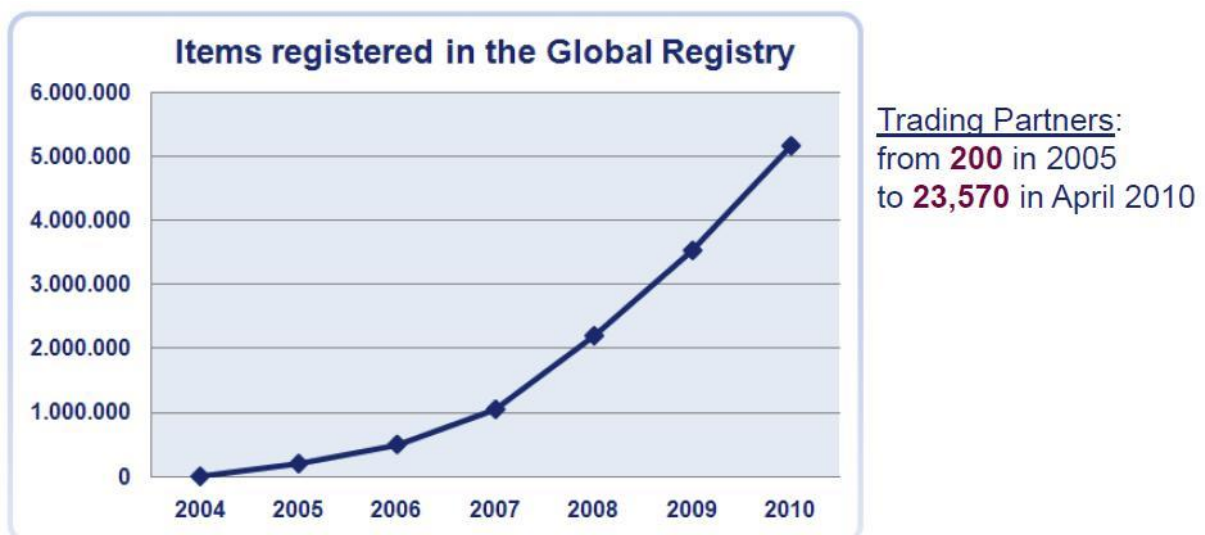


Figure 4.1, Global Registry Items, GS1 GDSN Proven Benefits for Trading Partners (2010)

4.3 Impact of inaccurate data

To get a better understanding what problems there are related to inaccurate data, the negative impact of inaccurate data was studied in the U.S. consumer products sector. This study was performed by A.T. Kearney. In a paper from Rosenfeld & Stelzer (2005) some results about inaccurate data were summarized. These results will be displayed below, and we will discuss if a connection to the healthcare sector can be made. These facts were also showed to employees of suppliers and hospitals in interviews performed in this research.

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

The fact that 3.5% of sales are lost each year due to inaccurate supply chain information seems not to be transferable to the healthcare sector. A supplier responded to this fact that the hospital needs the items, so inaccurate product data will more likely lead to more phone calls between the supplier and hospital, instead of fewer sales.

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

The hospitals acknowledged that their databases are inaccurate. However they did not believe that it would be as high as 30% of all item data. Also the cost to address a data error would be less than \$60.

- Companies invest an average of 25 minutes per SKU (stock keeping unit) per year manually cleansing out-of-sync item information.

Neither the hospital nor the supplier could acknowledge this fact that it would take 25 minutes per SKU per year to keep the data up-to-date. The suppliers said that about once a year they send a new list with item information, which the hospital loads in their database. A hospital said they do not alter the data in between those yearly update, unless a big data inaccuracy has occurred.

- 60% of all invoices generated have errors. Each invoice error costs \$40-\$400 to reconcile.

This high percentage of invoices with errors also includes pricing errors. According to the suppliers this percentage could be right. However pricing errors are not yet solved in the GDSN. In the near future this will probably be possible. The suppliers did note that for about 2% of the orders the article number is in error.

- 43% of all invoices result in deductions.

Both the hospital and supplier did not say anything about deductions. The supplier could have different price agreements with each hospital, but those are agreed upon before the order is sent. Deductions because of data errors in invoices do not happen.

- It takes an average of 4 weeks to roll out a new product – in large part due to the inefficient and error-prone approaches for the exchange and updating of new item information in buyer and seller systems.

When a new healthcare product is created it cannot just enter the healthcare sector. It needs to get a medical certification first before it can be sold to healthcare providers, which will take a few weeks. Because of this certification wait-time, the possible roll-out time reduction is not important to the healthcare sector.

4.4 UK Grocery Industry

GS1 UK researched the accuracy product data from participants in the grocery industry. In their Data Crunch report (2009) several retailers and suppliers cooperated with GS1 UK to get a good view of how big the problem is. The four large UK retailers who supplied its master data can be found on the left side of figure 4.3. The four major suppliers of these retailers can be found on the right side. The software used to compare the master data of the suppliers to the master data of the retailers was supplied by IBM.



Figure 4.3, Participating companies in the research

The first finding was that a large number of duplicate GTINs were found amongst individual retailers. Over one million records were provided by the retailers and more than 60% of the records were duplicates. After the duplicates had been removed the product data from the four retailers was compared against the product data of the four suppliers. The information should have been identical, however large degrees of inconsistency were found.

Figure 4.4 shows that the data that is stored at the retailers has little consistency. In the perfect situation the data should be the same at all four retailers, thus matching for a hundred percent. However this is not the case. When we look at the package weight of the products, the results show that the data amongst two retailers is for 40% of the articles the same. When a third retailer is entered into the calculations the analysis shows that only 6% of the articles has the same package weight data. When all four retailers’ master data is compared, only 0.2% of the articles has the exact same weight. With the use of a GDSN the data can match for 100%.

Attribute matched...	Across any 2 retailers	Across any 3 retailers	Across all 4 retailers
Traded unit dimensions	46%	6%	0.2%
Traded unit volume	36%	0.7%	0%
Traded unit weight	40%	6%	0.2%

Figure 4.4, Comparison of 4290 Traded Units

Figure 4.5 shows the master data of suppliers compared against the master data of the retailers. When we look at the traded unit weight, the data is the same for 9% at supplier 1, 18% the same at supplier 2 and 20% the same at supplier 3. This means that at least 80% of the weight is inaccurately stored at the retailers’ database. The other attributes also have low percentages of consistency. This can cause problems with the planning of logistic operations.

	Supplier 1	Supplier 2	Supplier 3
Consumer unit dimensions	19%	18%	22%
Consumer unit volume	11%	13%	20%
Consumer unit weight	4%	3%	43%
	Supplier 1	Supplier 2	Supplier 3
Traded unit dimensions	26%	37%	30%
Traded unit volume	20%	33%	24%
Traded unit weight	9%	18%	20%

Figure 4.5, Supplier data matched against retailers’ data

The inaccurate data plays a large part in the problems with invoice matching. The estimate is that 40% of invoices do not match and manual investigation is necessary. Many of these errors occur because of difference in pricing, but still a large part can be solved by data synchronisation. The hidden costs of these workaround processes to keep the supply chain running are estimated to be £47 million per year (£27 million for retailers and £20 million for suppliers).

Again the dimensions and weight attributes do not matter yet for the healthcare sector. However the amount of inaccurate information indicates that data synchronisation can be a useful process.

4.5 Dutch GDSN retail example

To improve their data accuracy, the leading Dutch food retailer Albert Heijn started a Global Data Synchronisation pilot with four trading partners in 2004. According to a Capgemini research (2005) these trading partners were SCA Hygiene, Kimberly-Clark, Ontex and P&G. For the recipient data pool Albert Heijn used the WWRE (WorldWide Retail Exchange) data pool . This data pool was also used by one supplier. The three other trading partners used GS1 DAS as the source data pool. The people at Albert Heijn who were involved in this project were people from data management, distribution centres, shelf management and the merchandising department. To obtain the data quality certification the suppliers send their products to the GS1 Netherlands measurement service. Here the products were checked against the product data.

When the pilot was completed they found that with the use of a GDSN all dimension related discrepancies were eliminated. Before GDSN, 40% of the items had these discrepancies. The big differences turned out to be in consumer and case dimensions, product description, minimum life span date, weight, cases per layer and layers per pallet. The productivity improvement in their data management department was measured to be 30%. This means less work by eliminating the need to manually cleanse out-of-sync information.

Since the GDSN participation was a success, Albert Heijn nowadays demands from all of his suppliers to deliver their product data via the GDSN. The elimination of dimension discrepancies is not yet important for the healthcare sector because most hospitals will not have a stock management program, which uses that kind of data.

The elimination of dimension discrepancies is not yet important for the healthcare sector because most hospitals will not have a stock management program, which uses that kind of data. However the productivity improvement of the data management department can be linked to the healthcare sector.

Also the fact that 40% of discrepancies on any attributes is brought back to 0% can be used in the healthcare.

4.6 Conclusion

In the retail sector the GDSN has already been used for a while. In this chapter facts from the retail GDSN implementations were linked to the Dutch healthcare sector. Loss of sales, which occurs in the retail sector because of bad data, is not an issue for the Dutch healthcare sector. Also deductions of invoices, dimension discrepancies or long product-roll out times, which are all inefficiencies in the retail sector, are of less significance for the Dutch healthcare sector.

The negative impact of inaccurate data that is valid for both sectors are: item data errors in catalogues, errors in invoices and load time for new data into the database. However the percentage of 60% of invoices with errors will not all to be solved with a GDSN. A large proportion of these errors are pricing errors, which are not yet fixable with the help of the GDSN. It seems that just a small part of the GDSN facts from the retail sector is applicable to the Dutch healthcare sector.

5. Medical Supply Chain Processes

5.1 Introduction

To get a good understanding of the change that the GDSN will bring to the supply chain processes, the current supply chain processes have to be described first. The current inefficiencies that exist will be pointed out. After this the new situation will be described. First we look at the setup of article data. Then the steps in the ordering process will be viewed and after that the receiving process is described. The processes will be displayed with the use of activity diagrams, written in UML (Unified Modeling Language). These UML diagrams are created by the researcher in Microsoft Office Visio. The legend of the UML can be seen in figure 5.1. The information in this chapter is based on interviews with employees in logistic functions from hospitals and suppliers, and on Erasmus MC work documents. The mentioned processes and departments might vary at the hundreds of different hospitals and suppliers.

5.2 Setup of Article Data

5.2.1 Current process

Before companies can start trading items, the demanding company needs to know what the supplying company has to offer. To achieve this knowledge transfer, the supplying company somehow needs to send information about its articles to the demanding company.

In this case the demanding company is the hospital and the information transfer concerns product data of medical implants.

The current process of article data information sharing is displayed in figure 5.2 and is a generalisation of all hospitals and suppliers. In individual cases the activities might be different. In this process the hospital initiates the information demand. The purchase department of the hospital sends an information request to the supplier via fax or e-mail. The customer department of the supplier receives the request and processes it. The requested information is prepared and sent back to the hospital's purchase department by e-mail. This department updates its article database with the new received information.

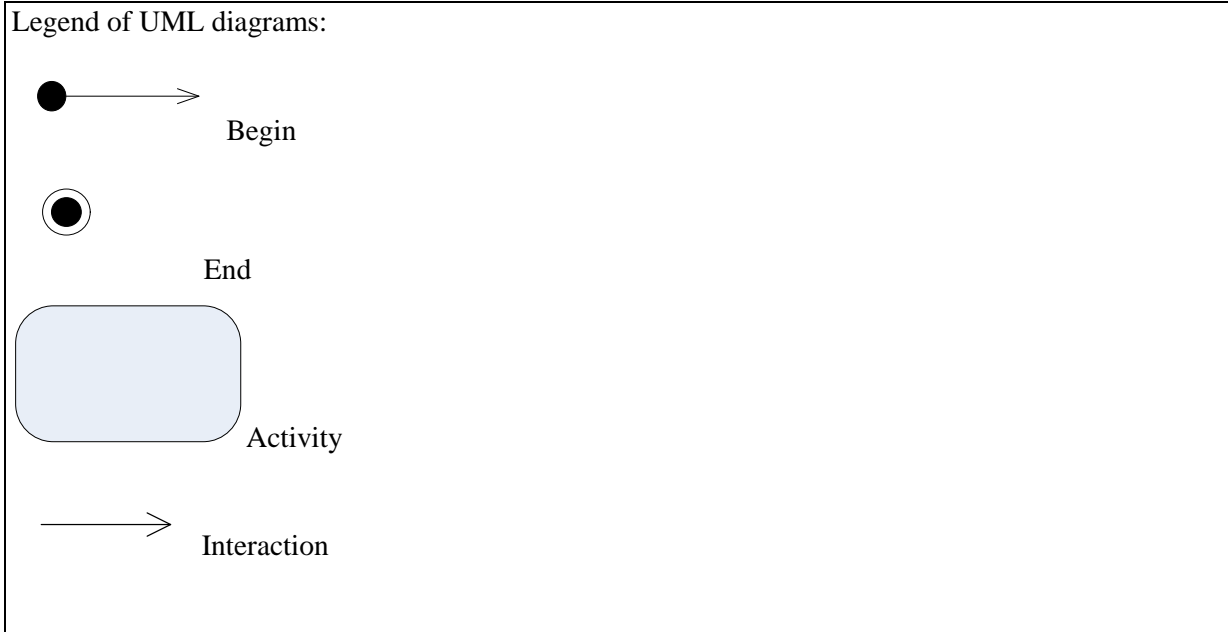


Figure 5.1, Legend of Activity Diagram

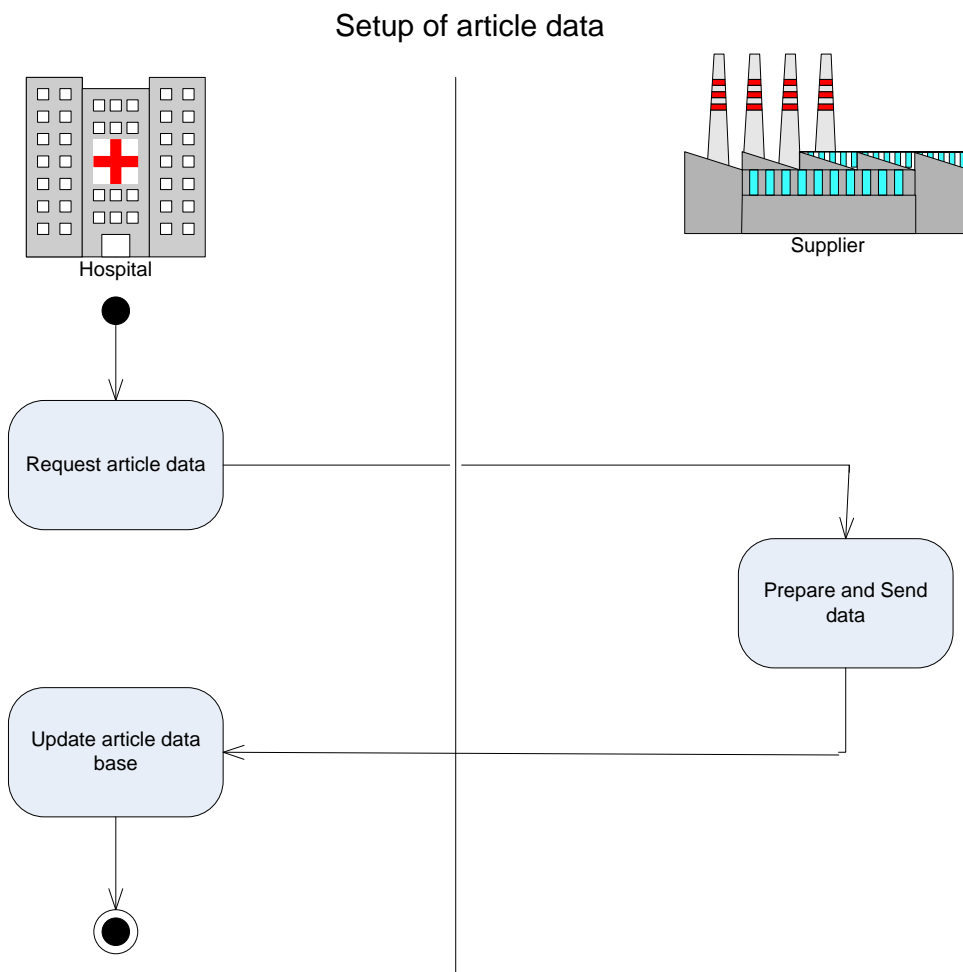


Figure 5.2, Setup of Article Data

5.2.2 Inefficiencies

The current setup of article data transfer has several inefficiencies. First of all the request of article data is performed manually. This is done by sending a fax or an e-mail requesting the article data for the selected products. The customer department of the supplier needs to process this information request. Depending on the supplier's response time it can take several days before an information request is answered.

Every hospital has its own information systems and databases. When the hospital request data from suppliers they want the format of the data to be the same as the format in their own database. Otherwise they need to spend time to convert the received data into their own format. For example when the hospitals database notes sizes in millimetres and the suppliers sends the article sizes in centimetres, the hospitals purchase department needs to spend time to convert the sizes before adding them to the product database. To prevent these conversion actions at the hospitals side, some hospitals send a "locked Excel file" to the supplier. In this file predefined fields are constructed, so that the supplier can only fill in the article data according to the customer's format. This saves the hospital time, but it takes extra work at the supplier side. Also the data on several articles might not be complete because there is no space to fill it in.

Another downside to manually sending article data information is the fact that errors might occur. Typographical errors can happen when the staff at the hospital's purchase department copies the received data manually into their system. Also the supplier might accidentally make typographical errors when filling in the Excel sheets with product data for each hospital. This error might be a small one that does not have a huge impact. For example if the description of the article is spelled with "teh" instead of "the". That will not create large logistic problems. However if the article number is entered incorrect it will have large logistic errors. An example of this is when the article number is "12345" and is saved as "12354". If this article number is used in an order, the hospital will receive a different implant than they expected.

Another problem that can occur is a problem with the Excel® software. When different versions and languages are used at the supplier side and the hospital side it might lead to changes in the stored data. When the purchase departments use automatic conversion programs to upload the article data files into their database, the data might change into inaccurate data because of unwanted changes during the conversion.

Beside these product data inaccuracies, the current setup of article data has other inefficiencies. As you can see in figure 5.2, there is no option for suppliers to send updates of new article data to the

hospitals. When for example the supplier discontinues a product and replaces it with another product he cannot send an update to the hospital. In the current situation the hospital requests a new set of article data at all his suppliers about once a year. When the supplier has new article data available he will wait until the yearly request of the hospital to send the new data with the total set of article data. The interviewed suppliers acknowledged the fact that **once a year** they send new article data to their customers. The suppliers would like to send updates from their article list **every month** or so, but that is not possible in the current situation.

5.2.3 New process with GDSN

The new situation of the setup process is displayed as an UML diagram in figure 5.3. The activities in this diagram have already been explained in chapter 2 of this paper.

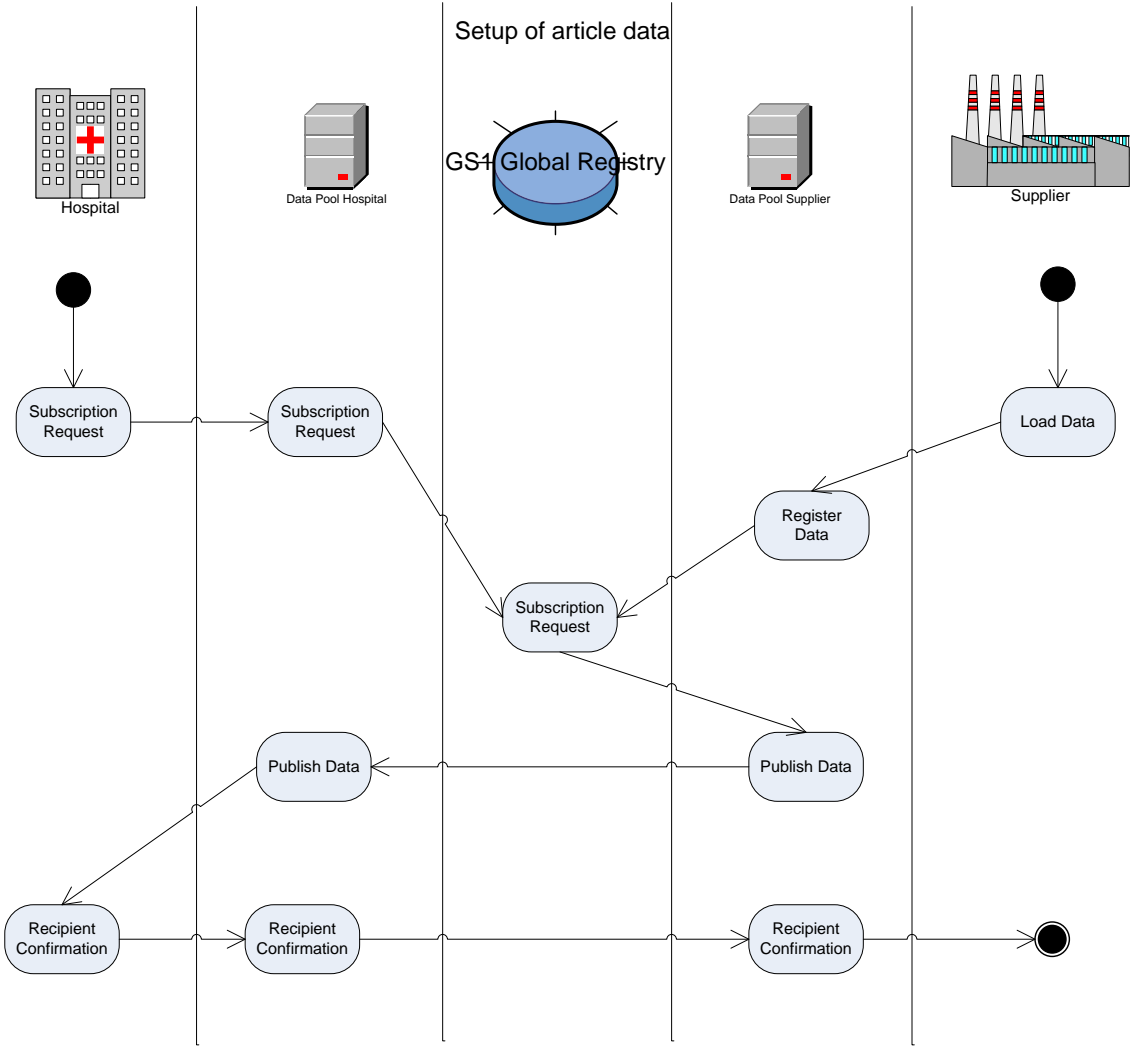


Figure 5.3, Setup of Article Data with a GDSN

In this new situation the hospital as well as the supplier both initiates the setup process. The hospital initiates the information request, which also happens in the current situation. However this information request does not directly go to the supplier. First the hospital's data pool receives the request. This data pool forwards the request to the GS1 Global Registry, which forwards it to the supplier's data pool. If the supplier rejects the request the process will proceed a little differently than displayed in figure 5.3. It is however not expected of a supplier to reject subscription requests, because that would only be a disadvantage for him. The supplier initiates the information upload, regardless of the hospital's request. This is because his data must be stored in the data pool.

Looking at the process inefficiencies mentioned at chapter 5.2.2 we can conclude that in the new situation these inefficiencies will not exist anymore.

Requesting article data is not a time-consuming activity anymore. The hospital creates a request for the wanted information, and if the supplier approves this request both the hospital and the supplier do not need to worry anymore about receiving or sending article data. This will happen automatically and continuously.

In the current situation the suppliers deal with information requests from hundreds of clients. Because of all the different information systems at the client-side there is no standard format of which data fields should be used in the information transfer. This means that the supplier might need to fill in hundreds of different forms with data. The time spent by hospitals or suppliers to convert the article data information into the desired format is not an issue anymore.

After implementation of the GDSN the hospitals receive all their article data information in one standardized GS1 format. The supplier does not have to fill in hundreds of different formats with requested article data. All they have to do is upload their article data one time to their data pool, and keep this data up-to-date. Because of this standard format in which the product data is transferred, the inaccurate data will be eliminated. The supplier does not have to fill in every form manually for each client. This will eliminate the typographical errors on the supplier side. The hospitals that want the article data can easily extract it from their own data pool in the standard format and it can be arranged to enter automatically into their system. This means the typographical errors made at the hospital side will also be eliminated, because there is no need for hospital staff to enter information into the system by typing it.

Because article data is no longer transferred in non-standard formats, for example self-made Excel sheets, there will be no problem with conversion errors. This means that the article data received by the hospitals is accurate and reliable.

When the supplier updates or adds new article data he does not need to wait for the hospitals yearly article information update to transfer his new data to the hospital. When changes are made in the suppliers data pool they are automatically transferred and updated in the subscribed hospital's data pool. This ensures the hospital always has access to the newest data for which they subscribed.

5.3 Ordering Medical Products

5.3.1 Current process

When the article data is stored in the hospital's purchase department database, the purchase employee's can start processing the orders from the hospital's medical staff. This order process is displayed in figure 5.4 and is a generalisation of all hospitals and suppliers. In individual cases the activities might be different.

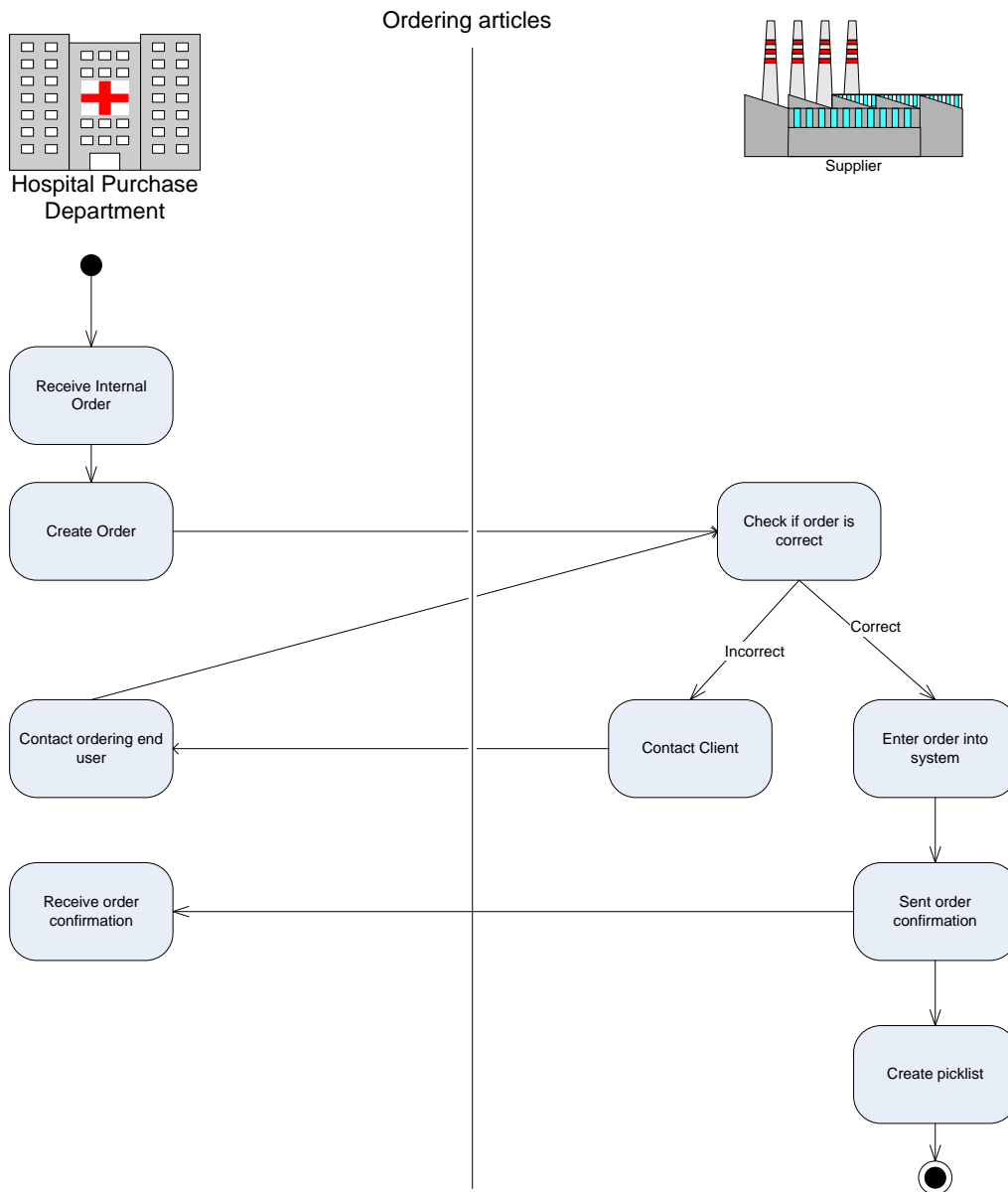


Figure 5.4, Ordering Articles

First we need to explain the order process, in this thesis related to medical implants, before being able to point out the inefficiencies. The internal order signal from the medical staff at the hospital can be received in several ways by the purchase department. At the Erasmus MC the purchase signals are generated if a nurse scans a badge when the stocks of an implant are running low. Also there is a digital catalogue available which the employee's can use to place orders. The last order method in the Erasmus MC is the use of order forms. This is a form which employee's can fill out when wanted medical products are not available in the catalogues or scanned when running low. The employee has to fill in all relevant information, like product numbers, description, supplier name, supplier address, etc. When the internal order signal is received at the purchase department, an order will be created. If the order is based on the catalogue or the scanned badges, the product data used to order the item (item

number, supplier name, etc) will be retrieved from the hospitals database. When the order is based on an order form, the product data used in the order is based on what the employee has filled in.

The order is then faxed or e-mailed to the supplier. The use of electronic data interchange is not used much yet in the healthcare sector. Electronic data interchange is the computer-to-computer transfer of business documents between the companies. The order is sent to the suppliers order entry department. Here the order is checked for errors. The article numbers are checked for abnormalities. For example if the article number really exists at the supplier, or if the ordered article number has been ordered before by the hospital. If the article has not been ordered before, the hospital could have made a mistake and the order entry department will contact the hospital to ask if the ordered product is the correct one.

When the order is entered into the supplier's system an order confirmation is send to the hospital and a pick list is created. The pick list is send to the supplier's warehouse where the order is picked and shipped.

5.3.2 Inefficiencies

The current process of ordering articles has several inefficiencies. The main inefficiency is the fact that orders are placed by the hospital based on data retrieved from a database with inaccurate product data. This can cause inaccurate orders which will lead to extra work to fix these orders.

In the previous section about the inefficiencies on the setup of article data a few causes were mentioned which could be responsible for inaccurate article data numbers. According to interviews with suppliers it turn out that a small percentage of orders have the wrong product numbers. They noted that the percentage of these wrong orders differs a lot depending on the client. This inefficiency was also mentioned in a data pool research by Schemm & Legner (2008).

There are hospitals with no article number errors in their orders at all, but there are also hospitals with 30% order errors. One supplier estimated that on all their incoming orders the percentage of wrong article numbers is about 1%. Another supplier estimated this order error to be around 3%. Because there is no other data available we will average these two percentages and say that in about 2% of the orders an article number is wrong. A supplier said that in the example when 30% of orders from one client are wrong, they inform the client of the right article numbers. However the client does not correct his actions and keeps ordering with the wrong data. The supplier does not want to lose a client, and develops a file referencing the wrong ordered articles to the right ones. The order entry department need to check this file when orders from that client come in. Even though the supplier checks every

order for wrong article numbers, according to a purchase employee at the Erasmus MC there are still about 60 wrongly delivered packages a year due to wrong article numbers in the order, which were not noticed at the suppliers order entry department.

In the current situation without data field standards other unwanted situations might occur. For example if the quantity or package type is not clearly defined. A supplier said that it has happened that a client wanted 100 boxes of a product, but received 100 pallets.

5.3.3 New processes with GDSN

The order process in the new situation will not differ largely from the old situation. The only difference is the fact that the database the purchase department of the hospital uses is now 100 percent accurate and up-to-date. The UML diagram in figure 5.4 will be the same. The order is still received internally and then sent to the supplier. The orders still need to be checked by the order entry department.

However there will be no more wrong article numbers in the order. The 2% of wrong article number in orders will be reduced to 0%. This means less work for this department. Fewer phone calls need to be made to the hospitals, because less wrong orders are received. Also the wrong delivered packages because of inaccurate article numbers will be reduced to zero.

5.4 Conclusion

In this chapter a change analysis was performed. The situation before and after the participation in the GDSN were compared to each other on two logistic processes: Setup of article data and the ordering of medical products. The process of the setup of the article data totally changes when the hospital and supplier both participate in the GDSN. Instead of a yearly cycle, the data exchange becomes an **automated continuous process**. This means less setup work for both parties and the data will be accurate and up-to-date.

The ordering process itself does not change. The amount of incorrect orders does change; it will decrease. This leads to fewer telephone calls from the supplier to the hospital. This means there will also be fewer telephone calls inside the hospital from the purchase department to the end user, to sort out the mistake in the order. The order entry department at the supplier should be much more productive because of fewer errors in the orders.

6. Costs and Benefits of a GDSN participation

6.1 Introduction

After describing the logistic processes before and after the implementation of the GDSN, it is possible to perform a cost-benefit analysis based on estimates derived from interviews and literature studies. According to the book “Applied cost-benefit analysis”, written by Brent (2006), the cost-benefit analysis relates to decisions that have an implication for the use of resources. We will use this book as theory for our cost-benefit calculations. The general model is developed to maximize the difference between benefits B and costs C ($B - C$). The difference between B and C can be seen as the additional resources that have become available. A large difference between B and C will mean a large contribution of the project. In the case of a GDSN implementation the costs exist only out of direct costs. The benefits exist out of direct benefits but also indirect benefits.

Before we can perform a cost-benefit analysis we will first need to determine the relevant costs, which are showed in section 6.2. After this the relevant benefits are discussed in section 6.3. The direct benefits mentioned in section 6.3 will be used in the cost-benefit analysis for the Erasmus MC in section 6.4. Because little to none data about costs and benefits is available in literature most numbers in this chapter are collected from interviews and internet searches.

6.2 Costs

This paragraph will provide insight into the direct costs involved with the participation of a GDSN. First we will look at the direct costs at the Hospital side. The next paragraph is about the direct costs for the suppliers. The direct costs are divided into initial costs and recurring costs.

The initial cost mainly exists of the development of a software tool which must connect the hospital's or supplier's database to their data pool. This software tool is different for each hospital and supplier because of each own specific information systems and processes. The recurring costs are mostly fees for the use of the data pool and GS1 standards.

6.2.1 Costs for Hospitals

Before the synchronisation process can start a connection between the hospitals information system and the selected data pool needs to be made. This is done by developing a software tool which is the connection between the data pool and the hospitals information system. According to a Lansa white paper (2006) this software tool should have some sort of GTIN manager to receive the GTINs and search through them. A more detailed list of what should be included in the software solution is available in Appendix C.

According to Lansa's website (January 2010), a software solution provider, this software tool can cost roughly between €5,000 and €100,000. This range is so wide because there is no standard solution. Most hospitals have their own information systems. For each hospital a specific software solution needs to be developed. There were several case studies available at solution providers' websites; however none of them mentioned anything about the costs. The researcher also contacted several solution providers but got no positive response. The cost for the software solution cannot be more defined than the statement below.

Implementation software solution costs €5,000 up to €100,000

When the implementation is complete the next step is to incorporate the new process of retrieving the article data. Employees have to be trained to handle the new way of receiving data. They need to be aware of the actions they need to perform to subscribe to new article data, and what to do when new data is coming in. This training will not be included in the calculations, because it will not cost much in relation to the price of the software solution.

The software solution is a one-time cost; however there are also recurring costs. In order to receive article information from data pools the hospital needs to pay contribution for the use of the data pool. This price is also linked to the annual turnover. The hospital does not have to pay a separate fee to GS1 to participate in the GDSN. GS1 collects that fee from the data pool.

For the Erasmus MC contribution to the GS1 DAS data pool (2010) would be €14,750 per year (Based on the annual turnover (2008))

For this price the Erasmus MC receives 1 GLN. For more GLNs a price of €1475 needs to be paid per GLN. Again this price is linked to annual turnover. Also a one-time fee needs to be paid which is the same as the yearly fee. This can be seen as the entry fee to the GS1 DAS data pool.

The cost for a Dutch hospital to participate in the GDSN will be the largest in the first year. The implementation software needs to be acquired and an entrée fee needs to be paid, next to the annual fee. The following years the only cost will be the annual data pool fee. When comparing these costs against the total revenue of a Dutch hospital, it will not have a significant impact. In the worst case scenario the costs in the first year for the Erasmus MC will be $(€100,000 + (2 * €14,750) =) €129,500$, while their revenue was almost a billion euro's (Erasmus MC, 2008).

6.2.2 Costs for Suppliers

As mentioned in the previous section, a connection between the company's information system and the data pool must be created. This is also achieved by implementing a piece of software which connects the two to each other.

The cost of such a software solution can differ greatly depending on the supplier's information system. According to solution provider QAD's paper (2003) there are many different solutions available. The solutions range in price from \$5,000 a year for hosted solutions up to \$500,000 for complex licensed catalogue solutions. One of the differences between these solutions is how much business transactions they can handle: the number of GTINs and trading partners.

According to an employee at GS1 Netherlands it will cost between \$10,000 and \$40,000 to build a connection from the suppliers ERP system to the GS1 DAS data pool.

One source states the cost range from \$5,000 to \$500,000 and another source states it ranges from \$10,000 to \$40,000. More information was not available on this cost topic. When a supplier wants to get detailed information what it might cost, the supplier should contact a solution provider to get an estimate.

Connection software can cost between \$5,000 and \$500,000
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The software solution is a one-time cost. For the supplier there are also annual costs. The main part of the annual costs involves the data pool. Every company needs to pay for a license to use his chosen data pool. This cost is usually dependent on the annual turnover.

The yearly GS1 DAS data pool (2010) fee is €2,137 for a supplier with €60 million turnover

A one-time entree fee, which is the same amount as the yearly fee, needs to be paid to have access to the GS1 DAS data pool as a supplier.

There are other small yearly costs, but they are not significant. For example if a supplier from the above example wants to use more GLNs he needs to pay €214 per extra GLN. These costs will not be used in the calculations.

To upload article data to the data pool the company must be GS1 certified. This means that GS1 performs a check on the data to see if it is compliant with GS1's standards. This GS1 certification costs €400 and only needs to be performed once. This cost will also not be used in the calculations, because it is too small to have a significant impact.

6.3 Benefits

6.3.1 Benefits Hospital

The benefits for the hospital exist of direct and indirect advantages. The direct benefits all involve the reduction of labor. With the use of the GDSN time is saved by not having to handle errors created by inaccurate data. The indirect benefits are mainly about opportunities that are becoming available with clean and trustworthy data.

6.3.1.1 Direct Benefits Hospital

In a previous chapter we have established that not all product data in the hospital's data bases is accurate. When an order for a medical implant is placed, the suppliers notice sometimes that the order is unusual or that the ordered product does not exist. As mentioned in the previous chapter, in about 2% of the orders received by the suppliers a wrong article is ordered due to wrong article numbers. The supplier contacts the hospital to inquire which product actually is needed. The hospital's purchase

department needs to contact the hospital staff who actually ordered the item. According to an interview with the head purchasing at the Erasmus MC this all together takes about 30 minutes to sort out.

With the use of a GDSN the hospitals database contains no wrong article numbers. The benefit for the hospital is less time needed to sort out wrong orders. To quantify this benefit you need to calculate 2% of all orders times 30 minutes. The GDSN implementation will result in a significant amount of time saved.

It takes about 30 minutes to correct an order with a wrongly ordered article number

Currently about 2% errors on items ordered

With GDSN 0% errors on items ordered

According to an interview with the head of purchasing at the Erasmus MC there are also a few wrongly ordered items that slip through the net and are not noticed by the supplier as a wrongly ordered product. This means that an unwanted product is delivered to the hospital. At the Erasmus MC this happens about 60 times a year. This number might differ at other hospitals. It takes around 1 hour time to figure out what should happen to the item.

Handling delivered items which are wrongly ordered takes around 60 hours a year at the Erasmus MC

6.3.1.2 Indirect Benefits Hospital

In the previous section we saw how many hours of work it can save the hospital staff by having accurate product data. The other benefits are hard to quantify. We see them as indirect benefits. The information in this section is based on interviews and a paper by Bix et al. (2007).

In the current situation every supplier sends his own article data to hospital, in different formats. This could lead to an unclear overview at the purchasing department. In the new situation all product data comes from a single point of entry in the same format, the data pool. This saves the purchase department the trouble of entering all the data from different suppliers into the system.

Indirect benefit 1: Single point of entry

When all suppliers participate in the GDSN the largest indirect benefit for the hospital would have to be the fact that all medical product data will be registered in a standardized way with standardized barcodes.

Indirect benefit 2: Standardized barcodes

Without these standards it is hard to automate certain hospital processes. There are many different non-standard barcodes on medical packages. This “chaos” in the barcodes gets in the way of innovating IT programs. For example the registration of medical implants linked to patients. In some hospitals this is still done by placing a sticker onto a paper patient dossier. With upcoming electronic patient dossiers the registering of these implants should be done digitally. Setting up of such an IT project would be easier if all implants have the same type of barcode and if the implant data could be easily retrieved from the data pool.

The situation nowadays is far from the previous described scenario. Recently a Dutch hospital started such a registration project. Around 25% of the medical implants could not be registered yet when implemented into a patient, because of non-standard barcodes on the packaging. On some medical implants packages there were 5 different printed barcodes. This caused a lot of confusion in the medical staff. They found it hard to select the right barcode to register the implant. For the 25% implants with wrong barcodes another solution needs to be found. All this confusion and extra work will be avoided in the future when all suppliers apply the GS1 data and barcode standards.

Indirect benefit 3: Easier to develop a digital registration of medical implants for patients

If the medical products are being scanned when they are implemented into a patient the hospital could develop more interesting automated processes, besides registering which patient has which implant. For instance the registration could be linked to an ordering system. When an implant is scanned in the operation room, a signal can go to the purchase department to order that same implant again. In some current situations at hospitals an employee walks by the stock shelves to see which implants need to be reordered. This manual process can be replaced by an automated reorder process. The price of the implant could also be linked to the operation, to use for better cost calculations for certain treatments.

Indirect benefit 4: Easier to create an automated reorder process

When digitally registering which implant is implemented into which patient, the recall procedure can also be executed faster. A recall happens when a manufacturer notifies the hospitals that there is something wrong with a certain implant. When the registration of implants is done on paper it might take a while to work your way through the pile of papers to find the patients with the recalled implants. When it is registered in a database the list of patients with the recalled implant can be generated with a few mouse clicks.

Indirect benefit 5: Easier to create a better recall process

The data received from scanning of used medical products can also be used to make better stock management decisions. At the Erasmus MC stock management is done manually. Twice a year two persons spent about a month to reorganize the stock. They decide if the quantity of kept stock should change. Also expiration dates are checked. This process could be made a lot easier when all incoming and used medical products are scanned and registered. A stock management program could then analyze and give warnings if stock quantities should change, or if a product is about to expire.

Indirect benefit 6: Easier to create a stock management program

When a stock management program is in place it is possible to go even further with the available data. The product data in the data pools contains the dimensions and weight of the package. This can be

used to optimize the storage of products to save storage space. Another project for even more efficiency is the forecasting of needed implants. If the hospital knows at what time which products are needed the logistic chain of the hospital can really be tweaked to gain optimal efficiency, for example by using just-in-time deliveries.

According to the A.T. Kearney research mentioned in section 4.3 there is a price error on 60% of the invoices. This also takes a lot of time to correct all those invoices. In the near future the prices will not be synchronised with the use of the GDSN. However there are developments in this area. When in the future the prices are also up-to-date and accurate, the errors in invoices will reduce drastically. This is however something for the future.

6.3.2 Benefits Supplier

In the previous section it became clear that the hospital has a lot of benefits to gain from clean accurate data. Some of those direct and indirect benefits are also valid for the supplier.

6.3.2.1 Direct Benefits Supplier

The suppliers stated that in about 2% of the incoming order a wrong article number was ordered. Besides the time this costs the hospital to find out the right article number, this also takes time at the supplier side. They notice the wrong article number and they need to contact the hospital. While the hospital sorts out the wrong order, they supplier needs to wait and maybe help the purchase department at the hospital. The order cannot be released before the hospital has fixed the order. A supplier stated in an interview that it would probably cost the order entry department between 5 and 8 minutes of work to fix the wrong order.

2% of incoming order has a wrong article number

Fixing order with error takes 5 to 8 minutes

With the GDSN in place the hospital has access to all the right article numbers. Orders with accidentally wrong article numbers will not happen anymore. Of course a hospital employee can still order a different product than he/she actually wants, but inaccurate article data is not the cause of that.

A supplier stated in an interview that his order entry department uses 3.5 FTE (Fulltime-equivalent). His estimation was that when there are no more errors in the incoming orders due to inaccurate article numbers, the order entry department could save 2 FTE, thus going from 3.5 FTE to 1.5 FTE. This is a large benefit for the suppliers.

The order entry department could be reduced, saving on FTE's

6.3.2.2 Indirect Benefits Supplier

An indirect benefit which is valid for the hospital as well as the supplier is the fact that there is a single point of entry into the GDSN. The supplier sends his article information only once to his data pool in a standard format. He does not have to send his article data to hundreds different hospitals in different kind of formats. All he has to do is give authorization to the hospitals to view the article data.

Single point of entry and only uploading the product information once

In the current situation the suppliers send their product information about once a year. They stated they would like to do it more often. Also when they introduce a new product or something changes on an existing product they do not update the information at the hospitals. They wait for the yearly sending of the product data.

With the GDSN the product information is being synchronised constantly. Also when they introduce a new product they can easily authorize the hospitals to receive the new information.

Continuous synchronisation, also with new products

The suppliers can also use the product information about the dimensions and weights. They can use this to optimize their inventory and the transport of the products.

When the hospitals have more advanced inventory systems in place, the suppliers might think about the integration of the order processes. If an item is used and scanned in the hospital, the supplier will get a direct signal, notifying that another one of that product needs to be sent.

Suppliers have contracts with some hospital to give products in consignment. This means that the product is situated in the hospitals storage room. However it still belongs to the supplier. The hospital has to pay for it the moment that the product is being used. When the hospitals implement inventory management and forecasting systems the quantity of stock at the hospital can be lowered. This means that the suppliers have to give fewer products in consignment which means they have less risk of products expiring

6.4 Cost-Benefit Analysis for Erasmus MC

To get a better understanding of the direct benefits a Dutch hospital could experience when participating in the GDSN, we will make a case based on the data of the Erasmus MC. We have made this calculation because we did not come across a calculation of this kind in scientific or other non-scientific literature.

According to an Excel file provided by an employee at the Erasmus MC purchasing department there were about 65,000 orders of medical products processed in 2008.

In section 6.3.1 we mentioned that for 2% of the orders a correction is needed which takes about 30 minutes of extra working time. To calculate the possible savings on working time we multiply the 30 minutes for 2% of the 65,000 orders.

$$2\% * 65,000 * 30 \text{ minutes} = 650 \text{ hours}$$

When we include the 60 hours of extra working time from wrongly delivered items, mentioned in 6.3.1, the savings of working time are up to 710 hours.

$$650 \text{ hours} + 60 \text{ hours} = 710 \text{ hours}$$

According to the Erasmus MC website a full workweek consists of 36 hours a week. When we calculate the monthly hours of working time we will assume a month exists of four weeks. This comes down to $(4 * 36 =)$ 144 hours of working time per month. According to my supervisor an average employee is effective for around 75% of his work time. This comes down to $(144 * 75\% =)$ 108 work hours per month.

The 710 hours of working time which could be saved are divided by the 108 hours per month, which shows that around 6.5 months of working time could be saved.

$710 \text{ hours} / 108 \text{ hours (a month)} \approx 6.5 \text{ months of working time which could be saved}$

According to Hadzima (2010) the real costs of an employee is 2.7 times higher than the basic salary. This is because employment taxes, benefits, space, office equipment etc. need to be added to the real costs of an employee.

We assume €3,000 is the payment for a purchase department employee per month. This comes down to $(€3,000 * 2.7 =)$ €8,100 per employee per month. When we multiply this number with the 6.5 months of saved working time, the total direct savings of the GDSN become visible.

$€8,100 \text{ (monthly employee cost)} * 6.5 \text{ months} = €52,650$

This shows that **€52,650** could be saved each year on employee costs, by synchronizing the inaccurate product codes. If in the future prices will also be synchronised, as mentioned in section 6.3.1.2, this savings number will be even higher.

However, to achieve these savings investments must be made. First the connection to the data pool must be created, which is mentioned at section 6.2.1. The cost for the Erasmus MC of this connection will probably range between €5,000 and €100,000.

If the Erasmus MC will choose the GS1 DAS data pool to synchronise its product data, the contribution of this data pool will be **€14,750 a year**. This is based on the Erasmus MC's annual turnover as mentioned before at section 6.2.1.

When deducting the annual savings with the annual costs a positive number appears.

$€52,650 - €14,750 = €37,900$

The calculation above shows that the Erasmus MC will spend **€37,900** less each year when participating in the GDSN (without calculating initial costs). Depending on the actual implementation costs of the data pool connection, the time to earn back the investment varies. In the best case scenario (€5,000 implementation costs) the initial costs will be earned back within one year. In the worst case scenario (€100,000 implementation costs) the initial costs will be earned back in about 3 years.

Best case scenario: $(€5,000 \text{ (implementation)} + €14,750 \text{ (one-time fee)}) / €37,900 = 0.52 \text{ years}$

Worst case scenario: $(€100,000 \text{ (implementation)} + €14,750 \text{ (one-time fee)}) / €37,900 = 3.03 \text{ years}$
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When the initial costs have been paid off, the benefit-cost ratio is calculated by dividing the value of the benefits with the value of the costs. The benefit-cost ratio shows the overall value for money of the project and should be larger than 1 for a project to be profitable. The benefit-cost ratio for the Erasmus MC is $(37,900 / 14,750 =) 2.57$.

The outcome of the cost-benefit analysis might seem small compared to the yearly hospital's turnover, but do not forget that there are also indirect benefits to be gained, mentioned at section 6.3.1.2, which might be even of greater value to the hospital than saving money.

6.5 Conclusion

The expected costs and benefits for the hospitals and the suppliers for participating in the GDSN were discussed and a cost-benefit analysis for the Erasmus MC was created. The costs for the hospital as well as for the supplier are mostly the same. A software connection from their database to their data pool needs to be developed, and a yearly fee for participating in a data pool needs to be paid. The benefits are partly the same for both sides. Both the hospitals and suppliers will have accurate and up-to-date data which they will use in their logistic processes. This means less product data errors in orders and invoices. This will lead to a reduction in the time spend on fixing those errors. The hospitals will also have indirect benefits, like the benefit of standardized barcodes with standardized product data on medical products, which will make it easier to scan and register products than some current barcodes. With this standardized information the hospitals could start more efficiency projects, like digital implants registration, automatic re-order systems, stock management programs and so forth. A calculation of the costs and benefits for the Erasmus MC has been made and shows a positive outcome. Beside the indirect benefits, the Erasmus MC could possibly save €37,900 a year (without initial costs) by implementing and using the GDSN.

7. Conclusion and future research

7.1 Conclusion

In the retail sector the GDSN has proven to be a successful and efficient way to exchange product data and keep this data up-to-date. The healthcare sector has not yet adopted this standardized way to keep its product databases error free. In this paper the impact of the GDSN has been researched for a Dutch hospital and the suppliers of medical implants.

The available information on this subject is mostly about success stories and expected benefits which the GDSN brings. Information about costs concerning the participation in the GDSN is hard to find. To find the actual costs and benefits for the hospitals and suppliers a literature study was conducted, several interviews were held with key personnel at hospitals, suppliers and GS1 and a process change analysis was made where the situation before and after the GDSN was compared.

During the research it became obvious the Dutch healthcare sector is just becoming aware of major inefficiencies in the purchasing process. This is because in the past the focus on healthcare costs was less important than nowadays. A few GDSN pilots were executed, and an early adoption group was created in 2008. This was done to see if it was possible for the GDSN to operate in the healthcare sector. The early adopters group reached their goals, and is now working on persuading more healthcare partners to join the GDSN.

In the interviews suppliers said that the biggest issue they encountered from inaccurate data is wrongly ordered products due to incorrect article numbers. Another issue is the distribution of the product information from the supplier to the hospitals. This happens once a year and is not performed in a standard way. The suppliers had vaguely heard about the GDSN but did not know what it was exactly. However they understood the concept very well and were positive about the effects it could bring.

Concerning the main question of this thesis, “*What is the influence of a data synchronisation implementation at a Dutch hospital supply chain?*”, we can conclude that the direct effect of the GDSN is that all supply chain partners work more efficiently because they all work with the same product data. The largest direct impact is the elimination of wrongly ordered article numbers. This saves the order entry department at the supplier and the purchase department at the hospital extra work. Also no wrong ordered products will be delivered, which saves more than one hour of corrective work per wrongly delivered item.

Other advantages for the supplier include uploading article data only once, instead of sending it to every client. Also it is easy to update product information and be sure every client receives the update correctly and within minutes.

The GDSN will have an effect on the whole hospital when all products will carry the right barcode. Nowadays there is too much barcode chaos on medical products. When every supplier participates in the GDSN, it means that every product will have a standard GS1 barcode. With this standard the threshold for hospitals to build automatic systems is a lot lower than it is now. Examples of these systems are automatic ordering, automatic stock management and improving patient safety by automatic registration of implants. Because of the possibility for more- and more accurate data all these projects will become easier for the hospital to implement. That is why the impact of data synchronisation will be larger on the hospital side than the supplier side.

According to the cost and benefit calculations the GDSN will save more money than it costs. Even if this is not the case: Can you still afford to work with inaccurate data in a sector where lives actually depend on it, while knowing the solution is right around the corner?

7.2 Future Research

Because of the limited scope and time for this research several topics for future research are available. In this thesis we focused on the hospitals and suppliers. The group purchasing organizations and the distributors, as showed in figure 2.1, were not in the scope. A possibility for future research is to include these supply chain partners in the logistic processes.

The use of price synchronisation with the GDSN is still in development. We did not come across any research for this kind of synchronisation which makes it is a possibility for future research.

Another possibility for future research is about the qualitative benefits for the hospitals. We mentioned several projects which would become easier for the hospital to implement, after the implementation of a GDSN. The role of accurate data for those projects could be a topic for future research.

8. References

- Babbie, Earl. 2004. *The Practice of Social Research*. 10th ed. Belmont. Thomson.
- Bar Code Graphics. *Resources and Education for the GS1-128 Symbology*. Available at: <http://www.gs1-128.info>. Last accessed October 2009.
- Bix, Clarke, Lockhart, Twede, Spink. September 2007. *The Case for Global Standards*. Michigan State University. Accessed November 2009.
- Capgemini. 2005. *Global Data Synchronisation At Work in the Real World*. Available at: <http://www.1sync.org/documents/GDSN/Global%20Data%20Sync%20in%20the%20Real%20World.pdf>. Accessed December 2009.
- C. Adcock. 2010. *The world of GS1 standards in healthcare*. Available at: http://www.gs1.org/docs/events/2010/saopaulo/presentations/4_World%20of%20GS1%20Standards%20in%20Healthcare_Adcock.pdf. Accessed February 2010.
- David L. Brock. November 2001, *White Paper – Integrating the Electronic Product Code and the Global Trade Item Number*. Auto-ID center. Available at: <http://www.autoidlabs.org/uploads/media/MIT-AUTOID-WH020.pdf>. Accessed November 2009.
- Department of Defense. September 2007. *DoD/VA Data Synchronisation Program*. Available at: <http://www.chestandards.org/pdu/DoDGDSNPilot.pdf>. Accessed November 2009.
- D. Schmaus. June 1991. *The basics of bar code technology*. AORN, Volume 53, Issue 6, Pages 1542, 1544-1545, 1547-1548.
- Drummond Group. December 2006. *GDSN Interoperability Test*. Available at: http://www.gs1.org/docs/gdsn/gdsn_interoperability_report_0107.pdf. Accessed December 2009.
- Edgenet. *GDSN History*. Available at: http://www.edgenet.com/index.php?option=com_content&view=article&id=320&Itemid=344. Last accessed February 2010.

- Erasmus MC. 2008. *Maatschappelijk verslag 2008*. Annual Turnover. Available at: http://www.erasmusmc.nl/5663/177341/183080/Erasmus_MC_Maatschappelijk_1.pdf. Accessed April 2010.
- GS1 DAS. *Tarieven*. Available at: http://www.gs1das.nl/overeandas_tarieven.asp. Last accessed February 2010
- GS1 Healthcare US. July 2008. *Healthcare Provider Tool Kit – Global Data Synchronisation Network*. Available at: <http://www.unspsc.org/AdminFolder/Documents/UNSPSC%20Tool%20Kit%20from%20GS1%20Healthcare%20USR1.0.pdf>. Last accessed March 2010.
- GS1 Healthcare. 2010. *GDSN in Healthcare: Experiences of Early Adopters in the United States*. Accessed April 2010.
- GS1 Nederland. *GSI-Symbolen*. Available at: <http://www.gs1.nl/gs1-symbolen.html>. Last accessed November 2009.
- GS1 UK. October 2009. *Data Crunch Report*. Available at: <http://www.cranfieldknowledgeinterchange.com/kihtml/topic/The%20Economic%20Downturn/1020/Report.pdf>. Accessed January 2010.
- GS1 US. GTIN Attributes for Healthcare Products. 2009. Available at: http://www.gs1us.org/Communities/Healthcare/HealthcareDocumentLibrary/tabid/166/DMXModule/586/Command/Core_Download/Default.aspx?EntryId=441. Accessed November 2009.
- GS1 US. *Healthcare Industry Sunrise Dates*. Available at: http://www.gs1us.org/sectors/healthcare/healthcare_sunrise_dates. Last accessed: January 2010.
- GS1. 2010. *GS1 GDSN Proven Benefits for Trading Partners*. Available at: http://www.gs1.org/docs/gdsn/GDSN_Overview.pdf. Accessed April 2010.

- GS1. 2010. *List of GDSN Certified Data Pools*. Available at: http://www.gs1.org/docs/gdsn/gdsn_certified_data_pools.pdf. Accessed May 2010.
- GS1. December 2009. *GS1 GDSN Certification Criteria Document*. Available at: http://www.gs1.org/docs/gdsn/gdsn_certification_criteria_document.pdf. Accessed December 2009.
- GS1. *GDSN User Testimonials*. Available at: http://www.gs1.org/gdsn/ds/testimonials_users. Last accessed November 2009.
- GS1. *GS1 Timeline*, Available at: http://www.gs1.org/about/media_centre/timeline. Last accessed October 2009.
- GS1. July 2008. *GS1 Identification Key Series*. Available at: http://www.gs1.org/sites/default/files/docs/idkeys/GS1_GLN_Executive_Summary.pdf. Accessed December 2009.
- GS1. May 2009. *GS1 Healthcare Reference Book 2009/2010*. Available at: http://www.gs1.org/docs/healthcare/GS1_Healthcare_Reference_Book_2009-2010.pdf. Accessed November 2010.
- GS1. November 2009. *GS1 Global Registry Statistics*. Available at: http://www.gs1.org/docs/gdsn/gdsn_dp_activity.pdf. Accessed December 2009.
- GS1. October 2007. *GDSN Security Audit*. Available at: http://www.gs1.org/docs/gdsn/gdsn_security_audit_recommendations.pdf. Accessed December 2009.
- GS1. October 2007. *Healthcare GTIN Allocation Rules*. Available at: http://www.gs1.org/docs/gsmph/healthcare/GS1_Healthcare_GTIN_Allocation_Rules.pdf. Accessed November 2009.
- GS1. *Synchronising Product Data in Healthcare – Global GDSN Healthcare Pilot Report*. 22 October 2008. Available at: http://www.gs1.org/docs/healthcare/Global_GDSN_Healthcare_Pilot.pdf. Accessed February 2010.

- GS1. *What is data synchronisation*. Available at: <http://www.gs1.org/gdsn/ds>. Last accessed November 2009.
- Hadzima. 2010. Enterprise Forum, *How Much Does An Employee Cost?*. Available at: <http://enterpriseforum.mit.edu/mindshare/startingup/employee-cost.html>. Last accessed June 2010
- Heather Nachtmann & Edward A. Pohl. 2009. *The State of Healthcare Logistics*. Available at: http://cihl.uark.edu/The_State_of_Healthcare_Logistics_July_2009.pdf. Accessed December 2009.
- Hospitals Worldwide. *Hospitals and Health Clinics Listings*. Available at: <http://www.hospitalsworldwide.com>. Last accessed November 2009.
- Lansa. April 2006. *GDSN Participation with a High Return on Investment*. Available at: http://www.lansa.com/register/whitepapers.htm?_00N3000000185DA=Download: Report - GDSN Participation with a High Return on Investment. Accessed May 2010.
- Lansa. *Lansa Data Sync Direct*. Available at: <http://www.lansa.com/products/datasyncdirect.htm>. Last accessed January 2010.
- M A Maffetone, S W Watt, K E Whisler. July 1990. *Automated specimen handling: Bar codes and robotics*. *Laboratory Medicine*, 436-443.
- Asperen, Eelco van. 2008. *Methodology of E&I .FEB33007*. Econometric Institute. Erasmus Universiteit Rotterdam.
- QAD. 2003. *Meeting Today's Challenge for Product Data Synchronisation*. Available at: <http://www.qad.com/Public/Documents/uccnet.pdf>. Accessed January 2010.
- Rosenfeld & Stelzer. 2005. *Data Synchronisation in Healthcare: A Solvable Problem*. Available at: <http://www.choicemeddata.com/articles/DataSynchWhitePaper.pdf>. Accessed October 2009.
- Schemm, & Legner. 2008. *The Role and Emerging Landscape of Data Pools in the Retail and Consumer Goods Industries*. University of St. Gallen. Accessed November 2009.

- Schemm, & Legner, B. Otto. October 2007. *Global Data Synchronization*. University of St.Gallen. Accessed December 2009.
- TCC. 2004. *Process Analysis*. Available at: <http://www.tcc.edu/students/resources/writcent/handouts/writing/process.htm>. Last Accessed June 2010
- W. Hammond. October 2005. *The Making And Adoption Of Health Data Standards*. Health Affairs Volume 24 Number 5. Accessed October 2009.
- Wikipedia. *Data Pool*. Available at: http://en.wikipedia.org/wiki/Data_pool. Last accessed November 2009

Appendix A

List of interviewed persons for this master thesis:

GS1

H. Lunenburg	-	Senior Consultant, GS1 Healthcare Nederland
P. Alvarez	-	Senior Director, GS1 Healthcare America

Hospital side

W. Stekelenburg	-	Head logistics, Erasmus MC
T. Weststrate	-	Policy Consultant purchasing, Erasmus MC
E. Nibbering	-	Head IT, Isala Klinieken
C. Oude Luttikhuis	-	Consultant, van de Geijn Partners
M. Manschot	-	IT Staff, Antonius Ziekenhuis

Supplier side

Two persons were interviewed on the supplier side. They wish to remain anonymous due to sensitive business information.

Appendix B

GTIN Attributes for healthcare products

1. Global Trade Item Number (GTIN)
2. Pack Level
3. Manufacturer Part Number
4. Hierarchy (Parent GTIN)
5. Hierarchy (Child GTIN)
6. Hierarchy (Quantity of Children)
7. Publisher Global Location Number (GLN)
8. Target Market
9. Brand Owner and GLN
10. Manufacturer Name and GLN
11. Functional Name
12. Brand Name
13. Description
14. Height + Unit of Measure
15. Width + Unit of Measure
16. Depth + Unit of Measure
17. Gross Weight + Unit of Measure
18. Net Content + Unit of Measure
19. Consumer Unit Y/N
20. Orderable Unit Y/N
21. Invoice Unit Y/N
22. Shipping Unit Y/N
23. Base Unit Y/N
24. Variable Unit Y/N
25. Returnable Package Y/N
26. Marked with Lot Number Y/N
27. Bar code Type
28. GPC code
29. Optional Classification Agency
30. Optional Classification Agency Value
31. Start Date
32. Effective Date

33. Shelf Life From Production
34. Shelf Life From Delivery
35. Contains Blood
36. Implantable
37. Contents of Concern
38. Reusability Types
39. Brand or Generic Flag
40. Does Product Contain Latex

Appendix C

List of Application Identifiers <http://www.gs1-128.info/ai-values/>

AI	Description	Data Format
00	Serial Shipping Container Code(SSCC-18)	18 digits - numeric
01	Shipping Container Code (SSC)	14 digits - numeric
02	Number of containers	14 digits - numeric
10	Batch Number	1-20 alphanumeric
11	Production Date	6 digits: YYMMDD
13	Packaging Date	6 digits: YYMMDD
15	Sell by Date (Quality Control)	6 digits: YYMMDD
17	Expiration Date	6 digits: YYMMDD
20	Product Variant	2 digits
21	Serial Number	1-20 alphanumeric
22	HIBCC Quantity, Date, Batch and Link	1-29 alphanumeric
23x	Lot Number	1-19 alphanumeric
240	Additional Product Identification	1-30 alphanumeric
250	Second Serial Number	1-30 alphanumeric
30	Quantity Each	-
310y	Product Net Weight in kg	6 digits
311y	Product Length/1st Dimension, in meters	6 digits
312y	Product Width/Diameter/2nd Dimension, in meters	6 digits
313y	Product Depth/Thickness/3rd Dimension, in meters	6 digits
314y	Product Area, in square meters	6 digits
315y	Product Volume, in liters	6 digits
316y	product Volume, in cubic meters	6 digits
320y	Product Net Weight, in pounds	6 digits
321y	Product Length/1st Dimension, in inches	6 digits
322y	Product Length/1st Dimension, in feet	6 digits

323y	Product Length/1st Dimension, in yards	6 digits
324y	Product Width/Diameter/2nd Dimension, in inches	6 digits
325y	Product Width/Diameter/2nd Dimension, in feet	6 digits
326y	Product Width/Diameter/2nd Dimension, in yards	6 digits
327y	Product Depth/Thickness/3rd Dimension, in inches	6 digits
328y	Product Depth/Thickness/3rd Dimension, in feet	6 digits
329y	Product Depth/Thickness/3rd Dimension, in yards	6 digits
330y	Container Gross Weight (Kg)	6 digits
331y	Container Length/1st Dimension (Meters)	6 digits
332y	Container Width/Diameter/2nd Dimension (Meters)	6 digits
333y	Container Depth/Thickness/3rd Dimension (Meters)	6 digits
334y	Container Area (Square Meters)	6 digits
335y	Container Gross Volume (Liters)	6 digits
336y	Container Gross Volume (Cubic Meters)	6 digits
340y	Container Gross Weight (Pounds)	6 digits
341y	Container Length/1st Dimension, in inches	6 digits
342y	Container Length/1st Dimension, in feet	6 digits
343y	Container Length/1st Dimension in, in yards	6 digits
344y	Container Width/Diameter/2nd Dimension, in inches	6 digits
345y	Container Width/Diameter/2nd Dimension, in feet	6 digits
346y	Container Width/Diameter/2nd Dimension, in yards	6 digits
347y	Container Depth/Thickness/Height/3rd	6 digits

	Dimension, in inches	
348y	Container Depth/Thickness/Height/3rd Dimension, in feet	6 digits
349y	Container Depth/Thickness/Height/3rd Dimension, in yards	6 digits
350y	Product Area (Square Inches)	6 digits
351y	Product Area (Square Feet)	6 digits
352y	Product Area (Square Yards)	6 digits
353y	Container Area (Square Inches)	6 digits
354y	Container Area (Square Feet)	6 digits
355y	Container Area (Square Yards)	6 digits
356y	Net Weight (Troy Ounces)	6 digits
360y	Product Volume (Quarts)	6 digits
361y	Product Volume (Gallons)	6 digits
362y	Container Gross Volume (Quarts)	6 digits
363y	Container Gross Volume (Gallons)	6 digits
364y	Product Volume (Cubic Inches)	6 digits
365y	Product Volume (Cubic Feet)	6 digits
366y	Product Volume (Cubic Yards)	6 digits
367y	Container Gross Volume (Cubic Inches)	6 digits
368y	Container Gross Volume (Cubic Feet)	6 digits
369y	Container Gross Volume (Cubic Yards)	6 digits
37	Number of Units Contained	1-8 digits
400	Customer Purchase Order Number	1-29 alphanumeric
410	Ship To/Deliver To Location Code (EAN13 or DUNS code)	13 digits
411	Bill To/Invoice Location Code (EAN13 or DUNS code)	13 digits
412	Purchase From Location Code (EAN13 or DUNS code)	13 digits
420	Ship To/Deliver To Postal Code (Single Postal Authority)	1-9 alphanumeric

421	Ship To/Deliver To Postal Code (Multiple Postal Authority)	4-12 alphanumeric
8001	Roll Products - Width/Length/Core Diameter	14 digits
8002	Electronic Serial Number (ESN) for Cellular Phone	1-20 alphanumeric
8003	UPC/EAN Number and Serial Number of Returnable Asset	14 Digit UPC +1-16 Alphanumeric Serial Number
8004	UPC/EAN Serial Identification	1-30 Alphanumeric
8005	Price per Unit of Measure	6 digits
8100	Coupon Extended Code: Number System and Offer	6 digits - numeric
8101	8101 Coupon Extended Code: Number System, Offer, End of Offer	10 digits - numeric
8102	Coupon Extended Code: Number System preceded by 0	2 digits - numeric
90	Mutually Agreed Between Trading Partners	1-30 alphanumeric
91	USPS services	2-digit service code, 9-digit customer ID, 8-digit package ID plus 1 Mod10 check digit
92	Internal Company Codes	1-30 alphanumeric
93	Internal Company Codes	1-30 alphanumeric
94	Internal Company Codes	1-30 alphanumeric
95	Internal Company Codes	1-30 alphanumeric
96	Internal Company Codes	1-30 alphanumeric
97	Internal Company Codes	1-30 alphanumeric
98	Internal Company Codes	1-30 alphanumeric
99	Internal Company Codes	1-30 alphanumeric

Appendix D

Hospital Solution Software

This software solution should have the following capabilities:

- *GTIN Management* — The application must allow for the retailer or wholesale distributor to easily receive the publication of GTINs (Catalog Item Notifications) from suppliers. It must be simple to search GTIN publications by suppliers by relative criteria (GTIN, GLN, Publication Status, etc.).
- *GTINs must be able to be properly routed to specific buyers or product managers.*
- *GTIN Net Change* — The application must allow “buyers” to easily see the “net change” in GTINs that have already been published and are being updated via item changes or corrections.
- *Demand-side Responses (Catalog Item Confirmation)* — The application must provide the ability to easily respond to trading partner publications with all of the status and response capabilities offered in the GDSN model.
- *Publication Receipt and Confirmation History* — The application must allow for the easy search/review/audit of publication receipt and confirm the response.
- *Catalog Update* — As demand-side ERP systems come in a variety of forms with varying levels of sophistication, it is imperative that the demand-side solution provides several flexible methods of updating the retail item catalog with synchronised GTINs. Supply- and demand-side Workflow should come preconfigured with the normal steps of the GDSN process. As each company has some feature(s) of its internal process that are different, it is important that the Workflow feature of GDS products be easily configured to create new Workflow events and enroll users, groups of users and/or applications to them.
- *Workflow and Messaging* — Evaluating and responding to GTIN publications can require a collaborative approach. In companies with thousands (or hundreds of thousands) of GTINs, it becomes increasingly difficult to track a GTIN through its life-cycle stages. A good Workflow solution should ease new product introductions and product changes by moving GTIN life-cycle actions through the various stages of approval and escalation. As each task is completed, a good Workflow solution notifies the next group (or person) of what needs to occur in the GTIN life cycle.

Supplier Solution Software

For the supplier a software solution should have the following capabilities:

- *Create and maintain GTINs*
- *Register GTINs with a certified data pool*
- *Publish new GTINs, GTIN changes, or removals to trading partners via a certified data pool, which are the base functions required for a supplier to publish via the GDSN*
- *Incorporate GSI Validation — A check of item attributes before registering them with a compliant data pool ensures that the data adheres to the GSI System. This avoids errors in your outbound synchronisation messaging.*
- *Support Containment (Links) — Containment lets you link common GTINs together to form a logical containment structure (such as each to case to pallet). For those trading partners that only have their products defined in one packaging level (typically case), a clone feature is desirable to eliminate the need to rekey item information.*
- *Auditing Capability and Non-Repudiation — Auditing allows you to track which retailer you've published to and the response. Non-Repudiation establishes that any messaging, such as registering an item, has been successfully accepted by the data pool.*
- *Publication History — When many GTINs are being published to trading partners, a history log lets suppliers quickly view every individual trading partner's response to their publications.*
- *Workflow and Messaging – Building good GTIN data is a collaborative approach and, in large shops with thousands of GTINs, it becomes increasingly difficult to track a GTIN through its life-cycle stages. A good Workflow solution should ease new product introductions and product changes by moving GTIN life-cycle actions through the various stages of approval and escalation. As each task is completed, a good Workflow solution notifies the next group (or person) of what needs to occur in the GTIN life cycle.*