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Master's Thesis

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**Analysis and comparison of the potential of  
RFID-technology in European and U.S. retail supply  
chains**

Titel: Analyse und Vergleich des Potentials von RFID-  
Technologie in Europäischen und U.S.-amerikanischen  
Handelswertschöpfungsketten

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### Abstract

This thesis presents an analysis of the potential of RFID-technology with a special focus on implementations at retailers. By analysing the RFID-roll outs of Wal-Mart and Metro the thesis outlines the necessary characteristics of a retail supply chain to successfully implement RFID. The changes in a retail supply chain as a consequence of an RFID-implementation are summarized and a detailed comparison with the two case studies is given. It shows that Wal-Mart's and Metro's supply chain correlate to a great extent with the typology beneficial to a successful RFID-implementation. Nevertheless, a conclusion on the success or failure of the roll-outs can not be drawn yet. Future developments will very much be dependent on the widespread implementation of RFID in other companies and industries and on the acceptance by the public.

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### Abbreviations

AIAG	Automotive Industry Action Group
AIM	The Association of the Automatic Identification and Data Capture Industry
ASN	Advanced Shipment Notice
ATM	Automated Teller Machine
ATP	Available to Promise
AVI	Automatic Vehicle Identification
BSE	Bovine Spongiform Encephalopathy
CASPIAN	Consumers Against Supermarket Privacy Invasion and Numbering
CIO	Chief Information Officer
CPFR	Collaborative Planning, Forecasting and Replenishment
CPG	Consumer Packaged Goods
CRM	Customer Relationship Management
DC	Distribution Center
DoD	Department of Defense
DSD	Direct Store Delivery
EAN	European Article Number
EAS	Electronic Article Surveillance
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange
EDLP	Every Day Low Pricing
EICAR	European Institute for Computer Anti-Virus Research
EPC	Electronic Product Code
ERP	Enterprise Resource Planning
ESL	Electronic Shelf Labeling
ETC	Electronic Toll Collection
FDA	US Food and Drug Administration
FoeBud e.V.	“Verein zur Förderung des öffentlichen bewegten und unbewegten Datenverkehrs e.V.” or translated as “(registered) association for the promotion of public mobile and immobile data traffic”

GTAG	Global Tag
ISO	International Organization for Standardization
JIT	Just in time
LTL	Less-than-truckload
MGB	Metro Group Buying GmbH
MRP	Manufacturing Resource Planning System
NRF	National Retail Federation
ONS	Object Name Service
OOS	Out-of-stocks
PDA	Personal Digital Advice
PML	Physical Markup Language
POS	Point-of-Sale
RF	Radio Frequency
RFID	Radio Frequency Identification
RIED	Real-time in-memory event database
RCC	Retail Council of Canada
ROI	Return on Investment
RSP	Retailer-Supplier Partnership
SKU	Stock Keeping Unit
TDMA	Time Division Multiple Access
TL	Truckload
TMS	Task Management System
UCC	Uniform Code Council
UCLA	University of California, Los Angeles
UHF	Ultra High Frequency
UPC	Universal Product Code
VDA	Verband der Automobilindustrie (German Association of the Automotive Industry)
VMI	Vendor Managed Inventory
WIP	Work in Progress
WLAN	Wireless Local Area Network
WM	Wal-Mart
WMS	Warehouse Management Software
WORM-tag	Write Once, Read Many - tag

### 1. Introduction

Imagine, you are standing in front of your closet thinking that one of your favorite sweaters is already pretty worn off. You use the electronic advisor with touch-screen built into your closet to see when you have actually bought the sweater. You can see that it was already more than two years ago, furthermore, you see that it has lost 20% of the original colour. You choose the option to search for equal new products in your favorite stores or on the internet. You choose some of the sweaters you like and order them to be available for fitting on in the store as you don't like to order clothes via the internet.

When you walk into your store, you are welcomed by a big TV-screen without even putting your loyalty card out of your pocket. It says your name and some special offers you might like and where to go to find the sweaters prepared for you. A small PDA on your shopping cart (or further multimediascreens on the way) shows you the way to the shelves. During trying on some sweaters you can immediately see information on where the wool comes from, where and when it was produced and how long it will probably last without losing its color. After choosing one sweater, the multimediascreen offers you other products like pants and jackets that would perfectly fit to your sweater. It also shows you some discounts you would get by combining the sweater with the pants offered. You think that the pants shown would really fit to the sweater so you also try them on. The discount and the nice combination convinces you, glad that you have even saved some bucks you head to the exit.

After passing the check-out gate, a screen shows the clothes that you want to buy and the system automatically verifies your ID as well as credit card to easily pay for the clothes with one touch on the screen. You notice that the system also lists a pair of socks in addition to your sweater. After you search for it, you find the socks hidden somewhere under the sweater where they have probably landed accidentally. You take the socks back through the check-out gate and proceed paying the sweater by touching the pay button. Before wearing the sweater for the first time, you would like to have it washed so you throw it into the washing machine which immediately recognizes the proposed washing temperature and adds the right amount of detergent on its own.

This could all be made possible with one technology: RFID. **R**adio-**F**requency **I**dentification. A small microchip with an antenna, attached to merchandise as the label and embedded into loyalty cards will completely change the way business is done by retailers. It is not clear if all mentioned above will come reality and time will show which applications will be wanted and accepted by the public. Even if it is not clear how RFID will change our everyday life, there is one thing that can be said with certainty: RFID is there and it can not be stopped anymore. Or to put it into the words of Heraclitus: “There is nothing permanent except change”.

This paper describes the effects RFID will have on the retail business, on retail supply chains. Retail business is facing increasing competitive intensity at the moment. Financial pressures are forcing retailers more and more to cut costs and implement new IT-solutions to effectively compete in the industry. RFID is only one measure to improve efficiency and eventually cut labor. The following thesis focuses on the RFID-technology and its implementation at two retail chains in the US and in Europe and asks the question: *How does RFID change retail supply chains and what are the essential parts of a supply chain to a successful implementation?* Two case studies have been conducted in order to answer this question. One case deals with European retailer Metro Group, the fifth biggest retailer in the world. The other case is about the world’s biggest retailer, Wal-Mart from the USA.

The paper first explains some different Auto-ID technologies, then gives a detailed description on how RFID works including various applications. In chapter number 4 it draws a model for a retail supply chain, analyses it and gives examples in chapter 5. The changes in retail supply chains caused through RFID are discussed in chapter 6. Two examples of retailers’ implementations of RFID in Europe and the USA are shown in chapter 7 and 8 with the examples of Metro and Wal-Mart. Finally, chapter 9 analyses the differences and similarities in the two roll-outs and compares the two supply chain typologies with the typology beneficial to an RFID-implementation, chapter 10 discusses the possibilities of transferability of RFID to other companies and industries and the last chapter draws a conclusion.

## 2. Different Auto-ID technologies

“Automatic identification, or Auto-ID for short, is the broad term given to a host of technologies that are used to help machines identify objects. Auto identification is often coupled with automatic data capture. That is, companies want to identify items, capture information about them and somehow get the data into a computer without having employees type it in.” (EPC Global 2004)

Radio frequency identification, or RFID, will be the main field of study in this thesis. Nevertheless it is only one technology under the Auto-ID umbrella. Before giving detailed information on RFID in chapter 3, the following sections will give an overview of the different kinds of Automatic Identification systems. The examples should show why RFID is superior in various fields of business and will play a major role in many industries in the future.

### 2.1. *Barcode systems*

The barcode is a binary code with bars and gaps specifically arranged to a predetermined pattern. The sequence of these wide and narrow bars and gaps refers to an associated symbol that can be interpreted numerically and alphanumerically. An optical laser scanner reads the barcode by the reflection of a laser beam from the black bars and white gaps. There are different kinds of barcodes with the EAN code (European Article Number) being the most popular one designed in 1976 specifically for the grocery industry. It is a development of the UPC (Universal Product Code) from the United States.

The EAN code consists of 13 digits. The first two or three numbers identify the country where the EAN code was assigned. This does not necessarily mean that the product was manufactured in this country. The next five numbers identify the company, then the 5 numbers manufacturer's item number and a one number check digit (Finkenzeller 2003: 3). The following figure shows the EAN barcode:

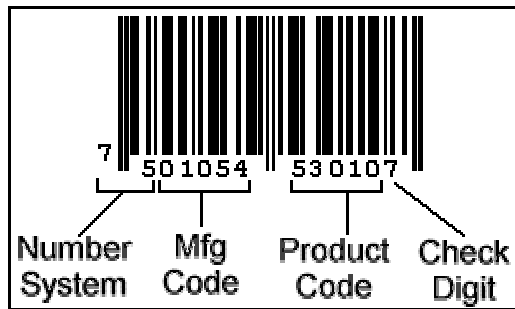


Figure 1: EAN-Code. Source : [www.barcodeisland.com](http://www.barcodeisland.com)

The negative aspects of barcodes are the limited storage capacity and that they can not be reprogrammed. Furthermore, the use in a dirty or dusty environment such as manufacturing plants might make it impossible to read the barcode. Nevertheless the barcode is still widely used and shows similarities to RFID from the protests when it was launched to the applications in today's business environment. Chapter 3.3. gives detailed information on the differences of the two technologies and shows what advantages RFID brings in comparison to barcodes.

### ***2.2. Magnetic strip and chip cards***

The magnetic strip card is the predecessor of the smart card, or chip card, with a magnetic strip attached on the back of the card. The magnetic strip cards were mostly used as credit cards, telephone cards, bank cards and even railway tickets with the information stored on the black strip in simple numerical form. The data on the magnetic strip card can be easily deleted by exposure to certain conditions such as strong magnetic fields (Silicon Trust: 2004).

Smart cards consist of an electronic data storage system with an optional computing capacity such as a microprocessor card. The big difference of smart cards to magnetic strip cards is that smart cards can be used for example on the internet without physical contact through a PIN-code that identifies the card. Furthermore a smart card can be used as a multiple card with expanding the range of utilization from a credit card to an access and loyalty card and more in one. The enhanced capability of smart cards makes them much safer than magnetic strip cards but the vulnerability of the contacts to external effects is still a problem.



### **2.3. Optical character recognition (OCR)**

“OCR is the electronic identification and digital encoding of either printed or handwritten characters” (American Heritage Dictionary: 2000). Originally special fonts were needed that could be recognized by machines and humans alike with the potential to store a lot of data on it. Nowadays the current devices can read most standard typefaces and even handwriting. It is possible to convert a paper document into computer-editable-text. All OCR systems contain an optical scanner for reading the data and a sophisticated software. A bitmapped image of printed text is transferred into text code which is readable by machines.

This technology was a field of research in artificial intelligence and machine vision and has been in use for a long time now by libraries and government agencies to make documents electronically available in a short time and for example by postal companies to sort mail.

### **2.4. Biometrics**

“*Biometrics* is defined as the science of counting and (body) measurement procedures involving living beings. In the context of identification systems, biometry is the general term for all procedures that identify people by comparing unmistakable and individual physical characteristics. In practice, these are fingerprinting and handprinting procedures, voice identification and, less commonly, retina (or iris) identification.” (Finkenzeller 2003:4)

#### **2.4.1. Voice recognition**

Application of voice or speech recognition is nowadays widespread from warehouse management, “language identification” to the use in call centers, as well as access controls and others. One of the applications is converting spoken words into digital signals and comparing the speech characteristics of the speaker with those stored in the database, which makes it possible to identify individuals. After the verification a reaction will be initiated as the opening of a door (Finkenzeller 2003: 4).

Today, the most common use for voice recognition systems is in the warehouse as a picking technology, called pick-to-voice. Voice recognition is taking the place of paper pick lists. The worker in the warehouse is equipped with a headset and a belt-worn computer, the system tells him what to pick and he confirms the pick via the headset.

This hands-free technology brings great advantages in accuracy and productivity and works well together with other technologies such as Warehouse Management Software (WMS), Customer Relationship Management (CRM) and RFID. Concerning interaction with RFID, the computer of the worker can be equipped with an RFID-reader making it easier to find special products (this could work just like a metall detector, but this application is still in development), and via voice commands, the RFID-tags can be interrogated and orders can be given to them with data being passed on at the same time to the WMS system (“Order Picking for the 21st Century”: 2004). Furthermore, the worker can tell the voice recognition system to print RFID-labels for the products which means significant time saving in the warehouse operations.



Figure 2: Pick-to-voice example. Source: Buhrmann (2005)

In call centers voice recognition can substitute employees and lead to significant cost savings. The “Virtual employees” bring advantages such as shorter wait times in queue, 24/7 accessibility and decreased operating costs.

### 2.4.2. Fingerprint procedure

Fingerprint procedure, or dactyloscopy, which is the practice of using fingerprints as a means of identification is today most commonly used in modern law enforcement (Encyclopaedia Britannica 2004). Fingerprints can not only be obtained from the person's finger itself, but also from things touched by the individual. Commercial use of this procedure can mainly be seen in entrance verifications. The finger has to be put on a special reading advice where a data record is calculated from the pattern and compared to the database. Less than half a second is needed today by modern fingerprint ID systems for checking a fingerprint (Finkenzeller 2003: 4). In Germany, a retail chain equipped its checkouts with fingerprint readers to initiate payment. This procedure makes the checkout process much faster, making a debit- or creditcard obsolete. The retailer "Edeka" started with one test store but has plans to implement this technology in 20 more stores until the end of 2005 and after that all over southern Germany ("Finger statt Karte": 2005)

### **3. RFID**

#### **3.1. *History of RFID***

Many important scientists can be seen as the pioneers of RFID such as Benjamin Franklin in the 18<sup>th</sup> century (electricity), Michael Faraday, James Clerk Maxwell and Heinrich Rudolf Hertz in the 19<sup>th</sup> century and Albert Einstein for their studies in electromagnetism. Hertz was the first to transmit and receive radio waves at the turn of the 19<sup>th</sup> century and in 1896 Guglielmo Marconi transmitted radiotelegraphy across the Atlantic (Encyclopaedia Britannica 2004).

The beginning of modern radio communication with Ernst F. W. Alexanderson and the birth of radar in the early 20<sup>th</sup> century pathed the way for RFID as this technology is the combination of radio broadcast technology and radar. Technical developments in radio and radar in the 1930s and 40s led to an “era of exploration of RFID” (AIM 2001) in the 1950s.

The first well-known and often-mentioned application of RFID was in World War II. Allied forces used RFID in FoF (Friend or Foe) systems to identify friendly aircrafts from enemy aircrafts. In the 1960s the first widespread commercial use of RFID was the counter theft measure of electronic article surveillance (EAS). Utilizing “1-bit” tags, where only the presence or absence of a tag is detected, was and still is an inexpensive and effective measure of detecting theft on the shop floor (AIM 2001).

In the 1980s the full implementation of RFID started. Interestingly the intentions of Americans and Europeans where somehow different. In the US, the studies on and the implementation of RFID concentrated on transportation, personnel access and only to a small extent on animals. Europe’s focus was more on animal tagging, industrial and business applications (AIM 2001). Electronic toll collection was a first major field of implementation of RFID mainly in the Americas.

### 3.2. The technology

An RFID system basically consists of three components (AIM 2004):

1. An antenna
2. A transceiver (with decoder)
3. A transponder (or RFID-tag)

**The antenna** is usually integrated in **the transceiver** and decoder making it a reader. Some sources state only two major components of an RFID-system combining the antenna and the transceiver. In this paper the term reader will be mainly used, always referring to both components.

Radio signals are emitted by the antenna activating the tag and reading or writing data on it. Antennas of different size and shape can be integrated into a door frame, put on a toll booth on a freeway or in shelves in the supermarket and there are many more applications. The antenna produces an electromagnetic field which can either be permanent when large numbers of tags are expected continuously, like on freeway toll booths, or it can be activated and deactivated whenever needed.

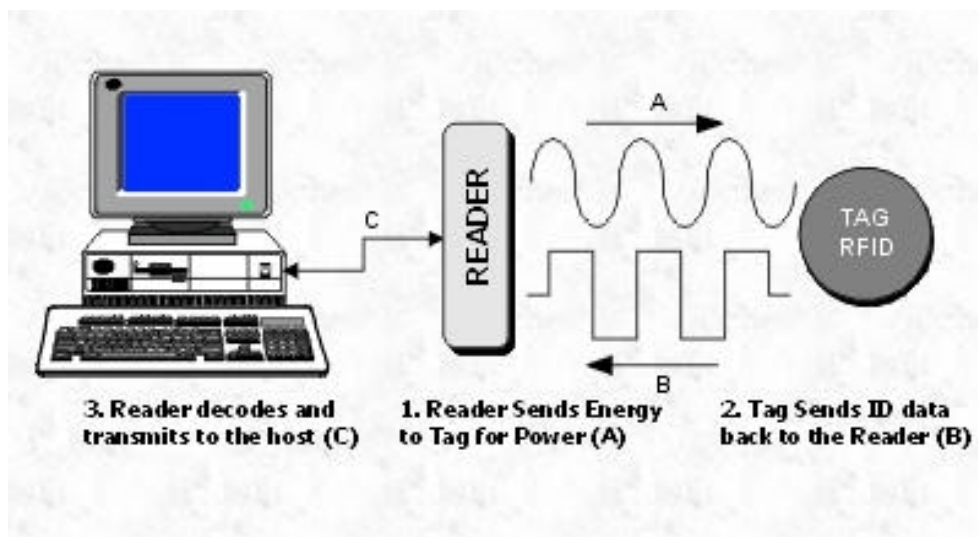


Figure 3: „How RFID works”.

Source: Rollsoft

A **transponder**, or RFID-tag, is the “data-carrying device” of an RFID-system and normally consists of a coupling element and an electronic microchip. It usually does not have an own battery so it is passive as long as it is not in the interrogation zone of a

reader. The power needed to send and receive data as well as to change data is sent by the reader through the coupling unit (Finkensteller 2003: 9). RFID-tags can also have different sizes and shapes and might be integrated in labels for products sold in supermarkets (see Figure1), be put under the skin of animals to track them, they can be credit-card shaped or be used as anti-theft hard plastic tags attached to products sold in stores.

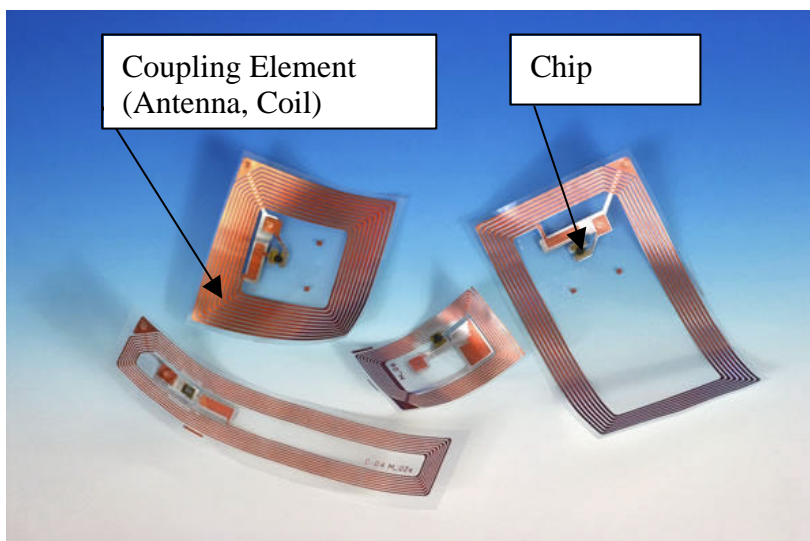


Figure 4: “Smart Label Inlays” adapted by Stefan Hofmayr, Source: Texas Instruments

There are many different variants of RFID systems and their components. To get an insight in the whole range of technical possibilities it is necessary to explain the most important differentiations:

The tags have to be classified into **read/write and read-only tags**. The data on read/write tags can be altered or rewritten. Read-only tags, in contrast, are programmed with a unique set of data, which is usually 32 to 128 bits that cannot be modified. RFID tags are divided in different classes concerning their read/write capabilities:

Class 0	=	Passive, Read Only
Class 1	=	Passive, Write Once, Read Many
Class 2	=	Passive, Multi Write and Read
Class 3	=	Active, Multi Write and Read
Class 4	=	Active, Networking Tags

Figure 5: „RFID-tag distinction“. Source: „RFID – Just the Facts“, p.5

Furthermore, RFID-tags are either **active or passive**. Tags powered by an internal battery are called active and usually read/write whereas passive tags are not equipped with an internal energy source but are powered by the reader. The main differences between those two kinds of tags are the following: Passive tags are much lighter, cheaper and have an unlimited operational lifetime but they have shorter read ranges and require a higher-powered reader. As the memory size also varies among the possible alternatives active tags can operate with up to 1mb of memory but the operational life might be limited to a maximum of 10 years depending on operating temperatures and the battery type.

Another distinction is the **frequency range** of the radio waves. “Radio frequency, or RF, refers to that portion of the electromagnetic spectrum in which electromagnetic waves can be generated by alternating current fed to an antenna” (Wikipedia.org: 2004). The following figure shows the frequency spectrum with its commercial applications:

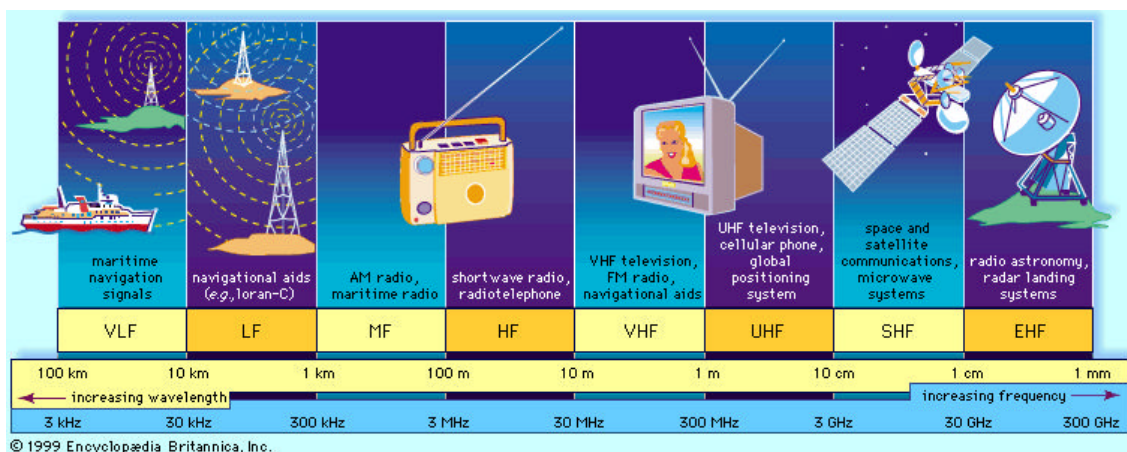


Figure 6: Commercially exploited bands of the radio-frequency spectrum

Source: Encyclopædia Britannica, Inc. <http://www.britannica.com>

RFID runs at different bands and frequencies within the bands. This is caused by the different applications required. The table below shows the various frequencies, which are used for the different applications of RFID. Furthermore, the advantages and disadvantages of the frequencies are listed as well as applications. The exact frequencies can vary as only few standards have been set yet.

Band + Frequency	Read range	Advantages	Application
Low Frequency (LF) 30-300 KHz	Up to 20 inches (~0.5m)	+ Good penetration in moist environments + No Anticollision - Slow data rate	<ul style="list-style-type: none"> <li>○ Animal Tagging (134.2 KHz),</li> <li>○ Access control</li> <li>○ Vehicle key-locks,..</li> </ul>
High Frequency (HF) 3-30 MHz	Up to 3 feet (1m)	+ Good penetration in moist environments - Poor performance in metal environment	<ul style="list-style-type: none"> <li>○ Item level tagging, libraries</li> <li>○ Smart cards,..</li> <li>○ Airline baggage</li> </ul>
Ultra High Frequency (UHF) 300-3000 MHz	Passive: Up to 16 feet. Active: More than 30 feet (6m)	+ Fast data rates + Good performance in metal environment	<ul style="list-style-type: none"> <li>○ Supply chain use at WM and Metro</li> <li>○ Baggage handling</li> <li>○ Toll collection,..</li> </ul>
Super High Frequency (SHF) “Microwave” 3-30 GHz	2+ meters	+ Fast data rates + Good performance in metal environment - Poor performance in moist environment - High cost	<ul style="list-style-type: none"> <li>○ Item tracking</li> <li>○ Toll collection</li> </ul>

Table 1: RFID-Frequencies. Sources: „Operating Frequencies“ by Electro-Com: 2004, Intermec 2004

**EPC, the electronic product code**, is a major issue when talking about RFID. It is actually a standard proposed by the Auto-ID center with two different types, a 64- and a 96 bit code. The 96-bit code gives a unique number to 268 million companies, with 16 million different object classes and 68 billion serial numbers in each class. The 64-bit version should be a compromise between the cost of a tag and the number of different codes. This version offers lower cost but fewer serial numbers, which will not be required yet the next years to come (“EPC Global Inc.” 2004b).

The EPC number is made up of a header and three sets of data. The header clarifies the EPC version used, as versions of different length and type might be used in the future.



The second part, the “EPC Manager”, represents the manufacturer’s code. The “Object Class”, the third part, identifies the type of product, usually the Stock Keeping Unit (SKU). The big difference to the bar code is the last part of the EPC, the serial number. It refers to one single item of this type of product and makes the EPC a unique code that only exists once, in contrast to the barcode which identifies to the type of product but not a difference in the single product. The differences to barcodes will be thoroughly explained in the next chapter and standards issues are further mentioned in chapter 3.4.2.



Figure 7: “Electronic Product Code Type1” Source: EPCGlobal Inc. Homepage

The so called “nervous system” (EPCGlobal Inc.) of the RFID-network is the **software** designed by the Auto-ID center. This software, called “**Savant**”, will run in stores, distribution centers, regional offices, factories and other places where RFID is used and gathers, stores and acts on information and interacts with other Savants.

Savants correct read errors, eliminate duplicated codes by two readers and decide which information is forwarded, which is important for example in a refrigerated warehouse where only the temperature is passed on. It maintains a real-time in-memory event database (RIED) so that other databases are not overloaded and all Savants feature a Task Management System (TMS) for data monitoring and data management with which they can be programmed to do a customized task in a special situation. An example would be an alert by the store shelf to the stockroom that only one product left in the shelf (“EPC Global Inc.” 2004b).

In order to find the associated item when a computer receives the EPC, an automated networking service called **Object Name Service (ONS)** is in place. The Savant therefore asks an ONS on a local network or the internet to find information on the product. The information in the EPC on the product is written in a new standard computer language, the **Physical Markup Language (PML)**. This is a simple startup language that will cover all industries and will be evolved over time just as it was the

case with HTML. The interesting thing about PML is, that there are two kinds of information included. Dynamic data, that changes constantly and temporary data, that changes over time. Dynamic data is for example the temperature of a product such as fish or the vibration level of a machine whereas temporal data changes discontinuously such as the location. The PML file will provide all kinds of information and can set triggers such as the decrease of the price of a product when it reaches its expiration date (“EPC Global Inc.” 2004b).

### **3.3. Advantages of RFID/EPC in comparison to barcodes**

The basic benefits of RFID in comparison to barcodes, which are widely employed at the moment in most industries are (IGD 2004, p. 2):

- No line of sight needed, scanning from a distance
- Greater capacity for information
- Possibility to write and therefore update information (not possible with all kinds of RFID)
- Ability of enabling “triggered” activities
- Identification of discrete items
- Improved data collection accuracy

It is very interesting to see that the barcode faced the same challenges after its development 30 years again until its widespread adoption. Required standards and high investment costs as well as the then not fully visible benefits that barcodes would generate hindered the implementation. It was Wal-Mart in 1984 to set a mandate for the majority of its suppliers to use barcodes within three years which led to a widespread international adoption of barcodes in the industry (IGD 2004, p. 6).

<b>Advantages of RFID</b>	<b>Bar Code</b>	<b>RFID</b>
<b>Handling</b>	Manual	Via Radio Frequency Waves
<b>Data capture</b>	Sometimes difficult because of dirt, bending	Readable even if dirty, can be encased ? protected

<b>Readability and read range</b>	Line of sight needed, very short range	No line of sight needed, readable from a distance at any angle
<b>Data capacity</b>	Limited (to EAN,..)	Depending on tag class, able to hold more data
<b>Read times</b>	One item after the other	Almost simultaneous read of many tags possible
<b>Usability</b>	One time use only, need for replacement after that	Read/write tags offer data change making them updateable and reusable
<b>Disadvantages of RFID</b>		
<b>Costs</b>	Low cost, usable in all markets	Costs of tags still too high for widespread implementation but decreasing, investment costs in new infrastructure required
<b>Read rates</b>	High	Not yet consistently high
<b>Technology</b>	Established, proven and accepted throughout the industry.	Some technological problems still exist such as the use of RFID with metall or liquids
<b>Standards</b>	Industry standards set	Standard setting still in progress

Table 2: „Advantages and disadvantages of RFID in comparison to the bar code“. Sources: IGD (2004)

### **3.4. Problems/restrictions of RFID (Challenges of RFID)**

The main problems and restrictions that occur with RFID can be classified into 4 categories. Technology, standards, privacy, costs and data security will be discussed in the next 4 paragraphs:

#### **3.4.1. Technical problems and restrictions**

Radio waves are absorbed by water and distorted by metal creating problems for RFID-tagging. Products with high water content or metall packaging might cause data chaos

or at least interfere radio communication from tag to reader. Moreover, tags on products with high density are much harder to read than those with low density.

However, those problems are very much dependent on the given application and vary a lot. The external environment and the product itself play an important role if a product is difficult to read and not every product with high water content or metall packaging can be generalized as hard to read. Intensive research in this field let these problems seem superable in the near future.

Interference of the signals of RFID-readers in the same coverage area may cause problems but can be managed by an anti-collision scheme, such as the TDMA, the time division multiple access, used by the Auto-ID center. The same applies for tag collision, when more than one chip at a time sends back a signal to a reader. The solution, with which a reader can read more than 50 tags a second, is a standard method where the tags respond one after the other (“EPC Global Inc.” 2004b).

### **3.4.2. Standards Problems**

The widespread use of a relatively new technology and decreasing costs as a consequence require a framework for all players in this field from users to hardware vendors. Without standards, companies would develop unique ways of passing unique information which would result in high costs, effort and time. Different standards like national and global technical standards (e.g. ISO, EPCglobal Inc.), industryspecific standards (e.g. AIAG, VDA), quasi-standards of leading technology providers (e.g. SAP) as well as standards of the logistics industry are in contrast and competition to each other (ECIN: 2004). To make hardware and software compatible, the role of international organizations such as the International Standards Organization (ISO) and EAN International (International Article Numbering Association) to set standards together with the industry is very important. Big companies with high interest in the standard setting process such as Wal-Mart and Metro engage actively in shaping the new standards.

A distinction in terms of standards for RFID has to be made between the unique identification numbering systems (EAN, UPC, etc.) and technical standards for

transmission protocols (i.e. GTAG, ISO 18000, etc.). In a joint-venture between EAN International and the Uniform Code Council, EPCglobal was founded “to work toward the development of industry-accepted standards and commercial adoption” (www.epcglobalinc.org). They are pushing the Electronic Product code (EPC), a unique number that identifies a specific object in the supply chain, which is described in chapter 3.2.. For the global adoption of EPC it is necessary, that the technology is free and open. In other words, total asset visibility through global data sharing via RFID can only be possible when open, standardized EPC interfaces enable interoperability and multi-vendor implementations (“Managing the EPC..”: 2004).

Concerning the frequency ranges used with RFID-tags, the existing problem is that governments around the world have regulated the electromagnetic spectrum. They have assigned different uses for the various parts of the spectrum. A practical example is the spectrum assigned by a country to it’s radio stations. In the U.S., they must operate between 88 and 108 MHz (“EPC Global Inc.” 2004b). The problem herein lies in the different spectrums assigned by different governments, making it impossible to find a common spectrum for the RFID-use<sup>1</sup>. A solution for this problem is the use of “agile readers” which can read RFID-tags of different frequencies.

In Europe the 13,5 MHz frequency and the 135 KHz frequency are the ones most commonly used in RFID applications at the moment with the first one on the top of the list of RFID-Users. Every one of this two standards has it’s advantages and disadvantages as the characteristics of the frequencies vary a lot. Different applications require different frequencies. The Kilohertz-systems (KHz) have great range but are easily “hacked”. Whereas encoding is best at 13.5 MHz (Gillies, Constantin: 2004). In terms of read range and speed, tags at 915 MHz or ultra-high frequency (UHF) would be better but this spectrum at 915 MHz is not globally available and therefore less useful (Chappell, Gavin et al.: 2003, p. 20). Furthermore, UHFs use more power but are less likely to pass through materials and they require a clear path between the reader and the tag. This might be more useful for pallet and case tagging than for level-item tagging.

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<sup>1</sup> Except for special ISM bands, set aside for industrial, scientific and medical use (“EPC Global Inc.” 2004b).

A distinction that has to be made is the one between Generation 1 and Generation 2 tags. Gen. 1 UHF tags were initially developed to meet low-cost and simplicity needs. Following the tag distinction in figure 3, Gen. 1 tags refer to Class 0 and Class 1 tags. Initially, they are with designed with either 64-bit or 96-bit EPC data with the 64-bit code keeping the costs down but soon the requirements would not meet the capabilities anymore. That is why the industry and the standards organizations pushed the development of the Gen. 2 standard. The characteristics of Gen. 2 tags are the higher memory capacity and a wider read range of 860-960 MHz in comparison to 860-930 MHz with Gen. 1 tags. Gen. 2 standards were ratified by EPCglobal in December 2004.

### **3.4.3. Cost of RFID**

In today's business environment and especially in retail business profit margins are very low and on single item level may start at some cents. Attaching an RFID-tag on to those products would not be of economic relevance. Besides the costs of the tags that are attached to cases, pallets and eventually to items, there are a number of costs of the implementation such as readers at every identification point, software, integration and implementation costs.

A very important issue is the price of the RFID-tags. Costs of the tags depend on volume. The more tags are produced, the lower the price of them. The critical number that is very often mentioned when talking about prices of tags is 5 cents for passive UHF tags. To harvest a ROI on the RFID-investments tag-prices have to decrease substantially. At the moment tag prices range from 20 to 30 Eurocents and many people think that it will take more than 10 years to reach the 5 cents level which is necessary for a widespread unit-level RFID implementation. According to Mark Roberti, the RFID-Journal editor, there will be a total consumption of 30 billion tags a year by 2008 and this is the theoretical level that has to be crossed in order to make 5 cents tags reality. In a widely announced bet called "The 5-cent challenge" he bet \$ 10,000 that by the end of 2008 the market price for passive UHF tags will be 5 cents at a purchase of 1 million tags. He well mentioned that he does not mean the average price which shows again the importance of volume in tag-production ("The 5-Cent Challenge": 2004).

### **3.4.4. Privacy Concerns**

The main concern of consumers and privacy advocates is based on item-level tagging and not actually on the now ongoing implementation of RFID at the retailers on case-, and pallet-level. Nevertheless there are issues of concern raised by those groups concerning some trials with item-level tagging and future applications in the retail stores. Those concerns have to be taken serious by retailers and other companies planning to implement RFID. The fears are that consumers can be tracked all the time and everywhere they go after purchasing a tagged product. Privacy-concern advocates warn, that RFID-tags in products carried or worn by people “can be read from a distance, right through your clothes, wallet, backpack or purse—without your knowledge or consent – ... it gives strangers x-ray vision powers to spy on you, to identify both you and the things you’re wearing and carrying” (CASPIAN 2004).

The New-Hampshire-based privacy rights group CASPIAN (Consumers Against Supermarket Privacy Invasion and Numbering) is furthermore creating fears that the RFID-tags will soon be invisible for consumers as they are “sewn into the seams of clothes, sandwiched between layers of cardboard, molded into plastic or rubber, and integrated into consumer package design” (CASPIAN 2004). CASPIAN pushed the “RFID Right to know Act of 2003” which was proposed legislation requiring labeling of RFID-enabled products to create consumer privacy protection. According to the group the act would “protect consumers from unwittingly purchasing products embedded with remotes surveillance devices” (CASPIAN: 2003).

State legislators in the United States started to support privacy concern groups and passed bills in order to protect individuals and their often limited scope of information. On February 24, 2004 the Utah House of Representatives passed a bill that any tagged product has to be clearly labeled. The California Senate introduced a bill on February 27, 2004 that “requires any business or state agency that uses an RFID system to track products and people to follow three rules. First, tell people that RFID is tracking and collecting information about them. Second, get express consent from customers before doing that. Third, detach or destroy tags before the customer leaves the store” (“Shutting Shopping Bags to Prying Eyes”:2004).

There might even be some kind of health risk concerning the frequencies and power used. In this respect CASPIAN is warning of a continual bombardement with electromagnetic energy as the readers will be everywhere . As we have seen with the mobile phone market and the mobile phone communication, other “neighbourhood” pressure groups can be very rapidly established after the widespread implementation of RFID and could create a lot of problems for all parties involved.

## **RFID** \_\_\_\_\_ **Task Force**

Figure 8: Eicar’S RFID Task Force

Source: Eicar

An industry initiative to fend off the criticism is the RFID Task Force founded by the “European Institute of Computer Anti-Virus Research“ (EICAR). The mission of the task force is to objectify the discussion about RFID and to develop application scenarios for the new technologies from different aspects such as organization, law and psychology. Members of the RFID Task Force are for example the Metro Group, Microsoft, IBM, Sun Microsystems or Airbus. Goals of this initiative include the providing of information to a broad range of stakeholders, a sensitisation of the topic, transfer of key messages such as the benefits, data protection and others (Eicar e. V.: 2005)

### **3.5. Range of application of RFID**

To grasp a picture on how diversified applications of RFID are and how big the impact of this technology on various industries is, five examples are given below. The author has intentionally chosen completely different applications in five 5 industries to show the nearly unconfined possibilities of this technology.

#### **3.5.1. Animal Tracking**

Livestock identification is a major part of herd management programs. In this field, RFID has been in use for a decade at some ranches. Formerly, livestock was identified



by ear tags, neck chains, freeze brands, tattoos, paint marks and many more. RFID can be integrated in ear tags, placed in the reticulum, which is a secondary compartment in the cow's stomach (RFID Journal 2004), and transponders can also be injected with eliminating the risk of loss. RFID leads to increased accuracy and efficiency in tracing the movement of livestock. Disease control and surveillance, emergency management programs, consumer concerns over food safety are some of the industry needs that can be better handled with RFID-tags (RFIDA: 2004). Not only the tracking of livestock and meat but also the automation of feeding stations and slaughterhouses are main applications in this field. The frequency of animals going to feeding stations can show if the animal is healthy. Another interesting application is the use of RFID pigeon rings for pigeon races to prevent fraud.



Figure 9: Cow with ear tag. Source: Holstein Canada

After growing concern of consumers in light of food safety scandals such as BSE and “Foot and Mouth Disease”, more and more countries have introduced stricter regulations. To track the origin of meat products, in late 2003 the European Union Council has adopted a law that requires the electronic tagging of sheep and goat using RFID technology throughout Europe. This regulation is in compliance with the “International Standard for RFID of Animals”. The ISO 111784/11785 contains the structure of the codes for animals and sets the frequency to be used at 134.2 KHz (RFIDNews: 2004).

### 3.5.2. Toll collection

The classic method of collecting tolls was by having each vehicle stop at a toll booth and make a cash payment. This method requires the construction of huge toll plazas with high labor needs and sometimes long queues of vehicles resulting in high costs and serious environmental problems are likely. Another alternative to the classic method is electronic toll collection (ETC) which has already been in use for many years now in several countries of the world.

Every vehicle using the toll road is equipped with an RFID-tag at the inside of the windshield. The readers on the roads are either installed under bridges, on overhead structures or on the roadside. The system can identify vehicles at normal highway speeds and greater distances unaffected by bad weather or dirt. ETC generally works with active RFID-tags being replaced more and more by passive tags. In 2004, the Georgia Tollway Authority switched to 915 MHz, 1024-bit read-write passive tags with a read range of 9.6 meters.

Payment can either be settled prepaid, by setting up an account and depositing money on it or the RFID-tags are linked to the subscriber's credit card or bank account. The second option makes it easier for a larger range and less regular payments. ETC also makes it possible to allow differential price strategies depending on time of the day and type of vehicle. If the system works with prepaid payment and the readers receive a signal from a tag of an over-due account or the tag was reported stolen, a picture is taken of the car by a surveillance camera.



Figure 10: Electronic Toll Collection. Source: Transcore

The toll collection system already in use, with cars being equipped with RFID-tags can be used for other applications as well. The parking industry can also benefit from it. With RFID-readers installed at the entrance and exit of parking garages a fast and cashless payment option for parking services is possible. This type of RFID-application is also called “Pay as you go” system (RFID Journal: 2003). In central Florida, the Orlando/Orange County Expressway Authority has started an RFID-based traffic monitoring system in late 2004. The system uses the already installed roadside readers and the about 1 million RFID-tags in vehicles to trace the travel time of individual cars passing the readers, calculating average trip time and publishing it to the public.

### **3.5.3. Medical Industry**

In the medical industry various different applications of RFID can be found. A big issue in the pharmaceutical industry is the problem of counterfeiting. According to the US Food and Drug Administration (FDA) counterfeiting of high-volume, high cost drugs represents 1% of the US market and up to 50% in less developed countries (IGD 2004, p. 20). Issues include not only the authenticity of pharmaceutical products, but in the domestic markets the refillment of used containers with counterfeit medicine, medicine being replaced by water and attachment of labels indicating wrong strengths of the medicine. Hundreds of recalls of drugs every year make a more effective trackability necessary to expediate the recalls.

Another application of RFID in the medical industry is the use of electronic pedigrees. They are secure records that document that a drug was manufactured and distributed under safe and secure conditions. The benefits are faster product recalls, detection and elimination of counterfeit drugs, the streamlining of processes and safer drugs for consumers. Information stored on such electronic pedigrees can be the product name, lot number, national drug code number, EPC and the purchase order under which it was shipped. In various states of the USA, such pedigrees are already required by law (IGD 2004, p. 20-22).

### 3.5.4. DoD (U.S. Department of Defense)



The implementation of RFID at the US DoD is similar to the one at Wal-Mart being one of the early adopters. The DoD required all new supply contractors after October 1, 2004 to deliver material equipped with RFID-tags beginning in January 2005. In the first phase of the implementation only specific classes of supply such as repair parts and components, clothing, packaged food and personal demand items shipped to the distribution centers in San Joaquin and Susquehanna were required to have attached RFID-tags. Through 2006 more and more classes and locations will be included and by 2007, RFID-tags have to be put on all shipping containers, palletized unit loads, exterior containers and UID item unit packs shipped to any DoD location (Wescon: 2004).

#### DoD's Draft Supplier Implementation Strategy

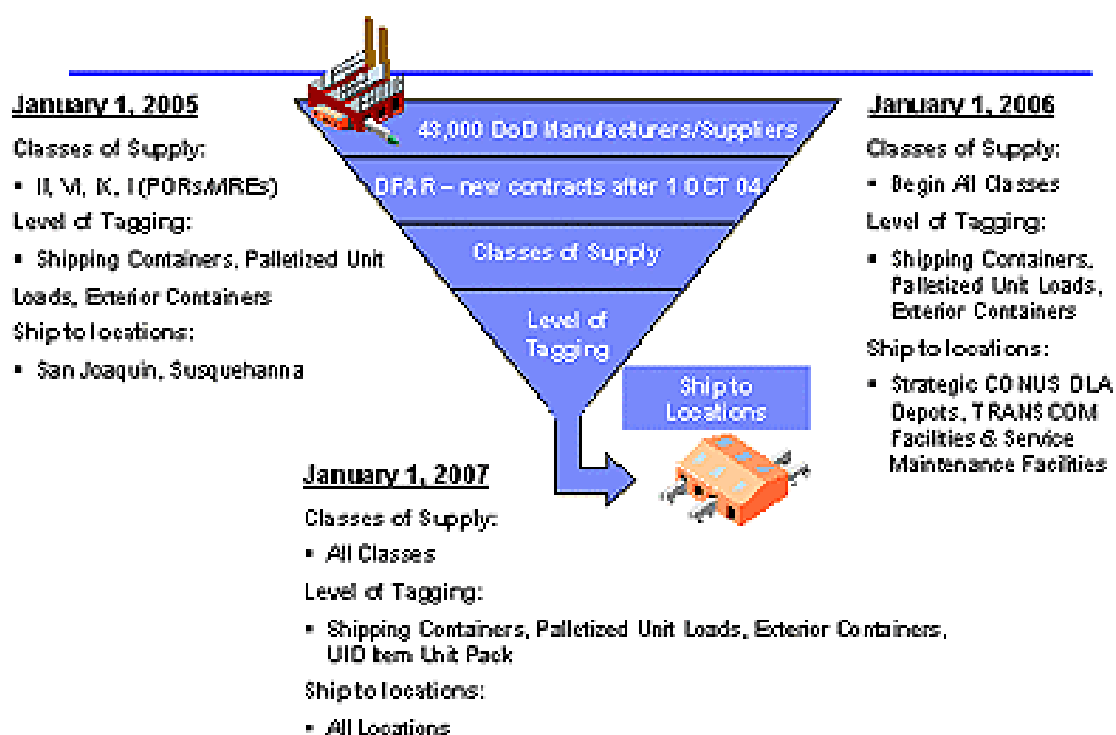


Figure 11: „DoD's Draft Supplier Implementation Strategy.

Source: IDEA (2004)

The implementation of RFID at the DoD is of great interest as it's supply chain is the biggest in the world and it has to serve completely different aims and tasks than conventional businesses. The DoD has more than 43,000 suppliers of differing sizes delivering from missile parts to clothes in comparison to more than 20,000 Wal-Mart suppliers ("Managing the EPC..": 2004).

Alan Estevez , the assistant deputy undersecretary of defense and responsible for the implementation of RFID at the DoD put it that way: "The way we fight has changed. We have to transform our logistics capabilities in order to meet that new way of fighting wars. RFID is a key component of changing logistics capability, of enhancing our ability to supply our forces" (IGD 2004, p. 25).

The DoD expects benefits in it's supply chain in inventory management, asset visibility and interoperability in an end-to-end integrated environment. It uses active, passive and semi-passive RFID-tags with EPC specifications and technology. The DoD relays on the 860-960 MHz frequency range with a minimum range of three meters. It was also waiting for EPC UHF Generation 2 tag specification and accepted the following tags until then:

- Class 0 64-bit read-only
- Class 1 64-bit read-write
- Class 0 96-bit read-only
- Class 1 96-bit read-write (DoD: 2004)

In order to inform suppliers and the public the DoD held one industry summit every year beginning in 2003 and has launched the website [www.dodrfid.org](http://www.dodrfid.org) that contains further information.

### **3.5.5. Skiing industry**

Skiing resorts and ski manufacturers are facing several challenges in this field of business. In order to check if a customer has paid his or her fees before entering the skiing area, access points have been installed where the individual skier has to push his ticket into a reader to pass the gate to the lift. The tickets used were very often magnetic

strip cards or cards with a barcode printed on it that is checked by a reader. For skiers this raises some problems because the card has to be fixed somehow to the clothes, found at the gate and entered into the reader. With all the wintersports gear on this task is very often tricky and exhausting. Another problem in skiing resorts is the growing number of ski and snowboard theft.

In terms of access control, RFID can help making lives of skiing customers easier and offer major developments for ski resorts in various ways. The former magnetic strip card or barcode equipped card is more and more substituted by a plastic card with an embedded RFID-tag. By paying a deposit, the skier gets the RFID-ski ticket and puts it in a pocket of his skiing overall. The skier can then pass the access point without having to push the card into the reader. Most of the newly sold overalls have a special pocket in the left sleeve which makes it even easier to pass the access point without having to press the body closer to the reader.



Figure 12: Access control with RFID-readers.

Source: SKIDATA

An implementation at an Austrian ski resort shows the many possible applications and advantages of such an RFID-ski ticket. The company SKIDATA implemented its SKIDATA™ Ski System in the Nassfeld / Sonnenalpe in Carinthia, Austria. Incorporated hotels, mountain huts, ski rentals, ski schools, cableways and similar service providers were integrated. The whole system includes internet booking or via WAP enabled mobile phones of the ski ticket and hotel room. The Off-site Point of Sale (OPOS) solution developed by SKIDATA allows the integration of third-party hotel management systems. Customers can buy their ski tickets directly at the hotel reception and also use it as their hotel room key. The RFID-ski ticket has an integrated electronic

purchase functionality that can be used to pay at ski rentals, ski lifts, bars, restaurants and alpine huts after loading cash in digital form on the ticket. Furthermore, all local businesses are linked via a RF network through over 40 transceiver stations connecting all the individual PCs to a central marketing server. The system is using both the 125kHz and 13.56MHz RF technology to have high system openness (SKIDATA: 2004a).

In order to make a halt to the increasing number of ski and snowboard thefts in ski resorts a joint project by the insurance and ski industry was formed in 2002 to use modern technology to fight this tendency. The project is called EC-Passage with readers being installed at ski resorts in Europe and North America. RFID-transponders (tags) with the serial number are integrated into skis and snowboards. The skis and snowboards are checked everytime they pass a reader by comparing the serial number through an online database with a list of equipment that was reported lost or stolen. Resort security is notified if a such equipment passes a reader (SKIDATA: 2004b).

### 4. Retail Supply Chains

#### 4.1. Definitions

In this chapter the author will draw a supply chain in the retail business and its processes and then show the changes that come along with an RFID-implementation in this industry. After the definition of RFID in the last chapter a further insight into the terms retailing and supply chain management will be given now and an approach of how to describe a supply chain.

“Retailing is the set of business activities that adds value to the products and services sold to consumers for their personal or family use” (Levy and Weitz: 2001;p. 8). Retailing consists of selling products and services, not only in stores but through different channels such as the internet, direct sales or catalogue sales. Retailers are the link between manufacturers and consumers of products and services.

Simchi-Levi et. al (2000: p. 1) define supply chain management as:

“... a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize systemwide costs while satisfying service level requirements.”

The Supply Chain Operations Reference (SCOR-)model allows us to give a general description of supply chains. The SCOR-model is a process reference model with a common set of definitions to describe any supply chain. It was developed by the Supply-Chain Council (SCC), which is a non-profit organization founded in 1996 with the aim to create “a cross-industry standard diagnostic tool for supply-chain management” (Supply-Chain Council: 2004a). As a management tool that stretches from “your supplier’s supplier to your customer’s customer” it is based on five distinct management processes which are “Plan, Source, Make, Deliver and Return” as shown in the following figure:



### SCOR is Based on Five Distinct Management Processes

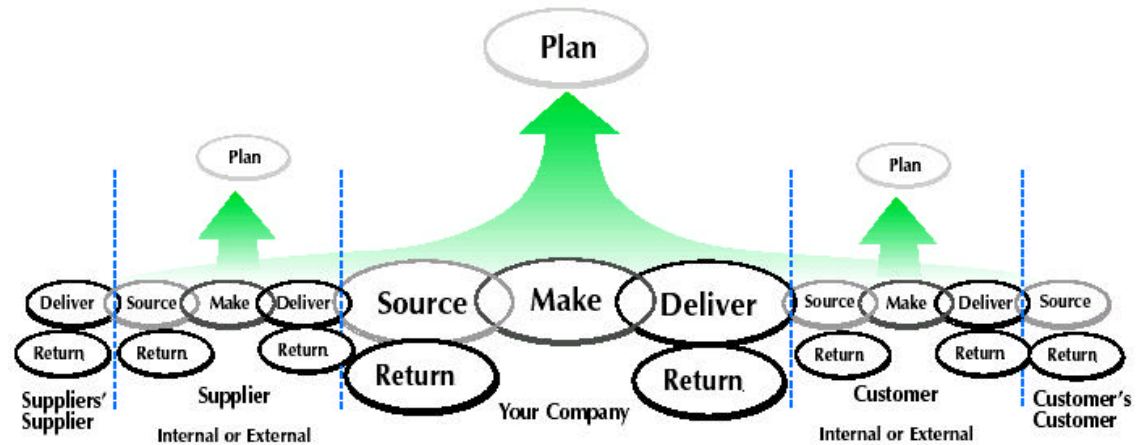


Figure 13: SCOR-Model.

Source: Supply-Chain Council (2004b)

Following this model, Meyr, Rohde and Stadler (Stadler, Kilger, 2002: p. 54-61) have identified a supply chain typology that helps to assess decision problems facing the supply chain. It is a special tool, mainly used for supply chain planning decisions to describe a supply chain by a set of attributes subdivided into categories. The functional attributes are grouped into four categories: Procurement type, production type, distribution type and sales type. The structural attributes are categorized into topography of a supply chain and integration and coordination. This typology was created in light of the manufacturing industry and has to be adapted to the retail sector as this is the main scope of the present research. The author nevertheless thinks, that the model presented here provides significant value to identify the important retail supply chain features that have to be evaluated facing an RFID-implementation.

## 4.2. Retail Supply Chain Typology

Retailers everywhere in the world are facing increased competition and an enhanced complexity in the supply chain. Global sourcing, internationalization of businesses and new technologies are changing the industry at an increasing pace and retailers have to find effective ways to manage their supply chain not only to stay competitive in the industry, but to survive.

A very significant change in the retail industry was the shift of importance from other entities in the supply chain to the retailers in the last decades and years. Formerly, retailers were the last entity with hardly any influence and importance. Nowadays, they

are the most important part of the supply chain without discussing the role of the consumers of course (Blackwell, 1997: p. 178). One important reason for this shift is the information advantage retailers have in comparison to their suppliers. Accurate sales data is generated at the store level of the retailer with information on every consumer and every transaction. An efficient supply chain has two benefits for the consumer: Fewer OOS and assortments of merchandise that consumers really want.

According to a study by the National Retail Federation (NRF) and IBM the challenges that retailers have to face nowadays are:

- Ever more demanding consumers are demanding for more service and information
- Strong competition in saturated markets makes it harder for retailers to create uniqueness and own strong brands
- The steady and fast development and implementation of new technologies creates chances as well as risks

A retail supply chain can not be easily defined and there is for sure not only one sample supply chain but many different ones adapted to the business operation of each retailer. The existence of thousands of supply chain paths from the manufacturer to the consumer makes it very difficult to grasp a picture.

As already mentioned in the previous chapter, the supply chain typology of Meyr, Rohde and Stadler allows a good framework to draw any supply chain and therefore the following figure shows the adapted model for a retail supply chain with its material and information flows. The retailer's part of the supply chain refers to a supply chain framework by Bonning et al (1998) in the article "The global retail supply chain" (Gattorna: 1998).

The functional attributes of a retail supply chain are categorized as follows:

1. Suppliers
2. Product Sourcing
3. Inbound Transportation
4. Processing

5. Storage
6. Outbound Transportation
7. Store Operations
8. Consumers

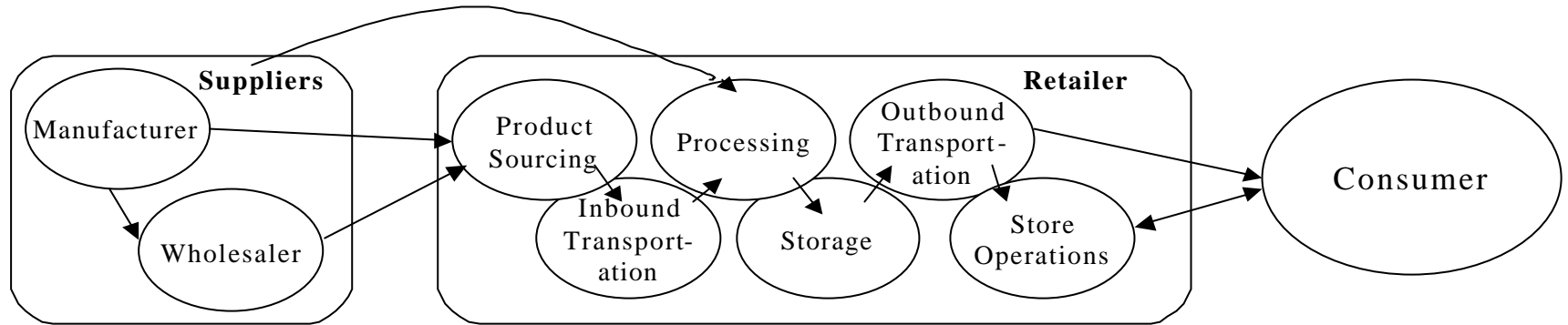
The structural attributes are still:

1. Topography of a Supply Chain
2. Integration and Coordination

Material flows in a retail supply chain can be explained as follows: Suppliers can either be manufacturer's suppliers, the manufacturers itself as well as the wholesalers and other intermediate stages. One of the three arrows describing material flows from the suppliers are the shipments of finished goods from the manufacturers or wholesalers directly to the distribution center (DC) of the retailer. The two arrows from those parties to the product sourcing signify inbound transportation done by the retailer himself. Once the products are in the retailer's possession they run through the internal echelons of the supply chain. From product sourcing and inbound transportation to the DC. There the products have to be processed and are either directly shipped on through outbound-transportation (cross-docking) or stored in the warehouse. Outbound transportation of the retailer can be carried out to the store and on to the consumer or directly to the consumer if the retailer is offering his merchandise through the internet or catalogue. The double-sided arrow between store operations and the consumers signifies the sales transaction and possible returns, warranty claims, recalls, returnable packaging etc.

Information flows in a retail supply chain are, as in many other businesses, essential for the success of a retail transaction. Most of the information is exchanged between the three major interfaces but also between every functional attribute in the supply chain. The three interfaces are the Retailer-Supplier-Partnership (RSP), the Distribution Center (DC) and the Point-of-Sale (POS). Information flows are mainly passed on backwards. POS-data has to be given on to the DC and the suppliers (through the RSP). The DC itself passes on information about it's stock level, future demand, etc. to the RSP. Furthermore, there has to be constant information exchange between the suppliers and the product sourcing operation of the retailer.

Material-flows:



Information-flows:

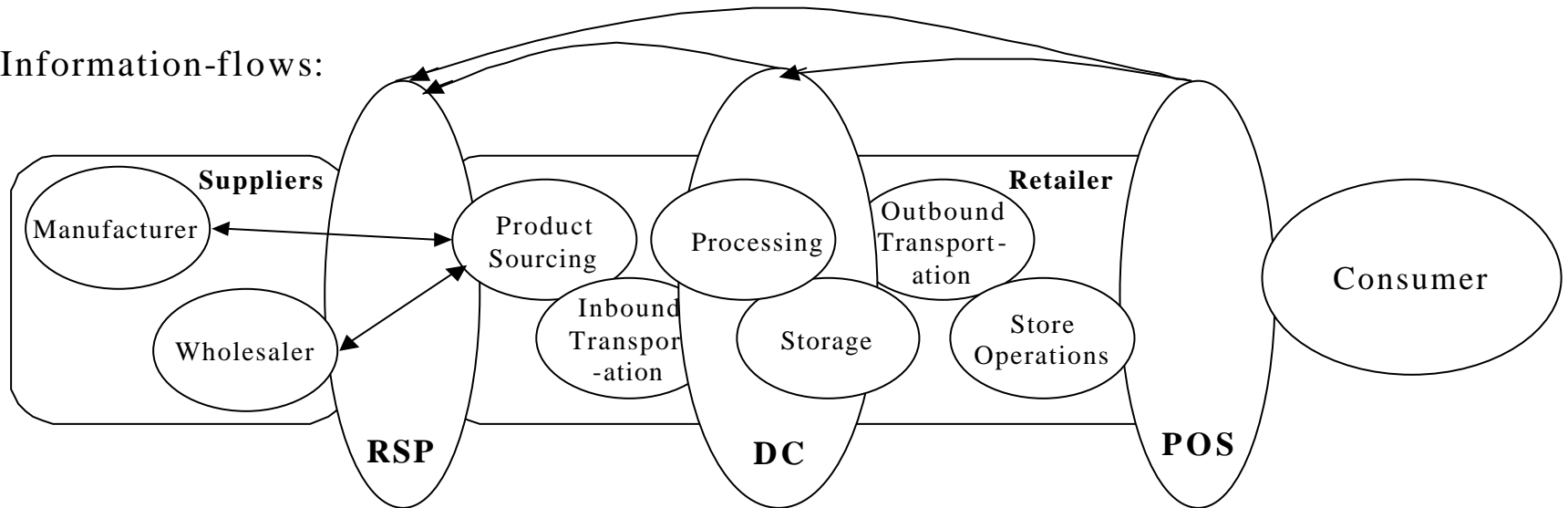


Figure7: Retail Supply Chain

Furthermore, those categories are divided by the author into attributes as follows:

<b>Functional Attributes</b>	
Categories	Attributes
Suppliers	Number and location of suppliers Flexibility of suppliers Power of retailers over suppliers
Product Sourcing	Sourcing type RSP-type Product Selection Life cycle of products Demand planning
Inbound Transportation	Inbound transportation structure Visibility and accuracy Control over inbound transportation
Processing	Distribution structure Operation method Vendor compliance programs
Storage	Inventory management
Outbound Transportation	Outbound transportation structure Outsourcing Loading restrictions Reverse Logistics
Store Operations	POS-data processing and availability Availability of future demands In-Store IT-devices Shelf management and replenishment
Consumers	Power of consumers Loyalty programs

Table 3: Functional Attributes of a retail supply chain typology

<b>Structural Attributes</b>	
Categories	Attributes
Topography of supply chain	Degree of globalization Bottlenecks
Integration and Coordination	Legal position Balance of power Collaboration IT-infrastructure

Table 4: Structural Attributes of a retail supply chain

### 4.2.1. Suppliers

The **number and location of suppliers** depicts the complexity of the supply chain and its internationalization. **Flexibility of suppliers** relates to the amount supplied to the retailers. Different possibilities in this respect can be fixed amounts, amounts with

upper or lower bound depending on the contract or they may be freely available. The **power of retailers over their suppliers** is important as of how easily a retailer can impose new technologies, practices or requirements upon the suppliers.

### 4.2.2. Product Sourcing

Considering the different strategies retailers are following sourcing is an integer part of their business activities as the acceptance of the merchandise by the consumer is crucial to the retailer's success. Sourcing describes "the method by which each retailer identifies, develops and maintains relationships with suppliers in order accurately to deliver the right product at the right price and at the right time" (Bonning et. al 1998: p. 241).

There are two basic approaches to the **sourcing type**. Branded products or private label. With **branded products**, the supply chain is mainly already defined with a close cooperation between suppliers and retailers. Suppliers have to follow the retailers operating procedures (Bonning et al 1998: p. 241). When a retail chain relies on **private label** it has to manage the whole supply chain on its own. This comes along with increased complexity especially for global business but lower prices for consumers.

Furthermore, if a retailer engages in massive **global sourcing** the complexity of supply chain management rises. Increasing liberalization and the opening of international markets will spur that development to more global sourcing in the future. Lost visibility and control of the retailer's supply chain would be the case. In addition, especially in developing countries, uncertainty would increase through poor infrastructure, security issues, sub-optimal storage facilities or export issues (Natarajan and Panchapakesan: 2004).

The relationship behind the sourcing types can also be identified as the **Retailer-Supplier Partnership or RSP**. It is evident that traditionally there was a lack of information between the retailer's demand and demand to suppliers from retailers. Furthermore, suppliers of course have more information on their lead times and production capacity than retailers have. In order to create a prosperous exchange of information, it is necessary to find a cooperative way of coordination. There are

different types of RSPs ranging from a quick response strategy, a continuous replenishment strategy to a vendor managed inventory (VMI) system.

In a **quick response strategy** point-of-sale (POS) data is given to the supplier by the retailer. Individual orders are still prepared by the retailer but the supplier can enhance its forecasting and scheduling to synchronize production and inventory activities with the actual sales at the retailer. In a **continuous replenishment** system, or rapid replenishment, suppliers also receive the POS data but ship the goods at previously determined intervals to keep a prearranged inventory level. It is also possible that the supplier might even be allowed to decrease inventory levels at the retail store to increase efficiency as long as service levels are met. The **vendor managed inventory** system allows suppliers to set the adequate inventory level and eventually manage it by itself taking away the work and responsibility from the retailer. The final goal of such a cooperation is that the retailer does not interfere anymore in supplier's replenishment decisions (Simchi-Levi, Kaminski: 2000).

**Product selection** varies widely among different retailers. There are retailers with megastores such as Wal-Mart offering one-stop shopping with a large variety of products or megastores with a specialization in one product group such as Home Depot, Best Buy or Saturn in Europe.

The management of **product life cycles** is very often a difficult task and therefore an important part of supply chain management for a retailer. Furthermore, the planning of seasonal products and promotional planning are related to product life cycle issues and complicate it even more. It is the **availability of future demands** and therefore demand planning as a key challenge in the sourcing stage for a retailer.

### 4.2.3. Inbound Transportation

The **inbound transportation structure** characterizes the mode and terms of inbound freight. The mode can for example be containers, truckload (TL), less than truckload (LTL) or air on prepaid or collect terms. In light of an ever increasing globalization of

the industry **accuracy and visibility** in the supply chain get more and more important as well as the **control over inbound transportation**

According to a study on “inbound supply-chain best practices” in the retail sector ordered by 54 US retailers with more than \$ 600 billion of sales, the main problems for retailers in the inbound transportation were considered as the following: The not-covering of the cost of capital by the retail industry which can be dealt with by speeding up cycle times and cutting inventory. Control over inbound transportation is also of great concern for retailers and “significant problems with the timeliness and accuracy of messages” occur. Big retailers such as Wal-Mart are enforcing their supply chain power to eliminate such problems but this “channel power” has its limitations (“Retailers in the Dark”: 2004).

#### 4.2.4. Processing

The **distribution structure** of a retailer describes “the network of links between the factory (warehouse) and the customer(s)” (Stadtler, Kilger, 2002: p. 57). In this respect, it refers to the types and number of distribution centers of the retailer. Furthermore, the location of the DCs depicts the distribution structure by differentiating the existence of central DCs or regional DCs or both.

In former times, value added services such as labelling, assorting, removing or modifying packaging and customer presentation, were a vital part of the retailer’s business. Nowadays, these processes are mainly moved to the suppliers and new **operation methods** such as cross-docking have revolutionized the distribution center. The complexity in a global supply chain to coordinate country specific requirements for labelling and presentation make **vendor compliance programs** necessary. These programs are mainly based on supply chain transactions (Bonning et. al 1998: p. 242).

#### 4.2.5. Storage

The service level is the fundamental issue in this respect. A high service level to keep shelves filled demands for sufficient inventory. However, new techniques such as quick



response, efficient consumer response (ECR), vendor managed inventory (VMI) and just-in-time supply and manufacturing (JIT) help to minimize inventory significantly. **Inventory management** is therefore of great importance but it does not only interfere in the warehouse but in many different operations of a company because it is defined as “the process of ensuring the availability of products through inventory administration activities such as planning, stock positioning, and monitoring the age of the product” (CSCMP:2005). Product availability is the main goal.

### 4.2.6. Outbound Transportation

The shipment of merchandise from the DC to the store or directly to the consumer can become a bottleneck and is therefore an important part of the supply chain. Every retailer seeks for efficiency in the coordination of outbound flows as the well-known “Last-Mile”-Concept can create high costs for every retailer.

The question for retailers is how to ship products from the DC to the stores. Different possibilities are the **mode of transport** such as LTL, or less-than-truckload shipments, or TL, truckload shipments, which are very often related to **loading restrictions**. Another decision is whether to use an own fleet or to **outsource** this task to carriers.

Another issue is **reverse logistics** which is a very specialized and complex part of every supply chain. It is defined as: “the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal” (Daga: 2004. p.3).

### 4.2.7. Store Operations

Store operations are the final stage in the supply chain where merchandise meets the consumer and a sales transaction is generated. Most buying decisions are only made in the store and that’s why it is a maybe the most essential part of the echelon to create success.

For retailers the important attributes in this part of the supply chain are the following:

The **availability and processing of Point-of-Sale (POS) data** is essential as accurate and timely information is needed to successfully manage store operations. It is not only the recording of the exact product, the amount and the price but new software to monitor much more information that can be processed to enhance operations. For example the analysis of buying behaviors - which product baskets are bought, at what time certain products are mostly sold, etc. - is only made possible with accurate POS-data.

Furthermore, the **availability of future demand** is significant for forecasting and the better management of product ranges, presentation of the merchandise and the planning of replenishment. **Shelf management and replenishment** has direct impact on sales. If a product is not available on the shelf, at least the consumer goods company will have lost sales or the retailer if the consumer goes to another retailer. In the worst case, both of them encounter lost sales as the consumer buys a rival product at another retailer's store. Replenishment practices in this respect go along with different RSPs with vendor managed shelves as one possibility of such a partnership.

**In-store IT-devices** will change the way shopping is done nowadays . Various possibilities to better present a product to consumers or to give them further information about the product is feasible with new technologies. Kiosks, multimedia displays, mobile devices, monitoring gates are only some examples.

### 4.2.8. Consumers

Concerning the interaction of the retailer with the consumer the **power of consumers** has to be considered to see the dependency on each other. If competition is really tough and consumers can easily go to other retailers and do the same shopping there, retailers have to listen much more to their consumers. They can not introduce new technologies or selling techniques without the acceptance of them. A certain size and (information) power of the retailer makes an implementation of course easier.

In terms of **loyalty programs** the industry goes different ways. Some retailers rely on such programs with loyalty cards and the tracking of the shopping behavior of each

single consumer. Others see it as a further cost-burden with not enough potential to increase customer service.

### 4.2.9. Topography of supply chain

The **degree of globalization** of a retailer defines the complexity of the business and its interdependence on international market changes. Globalization in this respect relates to the internationalization of store operations. A retailer can either have only one company on the home market but can also do business internationally through subsidiaries or major stakes in foreign retailers.

**Bottlenecks** in a retail supply chain are creating the problem of Out-of-Stocks (OOS). Special sales and offers, hardly any availability of POS-data, the unclear stock level in the store's backroom as well as bad production planning of the manufacturer can lead to OOS. This bottleneck in a retail supply chain can be named visibility.

### 4.2.10. Integration and Coordination

The **legal position** of entities in the supply chain defines if an inter-organizational or intra-organizational supply chain exists. If the entities are legally separated it is an inter-organizational supply chain with the result that it is more difficult to coordinate flows centrally than in an intra-organizational one.

The **balance of power** in an inter-organizational supply chain is important in terms of decision making. A supply chain, where the entities are equal, is called polycentric in contrast to a supply chain with a dominant member which acts as a focal firm.

**Collaboration** in the supply chain is of great importance for success. Information exchange upstream as well as downstream are especially in retail business essential to prevent from out-of-stocks.

## **5. Examples of retail supply chain typologies**

In order to analyze in the best way how RFID changes retail supply chains and what the essential parts of a supply chain for a successful implementation are, this chapter describes some different retail supply chain typologies. It is important to note that different retail concepts exist that do have some rather contrary characteristics. There are huge differences between discount retailers and traditional supermarkets, between hypermarkets and convenience stores as well as between bookstores and hardware stores. To be able to grasp a more comprehensive picture, the following three examples of retail supply chain typologies will show the important differences in characteristics.

### **5.1. Discount retailer**

Discount retailers are selling all kinds of merchandise at lower price margins than other retailers. The key concept of such retailers is the price. By buying large quantities of goods the retailer can obtain a lower price and passes the savings on to consumers.

Two types of discount retailers can be distinguished. The hard discounter or limited line discounter and the soft or extended range discounter as one can see from the following table:

<b>Attributes of different discount retailers</b>	
<b>Hard discounter</b>	<b>Soft discounter</b>
Limited product range (under 1,400 lines)	Extended product range (1,400 – 7,000 lines)
Exclusive own labels	
Small stores (less than 1,000 square meters)	Larger Stores (1,500 square meters)
Use of limited availability non-food items	Fresh, chilled, frozen ranges
Basic and functional store environment	Better presented store environment
Low staffing levels	
Can account for 75% of a normal shop	Can account for 90% of a normal shop

Table 5: Attributes of different discount retailers. Source: IGD quoted in “European Retail Digest, Issue 38, Article 15”

In Europe, German discount retailers are dominating the market with 4 of the leading seven discount retailers coming from that country. The hard discounter concept is dominant in Europe as German discount retailers rely on that concept as rapid store development and economies of scale are easier to reach through the low cost, restricted assortment, hard discount model (European Retail Digest, Issue 38). Examples of hard discounters in Europe are Lidl, Aldi and Netto and soft discounters are Penny and Plus.

The **number of suppliers** is usually smaller than of normal retailers as the number of SKUs is also significantly smaller. But as discount retailers very much rely on private label or no brand name products the **power of retailers over suppliers** is higher. Discount retailers don't change their SKUs as frequently as other retailers which gives suppliers a better chance to plan and forecast. Flexibility of suppliers has of course to be high but does not have to meet the very high requirements from normal retailers that change their SKUs frequently.

In terms of **product sourcing** the **sourcing type** of discount retailers is in so far different to normal retailers as the percentage of exclusive private labels exceeds 90 per cent in the hard discount and about 50 per cent in soft discount (Colla: 2003). This is a very high percentage. In general, the difference in various country markets may be significant as the private label percentage is at about 40 per cent in Germany in general and only at 11.5 per cent in Austria in foodstuffs ("Diskont-Supermärkte erobern Österreich":2005) but the percentage of private labels at discount retailers is significantly higher than at normal stores.

**Purchasing power** is an important factor of success for a discount retailer because it has to be able to purchase a large amount of products at very low cost in order to achieve such big price differentials on the shop level in comparison to normal retailers. Own label management is therefore of great necessity as discount retailers are trying to save costs by offering the highest percentage of cheap private labels or by purchasing large volumes of exclusive products without any manufacturers' proprietary brand name. They are then saving on marketing costs.

The **product selection** is much smaller at discount retailer. As one can see from table 5, hard discounters have up to 1,400 items in the shop and soft discounters about 4 times more which is still a not a big number as in hypermarkets the number of products in stock can be as many as 70,000. This gives discount retailers the possibility to better forecast and organize **demand planning** in a more efficient way. Furthermore the **life cycle of products** can be easier managed as the number of product variations is lower and inventory turnover is higher.

**Inbound transportation** is rather simple at discounters as the number of SKUs is smaller and only a small number of suppliers ship products to those discounters. As the volumes to be shipped to the retailers are high, most of inbound transportation is done in TLs. The retailers don't spend much money on **visibility and accuracy** and **control over inbound transportation** yet as the structure is simple and the distance to suppliers is very often rather short.

In terms of **processing** and **storage** discount retailers stick to their strategy by having a low-cost logistics and operational system. The lack of promotions or special sales ensures constant demand and easier forecasting for suppliers as well as the retailer. At Aldi 90% of the product volume going through the warehouse is cross docked and the inventory turnover in stores is one week ("Aldi in Australia:.." 2000) which shows the lean logistics concept.

**Outbound transportation** is usually done directly by the retail chain with an own fleet of trucks through the warehouses. Aldi as an example, delivers 100% of its items, including milk and bread from its warehouses eliminating direct store delivery and suppliers don't have to run regional warehouses ("Aldi in Australia:.." 2000).

**Reverse logistics** are held to a minimum. Hard discounter very often don't sell products with reusable packaging that have to be taken back by the supermarket. In a classical hard discounter consumer will not find beverages in bottles where a deposit is retained.

In their **store operations** discount retailers concentrate on simplicity and the lowest possible costs. That's why one will not find any **in-store IT-devices** in a discount store. **Shelf management and replenishment** is also kept rather simple. As the product is displayed in the shipping box or on the pallet, handling is reduced and total

replenishment time per item can be minimized to 2.83 seconds at Aldi. As the pallets or transport units are brought to the sales floor by the truck driver, labor is reduced and backroom inventory and restocking is nearly totally eliminated (“Aldi in Australia” 2000). In terms of **POS-data processing** hard discounters such as Aldi relied on manual checkout operations with the employees memorizing the about 600 SKUs prices. This lead to an average of 42 items/minute at the checkout in comparison to 15 items/minute in normal supermarkets (“Aldi in Australia” 2000). Some discount retailers put more sophisticated new technologies into place now to reap the benefits of such new technologies.

At discount retailers the **consumer** has a special role. Hard discount is very often said to go along with inconvenience. Consumers visit the store in addition to normal shopping just to save 30-40% on some items. This does not necessarily have to be the fact for every consumer and every hard discounter but it shows how low the **power of consumers** in this type of retailing is. Lidl could be named as such a retailer who does not yet adapt to the consumers wishes in every detail in contrast to Aldi Süd (Hofer in Austria) who offers a wide range of products considered to be of a high quality with a high reputation at consumers. Discount retailers usually don’t offer **loyalty programs**.

The **degree of globalization** at discount retailers varies a lot. Some hard discounters such as Aldi, Lidl and Netto do have a strong international presence whereas soft discounters such as Plus or Penny only have limited international activity. A generalization can not be made.

The **balance of power** is definitely on the side of discount retailers, companies in the supply chain are **legally** seperated but practices among the different retailers do vary a lot. Aldi is actively working on a collaborative basis with suppliers, the company has a reputation of “straight dealing” as the prices are fixed once and neither the supplier nor Aldi is allowed to change those prices afterwards anymore. To have a strong position in negotiations discounters tend to preferably buy from small manufacturers but together with Aldis fair practices and huge sales volumes those suppliers can grow significantly. Nevertheless Aldi wants to stay independent from suppliers and does not allow them to wholly depend on Aldi. **Collaboration** with suppliers can be seen from the example

that Aldi works closely together with suppliers to create new own-label products that are cheaper to transport, stock and sell (“Aldi in Australia:..” 2000).

The following figure shows a visualization of the typology of a discount retailer’s supply chain. The power of retailers over suppliers is very high but the number and average value of SKUs is very low. Most of the discount retailers do have an own fleet of trucks. In-store IT-devices are not part of the strategy of a discount retailer as well as loyalty programs. The power of consumers can be mentioned as rather low.

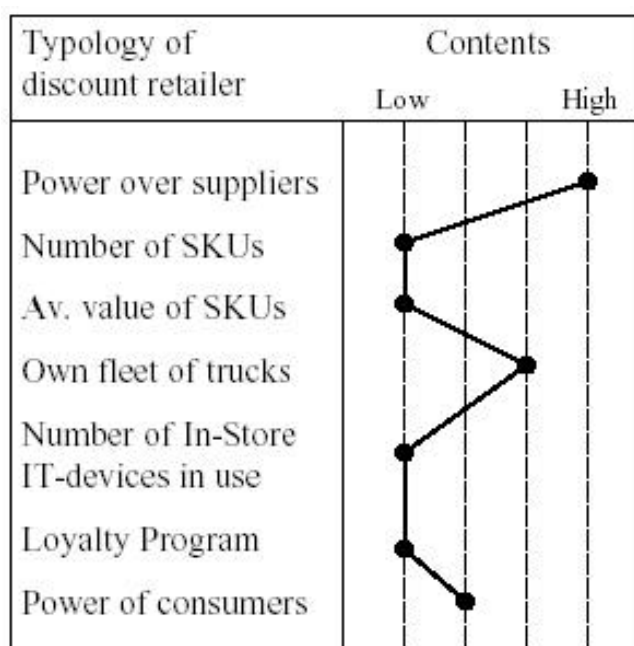


Figure 14: Typology of discount retailer

### 5.2. *Hypermarket retailer*

By definition, a hypermarket (which derives from the french word hypermarché) is a combination of a supermarket and a department store. It is a huge retail facility offering a wide range of products including fresh groceries and apparel. The aim of a hypermarket concept is that a consumer can satisfy all his routine shopping needs in one trip to a hypermarket (www.answers.com). Some sources state that the minimum sales floor space is 5,000 square meters.



To give examples, a typical French hypermarket has a sales area of about 5,800 square meters (average in 2004) with about 3000-5000 food products and up to 35000 non-food products in stock. Hypermarkets are characterised by huge parking facilities in front of the store and further service providers such as travel agencies, jeweller's, bank services, petrol stations and more ("Retail Distribution in France":2004). As examples of hypermarket concepts the two biggest retail chains in the world can be named: US. Wal-Mart with its supercenters and french Carrefour, the founder of the first hypermarket in 1962 near Paris.

The **number of suppliers** of hypermarkets is high and the **location** of them can be widespread. **Power of retailers over suppliers** is as high as it is with other retailers. **Suppliers** have to be very **flexible** as retailers might demand from suppliers to ship to single stores on short notice.

### **Product Sourcing:**

**Sourcing type:** In France in 2004, the proportion of private labels in hypermarket sales was about 25-30 per cent of total sales ("Retail Distribution in France":2004). It was especially competition from discounters that made hypermarkets launch more private labels.

As already mentioned before, the **product selection** at hypermarkets is very diverse and high. The number of food and non-food SKUs is very often about 30,000 to 70,000. Interestingly, it is common that each hypermarket has a great autonomy on purchasing. Buying decisions are very often made by individual store buyers ("Retail Distribution in France":2004). Especially local food produce is individually purchased by every hypermarket.

### **Inbound transportation:**

Hypermarkets are very often supplied directly from suppliers. This is made possible as a hypermarket retailer has huge sales rooms and high sales figures. The chains still run warehouses but a great amount is supplied directly.

### **Store operations:**

Although hypermarkets, other than discount stores, want to offer convenience to its consumers, the nice and pleasant shopping experience, as the concept is based on one-

stop shopping, is hardly achieved. The nice shopping atmosphere is not offered as the sales room area is very huge and the store itself can very often be mistaken with the store's backroom.

**Processing and storage** is mainly done in warehouses although a huge amount of storage is shifted to the hypermarket itself. As the stores are very often supplied directly by suppliers and the storage space is high – very often right over the products promotions. As already said, some **outbound transportation** is done by the suppliers but the hypermarket retailers usually have an own fleet of trucks as well to supply their stores.

### **Store operations:**

Hypermarkets run a huge number of checkouts to offer best service to their consumers. **POS-data processing** is done by traditional checkouts but many hypermarkets implement self-checkouts and other technologies to increase the shopping experience and offer better service. In some departments of the store as in consumer electronics **in-store IT-devices** are already in place in order to provide the same service and convenience as in consumer electronics stores.

**Power of consumers** is getting higher as competition gets tougher and hard discounters are more and more challenging the hypermarket concept. In various markets of the world such as the U.S., the UK and Australia, where the two leading discounters Aldi and Lidl are aggressively penetrating and shaking up the market hypermarkets will see a lot more competition and danger coming from those retailers. **Loyalty programs** are in place in most hypermarket chains such as Carrefour, Tesco, Safeway etc. although a generalization can not be made.

The **degree of globalization** of such hypermarkets is rather high as such stores supply a huge area, competition in a market is tough and economies of scale are important. That's why many hypermarket retailers expand their business abroad. The **entities** are usually **legally separated** and **balance of power** is on the retailers side.

To summarize the typology of a hypermarket retailer figure 15 shows that power of retailers over suppliers is very high. The number of SKUs in a hypermarket is huge

although the average value of the SKUs is rather low. Most of the hypermarket retailers own a private fleet of trucks and due to the concept of those retailers, In-Store IT-devices are in use in some departments of such a hypermarket. Many hypermarket retailers do have loyalty programs but the power of consumers is relatively high as competition is fierce.

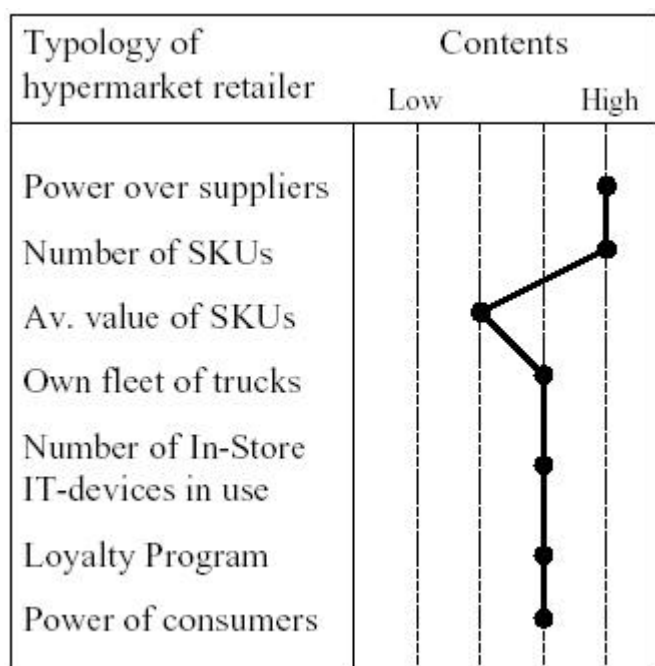


Figure 15: Typology of a hypermarket retailer

### 5.3. Consumer electronics retailers

Consumer electronics retailers are selling products like televisions, DVD players, audio systems as well as home office products such as computers, telephones, copiers. Furthermore entertainment software like CDs, video games and DVDs and appliances such as microwaves or vacuums. These retailers are facing special issues as a high rate of theft, high rates of returns/exchanges and big competition from music discounters as well as online music piracy.

The consumer electronics manufacturing industry has changed significantly in the last years with more and more big players entering the market. Companies such as Hewlett-Packard, Intel and Dell are entering this for them rather unknown field as the opportunities are high and market entry barriers are low.

This paper will now show the typology of a supply chain where consumer electronics goods are manufactured and sold. First, the functional attributes of a retail supply chain are categorized and after that, the structural attributes:

### Suppliers

**Number and location of suppliers:** Electronics products are to a great percentage produced in Asian countries nowadays and that's why most suppliers of electronics retailers are from that region of the world. The location of manufacturers in low-wage countries in Asia makes the supply chain more complex. Some manufacturers have been producing products for different companies where the brand name was attached to the product only in the last stage. As already mentioned, competition in this field gets tougher as big players penetrate the market nowadays who want to take an advantage of those rather low market entry barriers. They can perfectly take advantage of their established brand name from other fields.

**Flexibility of suppliers** has to be and therefore is rather high as there are many different manufacturers under strong competition. **Power of retailers over suppliers** is as high as in other retail businesses. Manufacturers have to keep up with the retailers' requirements.

### Product Sourcing

**Sourcing type:** The industry is still dominated by branded products. Because of high competition and low profit margins deriving from an optimized, outsourced production. It is very unlikely that existing retailers in this field will start with private-label products in the way food retailers did although some discount retailers already started to sell private-label electronics products. The industry is characterized by massive global sourcing.

The **Retailer-Supplier Partnership** has to be strong. Many retailers in this field rely on direct-import strategies, thus sharing information with their suppliers and working together with them in terms of product development is fundamental. Product tracking and tracing also gets more important to retailers, that's why suppliers, or their forwarding companies have to offer these services.

**Product selection:** Formerly, electronics retailers such as Best Buy relied on the practice to ship the same amount and type of products to all of the stores. Nowadays, retailers realize that the demographics and the demand are different for each location. In this respect, supply chain visibility is of great importance for electronics retailers as they can create a more optimized assortment for each store

The **life-cycle of products** is also relevant in the consumer electronics supply chain as the innovation level is high, strong competition is given and the products are mostly of high-value. This makes it necessary to manage the product's life cycle cleverly. For the same reasons as just mentioned **demand planning** is essential in this business. New innovations and very demanding consumers make it one of the key areas to focus on for the whole industry.

**Inbound transportation** in this field can be effected in any of the possibilities such as containers, truckload (TL), less than truckload (LTL) or air, depending on the product and it's value. **Visibility and accuracy** as well as **control over inbound transportation** is necessary because of the high-value of products.

### **Processing**

In the consumer electronics field the concept of Merge-in-Transit (MIT) is used more and more. MIT is the consolidation of shipments. Multi-component orders from various sources are brought together for final delivery as a single, complete order. For retailers, this means a further push upstream of inventory in the supply channel. Furthermore, it simplifies tracking of the shipments and creates faster cycle times in processing in the DC. It decreases inventory, warehousing and administration costs (APLLogistics: 2005). Cross-docking is widely used in this field and vendor compliance programs are of absolute necessity.

**Storage** considerations in the consumer electronics field are of great interest for retailers as the majority of products is of high value. **Inventory management** is therefore essential to keep costs down. Furthermore, with new regulations on financial reporting, namely Basel II and Sarbanes-Oxley in the United States it gets more important for any company to keep inventory and capital commitment low.

### **Outbound Transportation**

As already mentioned, in the consumer electronics industry all kinds of **transportation structures** can be encountered. For outbound transportation, LT-shipments are very common in either store deliveries or direct-to-customer deliveries. The big retail chains rely on own truck fleets as well as **outsourcing** of such services. The importance of **reverse logistics** in a consumer electronics supply chain mainly focuses on warranty claims and return of goods with the consumer being obliged to bring the invoice together with the product back to the store. With the use of new technologies such as RFID this could be simplified to a great extent.

### **Store Operations**

**POS-data** is collected by the means of barcode scanning. The data is available but yet not accessible in real-time and accurate. As a consequence, the **availability of future demand** is likewise not given either. A big problem concerning the check-out process in consumer electronics stores is theft. Employee- as well as consumer theft is a major issue and the industry is constantly searching for security in this field. This is either done by better in-store surveillance or anti-theft measures.

**In-store IT-devices** are not yet widely in use in this field except for info-terminals to listen to CDs. For consumer electronics retailing, a lot of innovations and developments are possible to increase the consumer's shopping experience and convince him or her of the products features.

### **Consumers**

The **power of consumers** is very high as the huge number of consumer electronics manufacturers and retail chains gives the consumer a broad range of choice. Mainly discount retailers are shaking the market as they offer no-name or private-label

consumer electronics products to a low price. This is possible through their high sales volumes and simple distribution structure. Brand name manufacturers can never beat that price and consequently rely on value-added services to attract consumers. As in other retail operations **loyalty programs** are used by some retailers to better track consumer behavior although there would be still a lot of potential in this field for consumer electronics retailers.

Contents of the structural attributes **topography of a supply chain** and **Integration and Coordination** are the following: The electronics products supply chain has seen huge developments into **globalization** in recent decades. The possibility of global sourcing and the easier relocation of production sites lead to a tremendous internationalization of the industry and its companies. **Bottlenecks** can therefore still occur and lead to OOS.

The supply chain of consumer electronics products can be described as an inter-organizational one with the entities being **legally separated**. The **balance of power** lies on the retailer side as it is widely the case nowadays in the retail industry because of the information advantage of the retailers. Yet, **collaboration** with suppliers is key for success in many different respects.

In figure 16 one can see that consumer electronics retailers do have only limited power over suppliers as mentioned before. The number of SKUs is low but the average value is very high. As the practice of DSD is common, the content “own fleet of trucks” is estimated rather low. The number of in-store IT-devices in consumer electronics stores is high and many retailers do have a loyalty program for their customers. As competition is really fierce, the power of consumers over the retailer is also rather high.

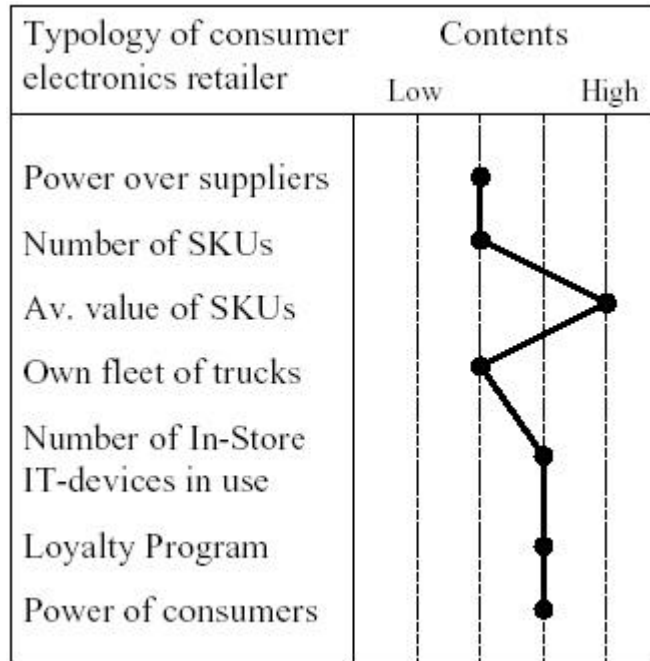


Figure 16: Typology of consumer electronics retailer



### 6. Changes in the retail supply chain through RFID

RFID changes retail operations in many different ways. The following figure shows how a big international retailer sees opportunities of RFID in his supply chain.

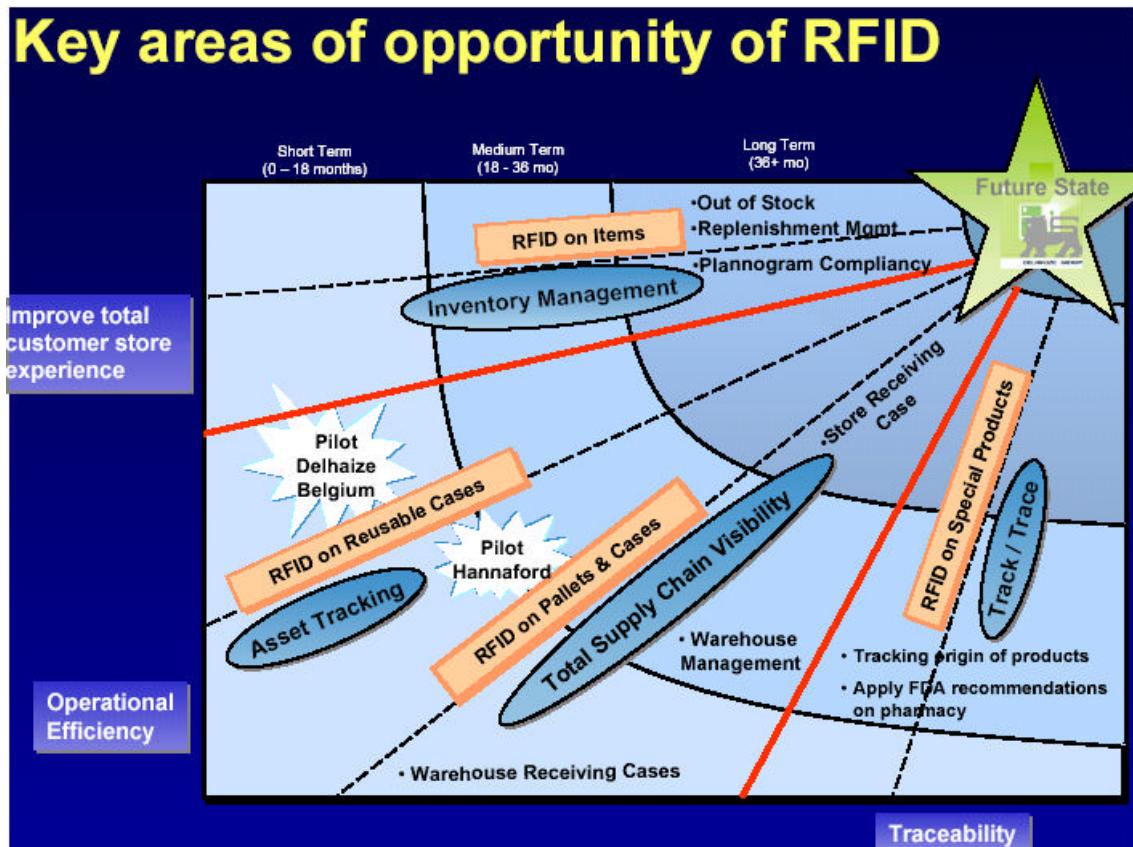


Figure 17: Key areas of opportunity of RFID.

Source: Delhaize

#### 6.1. Suppliers

In terms of **flexibility of suppliers** with their deliveries to the retailers, RFID makes sales data much more accurate and forecasts by the manufacturers can be made more easily. This increases the flexibility of suppliers helping them to better organize their manufacturing facilities and improve the service level to the retailers. Just-in-time production is made easier and the number of faulty deliveries to the retailers is reduced. The cost of expensive product recalls is diminished as faulty deliveries can be faster identified and taken from the shelves efficiently. At an RFID-implementation, the **power of retailers over suppliers** is of some importance as major costs accrue mainly for suppliers. The whole RFID-infrastructure comprising readers, IT etc. leads to high

costs. Furthermore, testing in general and the pilot phase afford big contributions of labor and money by suppliers. Another huge cost factor is the tagging of the products, considering RFID-tag prices which are still rather high at the moment is a big cost burden. Especially for smaller companies supplying to retailers those costs are really significant and might threaten their existence as they already calculate at low profit margins.

If the **number and location of suppliers** will be influenced by the use of RFID is not yet clear. Obvious is, that a big number of suppliers spread all over the world makes an RFID-implementation far more difficult mainly in terms of communication.

### **6.2. Product Sourcing**

Considering the **sourcing type** it does not make a big difference if a retailer relies on his own private label products or if he only sells branded products. Either supply chain has to comply with the mandate and will adapt its business processes. In terms of global sourcing other issues have to be looked at. An RFID-implementation requires constant and extensive communication and interaction between retailer and supplier. It can be much more difficult to interact with international suppliers and have them comply with the mandate. Primarily Chinese suppliers have to be watched closely as business operations might not be on an international level yet. They ship substantial amounts of products to retailers all over the world and become more important especially for discount retailers.

**Retailer-Supplier Partnerships** have great potential to evolve in light of a RFID-implementation. Strategic alliances between retailers and suppliers have become more important over the last decades and together with RFID there is potential for a further step on the way to a cooperation with unconfined trust. Given the existence of real-time inventory data in an RFID-based retail supply chain as well as instant POS-data and nearly permanent visibility of the goods it is possible to reach the highest cooperative stage in a RSP. EDI can be developed to its best with RFID by decreasing data transfer time and entry mistakes.

It is of course essential that the former problem of the top management keeping information confidential is eliminated. Otherwise, there is no chance of reaching the end of the partnership spectrum. Trust is the key word in this respect as an alliance is doomed to fail if trust is not given. The highest stage of a RSP ought to be vendor-managed inventory (VMI) as it is considered today. In a VMI system the supplier himself decides on the appropriate inventory levels and on the inventory policies. Intra-organizational change might occur as power is shifted from the marketing and sales department to the logistics department. The reason thereof is that daily contacts of the marketing and sales personnel with the supplier is substituted by the logistics personnel (Simchi-Levi, Kaminski: 2000).

In a more futuristic approach, logistics experts sometimes speak of an even further development of a RSP. They think of vendor-managed shelves. Suppliers buy the shelves and equip stores with them and fill them up. When item-level tagging becomes due, the readers on every shelf report the exact amount of products available on the shelf. Together with exact information on how and where the products are at the very moment in the supply chain total visibility is given. It is possible to only make this information available to that supplier of the products. He is then responsible to watch every supply chain echelon of this product. This goes from demand forecasts, analysis of POS-data, shipment of the products, managing inventory levels to managing replenishment. It is uncertain if retailers will be willing to give this huge amount of information and the associated power of it out of hands but in view of the ongoing effort of retailers to reduce operating costs it could be a possible development.

The next attribute of a retail supply chain that this paper looks at is the **product selection**. It is clear that now in the early phase of adoption of RFID in the retail business, certain products are better suited for RFID-tagging than others. High value, low amount products do have an advantage in this respect. The higher price and profit margin makes the cost of RFID-tagging less significant and the increased danger of theft of these products can be eliminated through RFID. Certain products are still more difficult to equip with an RFID-tag as they have a metall packaging or contain a high amount of liquid.

It is therefore possible to say that certain retailers, such as consumer electronics retailers with a low amount of products of high value would profit from a such an implementation faster than other retailers. This is valid for item level tagging. The first phase of RFID-implementation on case- and pallet-level might create enough value even for other retailers. With substantially decreased prices, international standards and item-level tagging, constraints will be gone and RFID-tagging a significant benefit for all retailers.

Together with better visibility in the supply chain, it will be easier to manage the **life cycle of products** and the planning of seasonal products and promotional planning will be facilitated as information is more accurate and in real time. The same is true for the **availability of future demands**. With a loyalty card it is much easier to record and analyse shopping habits and behavior. Together with POS-data captured through RFID, shopping basket analysis can be made in a much simpler way than before also without a loyalty card. This helps the retailer significantly with making demand forecasts.

### **6.3. Inbound Transportation**

The **inbound transportation structure** generally varies within each retailer. It is not of great importance how inbound freight arrives at the retailer as every packaging unit from container to case and even single unit can and will be equipped with RFID-tags. It is mainly **visibility and accuracy** of shipments in the inbound transportation that benefit from RFID. When the shipments are received in the distribution center or already in the store if it is a direct store delivery (DSD), the process of checking all incoming pallets, cases and maybe even products is very labor-intensive and ties employees to the receiving process who could serve consumers in the store. Pallets and cases tagged with an RFID-chip will be recorded automatically through a reader and the accurate inventory is communicated to the store inventory system (Auto-ID Center 2003, p. 8). **Control over inbound transportation** will increase with RFID as the technology perfectly enforces tracking and tracing and retailers as well as suppliers can better monitor shipments and inform consumers on when exactly the shipment arrives in the store.

### **6.4. Processing**

**Operation methods** in the distribution center like cross-docking or other operations can be simplified through RFID as line-of-sight scanning of barcodes is not necessary anymore. Even on conveyor belts at high speed it is possible to read RFID-tags and accelerate processing of shipments. Through **RFID vendor compliance programs** are enlarged by the requirements for the RFID implementation. They therefore get indispensable.

### **6.5. Storage**

The process of **inventory management**, as it was defined in chapter 4.2.5. has the function to ensure product availability through activities such as planning, stock positioning and the monitoring of the age of products (CSCMP:2005). All those activities are eased with the implementation of RFID-technology in warehouses and DCs. Monitoring of the age of products at item-level tagging in the store is made possible through readers in the shelves. In the warehouse (and on the store level) even the temperature of products can be monitored through RFID-readers in the warehouse and at entry- and exitgates. The evolution of data accuracy and availability in terms of demand planning also helps with warehouse operations. Stock positioning gets more scientific as more data is available to better organize this operation.

### **6.6. Outbound Transportation**

Concerning transportation of merchandise from the DC to the store RFID helps to control that the arriving goods match the order in a less labor- and time-consuming way. If outbound transportation is **outsourced** advanced cooperation with the carrier is necessary as tracking and tracing of the goods has to be possible. The carrier therefore has to equip his trucks with RFID-tags or GPS location systems to know the position of the truck at any time.

Outbound transportation is very often combined with inbound transportation. As already mentioned in chapter 6.3. it is not of great importance for RFID how the products arrive in the store or at the consumer. There are of course trends that dominate the **outbound**

**transportation structure** in the industry. To reduce costs in this process of the supply chain time-specific deliveries are of great necessity. Some retailers have chosen LTL-carriers to ensure complete on-time delivery within a short time-window. To optimize labor management in the store level a nearly 100% certainty of when the shipment arrives helps to allocate store labor in the most effective way. With RFID, this development will go on even further as the increased visibility in the supply chain makes it easier to predict when the products arrive and the allocation of labor can be better managed (“Windows of Opportunity”: 2003).

**Reverse Logistics** is an integral part of nowadays business. RFID first of all brings benefits when attached to transport units to better manage their flow. It is very often the case that those sometimes very expensive transport units get lost or stolen somewhere in the supply chain and it is not possible to track where exactly that was and who will have to bear the costs. Another benefit of RFID helps consumers when they have warranty claims or want to exchange products. With the attached RFID-tag on the product the whole history of the product with the date and location of purchase is recorded making it redundant to bring the sales slip.

### **6.7. Store Operations**

Not only easier control of arriving products is an advantage of RFID on this level but also the transport of goods from the store’s backroom to the sales room. The goods flow system, in which the products are registered upon arrival identifies the products as “transported in the store”. On the store level RFID-tags on higher-priced products that are a primary target of shoplifters like CDs and DVDs serve as theft prevention.

**POS-data processing and availability:** With new technologies such as data mining the amount of data that can be stored and the quick accessibility is increased significantly with RFID. The further advanced and faster accessibility of POS-data through RFID helps analyzing consumers’ shopping habits with interesting results. Analysis showed for example, that during 6.30 and 8.30pm the purchase of wine together with babies’ nappies in supermarkets was rather high. Young parents at home with children called their partners to pick up nappies on the way home from work. Through further analysis,

it was found out, that those consumers were very likely to pick a bottle of wine at the same time. Retailers who have such information can place special offers of wine next to the nappies section or the other way around and target those consumers with special promotions (Quarrie and Hobbs: 1997, p.33).

Within the retail store RFID on item-level will have major impacts on how retailers conduct business in the important part of their operations where the consumer is served. Especially **In-Store IT-devices** will change the way of shopping with RFID. Some examples of such devices are listed below:

Kiosks, such as product information displays, help consumers with their buying decisions, gather information and use self-checkout and self-ordering-facilities. The consumer just puts the product with RFID-tag to the reader and the information is shown. Mobile devices on shopping-carts or embedded in PDAs help consumers as well as employees in gathering information and performing tasks anywhere in the shop. An item locator function helps to find products. Those mobile devices are actually RFID-readers with which information can be gathered or the product can be found. In combination with the consumer's RFID-loyalty card the devices could display the location of certain frequently bought products or complementary products.

Monitoring gates throughout the store, for example at the entrance, can identify the consumer's loyalty card and trigger special promotions or selling processes. On the shelves, such gates can help identify products taken from the shelves but not being purchased and thus reducing shrink. Multimedia displays will individualize marketing messages to the bypassing consumer. The display, equipped with a reader identifies the products in a bypassing shopping cart and shows specific information about a complementary or even a rival product. Aisle-specific advertisement can be shown if the customer profile, stored on the RFID-loyalty card, includes information on demographic or other data such as the information that the consumer is a new home owner. RFID-tags on CDs, DVDs and videos can trigger the viewing of trailers for films or the playing of music.

Smart shelves, also equipped with an RFID-reader, will notify employees if only few items are left and the shelf has to be replenished. Furthermore incorrectly displayed

## Changes in the retail supply chain through RFID

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products will be identified with the embedded reader sending the information to employees. In this respect, electronic labeling in combination with real-time item-level views of inventory can trigger special discounts if the expiration date is close. Unattended retailing machines offer consumers self-service access to products and services 24 hours a day. Expiration date of products in the machine, the stock-level as well as the appropriate environment (temperature, humidity,..) can be observed from afar via RFID-devices.

RFID-enabled POS systems make the check-out faster, more accurate and more sales transactions can be generated with the same amount of labor employed (IBM: 2004). As the check out is the biggest stress point of consumers in the store, RFID can help facilitate this operation significantly. Queuing, unloading and reloading are the most time-consuming parts of shopping (Quarrie and Hobbs: 1997, p.14). Initiatives such as self check-out have already addressed this problem. Checking-out in a supermarket, where every product is equipped with an RFID-tag should be much quicker and less labor intensive. The consumer walks with his/her cart through an RFID-gate and every product is immediately recognized by the reader and listed on an electronic shopping bill. Payment can be instantly processed with a credit or debit card or even with the loyalty card if equipped with payment function. RFID in this respect helps to decrease check-out times, increase customer satisfaction and reduce checkout labor. If products were not payed for at the check-out, the reader-gates at the exit would raise an alarm.

Fraud is frequently encountered at the exchange of goods in supermarkets. Costumers take a product from a shelf and bring it to the management to have it exchanged although it has not been payed for yet. If such a product would be equipped with an RFID-tag, the shopping-history of the product could be stored and the information when and where the product was bought would be available instantly. Fraud would be made very difficult. An advantage for consumers concerns warranty claims. With the exact history, the date of purchase is also stored and marks the beginning of the warranty period.

Concerning **availability of future demand**, retailers can more and more rely on their investigation of buying habits of consumers. RFID makes it easier to collect and analyze POS-data and link the information to existing consumers through loyalty cards.



“The focusing on buying habits allows retailers to manage stock more efficiently... [which leads to] ... reduced warehouse and staff costs and allows manufacturers to produce goods on demand” (Quarrie and Hobbs: 1997, p.4).

**Shelf management and replenishment:** RFID leads shelf replenishment to a completely new level. Although this is only true for item-level tagging. New processes in the RSP such as vendor managed shelves revolutionize the way business is done.

The main problem on the shelf-level in a retail store is the availability of products, the Out-Of-Stock problem (OOS). A study by Accenture from 1996 estimated, that 33% of OOS items were located in the store, but just not at the correct location (Accenture: 1996). There are various reasons for OOS such as:

- Consumers picking up products but leaving them somewhere else in the store
- Employees not stocking products at the correct location
- Fast selling of a product before employees recognize it and restock the shelf
- The “loss” of a product in the backroom or at another storage location where it is found later again

If all shelves were equipped with an RFID-reader the store inventory system would be dynamically updated and “wrong” items could be identified immediately and brought to the correct location by an employee. Furthermore, readers on shelves where the amount of a certain product falls below a pre-configured number, an employee is informed by a message of the system to restock the shelf. Employees don’t have to run around in the store anymore to search for misplaced items (Auto-ID: 2003, p. 9).

### **6.8. Consumers**

The **power of consumers** concerning an RFID implementation can become critical as the technology is not yet widely deployed and the benefits are still not obvious in every respect. High consumer power might become an issue during the RFID implementation when consumers do not accept the new technology and threaten the company to boycott it’s stores, products, or business in any way. Concern by consumers can vary widely ranging from environmental hazards (“electrosmog”), fear of job reductions, privacy

concerns to higher prizes. It is very important to inform consumers to a great extent during an implementation about the benefits RFID will generate.

Although **loyalty cards** were not newly invented with RFID, the technology leads the consumer membership scheme to a new level. Those cards, which could either be just plastic cards with a barcode or magnetic strip cards, are swiped before the check-out and special discounts are given only to those consumers then. Furthermore, specific consumers were and still are targeted with certain products and offerings, also with the intention to make them feel special, as they are members of an exclusive but personal club (Quarrie and Hobbs: 1997, p.11). With RFID-chips embedded in those loyalty cards, collecting and storing of information and the triggering of other activities (look at in-store IT-devices) are made much easier.

### **6.9. Topography of a Supply Chain**

The **degree of globalization** of a retailer certainly makes his business operations more difficult and challenging. It is necessary to extensively plan an international RFID-roll-out and gradually implement it at subsidiaries in other countries.

The problem of out-of-stocks through **bottlenecks** in the supply chain can be eliminated according to supply chain and RFID specialists. OOS are created by the lack of visibility throughout the supply chain. No exact availability of POS-data, unclear stock levels, bad production planning are some of the reasons for OOS. As we have already heard very often in this chapter 6, most of those problems can be solved through RFID. Some retailers and other supply chain specialists think, that RFID leads to no OOS at all anymore. POS-data will be available instantly, real time inventory checks are possible and remove unclear stock levels. Production planning will be much better as more data on forecasted demand exists.

### **6.10. Integration and Coordination**

The **legal position** of entities in a retail supply chain generally depicts an inter-organizational one. The entities are legally separated and a lot of cooperation and trust is necessary to successfully manage the flow of goods. In retail supply chains, the **balance of power** is usually very much concentrated on the retailer. It is therefore

easier for them to initiate a mandate for RFID and “force” all suppliers to meet the requirements set out by the retailer.

**Collaboration** in a supply chain following an RFID-implementation is certainly the main driver for success or failure. The exchange of information, willingness to give certain information out to another company and permanent communication especially in the implementation phase is of great importance.

The **IT-infrastructure** in the whole supply chain encounters massive change with the implementation of RFID. Immense amount of data has to be processed and analysed. New software and hardware has to ensure integration into the IT-system of every entity in the supply chain and most importantly the systems have to be linked to each other and work on a collaborative basis. To give an example of what an RFID-system requires and how a supply chain is effected by that, the following example gives an overview of the impact of RFID on information technology in a retail supply chain:

When the logistics vehicle picks up goods from the manufacturer the RFID-tag on the vehicle is checked by the readers at the loading dock and verifies if the logistics vehicle is authorised to pickup goods. Pallets and cases leaving the loading dock are read by the readers and the B2B system (ASN) and ERP systems are alerted to initiate electronic transactions, proof of pickup and potentially shipment invoicing.

When the logistics vehicle arrives at the distribution center and the pallets pass the RFID-reader gates, the arrival of the manifest is triggered to initiate automatic routing of the goods to the next logistics vehicle (cross-docking). When the goods leave the logistics center again via the RFID-reader gates, the middleware transfers the information to the ERP systems indicating again that the manifest is loaded. Upon arrival of the goods in the retail store being read by RFID-gates, ERP systems are updated to manage inventory levels and a B2B message to suppliers is initiated to go on with invoicing.

On the shop-floor level, the picking of a product from the shelves by a consumer is recorded and the middleware is able to initiate additional product supply requests directly to the supplier. Stock levels in the store-backroom can be diminished

significantly. The consumer is initiating direct demand generation on the supply chain management process (“RFID in the Supply Chain: 2004).

### 6.11. Summary of benefits

An important difference in terms of an RFID-implementation is the level on which it is executed. It can either be on pallet-, case-, or item level or a combination of those. The following figure shows the benefits of each stage. Present roll-outs at European and US retailers are confined to the first two levels adding up the benefits of pallet- and case-level tagging. This figure of Hewlett-Packard estimates, that item-level tagging will not be in place before the next 5 years. In this respect, opinions tend to vary a lot, some specialists think of a early adoption in 5 years, others believe that item-level tagging will need another 10 to 15 or maybe even 20 years before adoption.

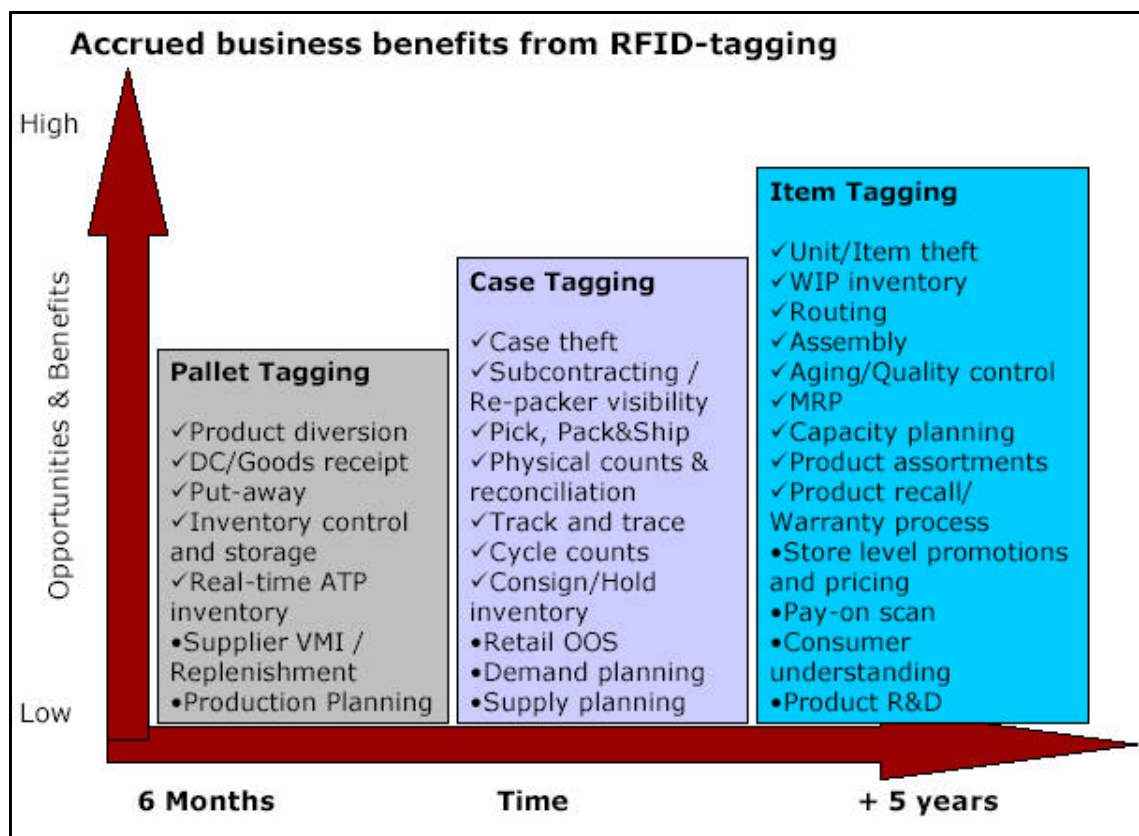


Figure 18: „Accrued business benefits from RFID-tagging.

Source: Data from Hewlett-Packard Development Company

Some further advantages of an RFID-implementation already at case- and pallet level are:

1. Reducing the reorder time for shipments from warehouse
2. Reducing product shrinkage and/or theft
3. Improvement of authentication of shipments
4. Optimization of inventory

According to the Retail Council of Canada (RCC) shrinkage is “the financial loss incurred when there is a shortage of merchandise currently on hand versus recorded merchandise received. This type of loss can be attributed to a combination of customer theft, employee theft, administrative (paperwork) errors and vendor and customer fraud.” (RCC: 200).

The average loss due to shrinkage for U.S. retailers amounted to 1.65% of sales annually, that’s an estimated \$ 33.6 billion even though retailers spend about 0.5% of sales on security. These are the results of the “2003 National Retail Security Survey” of the University of Florida. The study also found that about half of the “shrinkage” occurs through employee theft and one third through shoplifting (“Stopping Sticky Fingers with Tech”: 2004). Even though shoplifting might come to a halt with RFID, employee theft could be more difficult to reveal as clever employees will find a way to circumvent anti-theft measures of RFID.

It is not yet possible to put the benefits of an RFID-rollout in numbers. Nevertheless it is feasible to put down the advantages of RFID and how shareholder value will be effected by an RFID-implementation. The Auto-ID Center at the MIT draw the following figure in their report “Auto-ID in the Box: The Value of Auto-ID Technology in Retail Stores”:

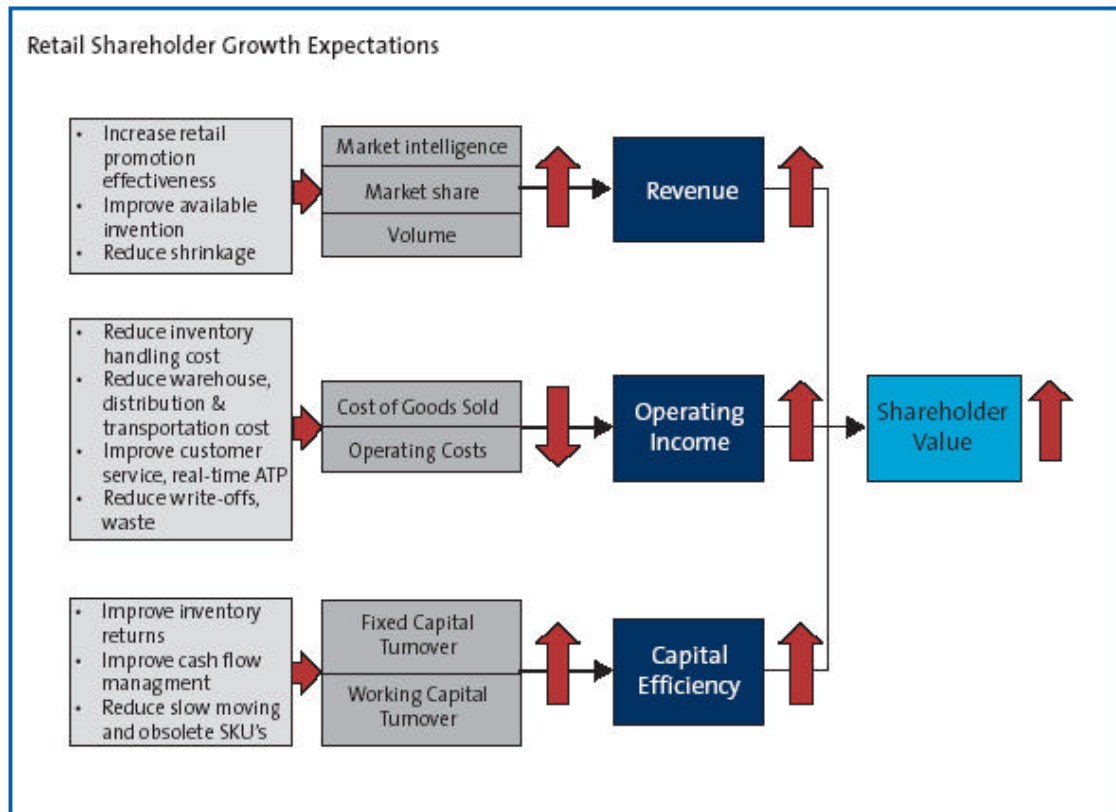


Figure 19: „Retail Shareholder Growth Expectations“.

Source: Auto-ID Center (2002)

## 7. Implementation of RFID at Metro – The Case Study

### METRO Group

#### 7.1. Company profile Metro Group

Metro was founded in 1964 by Otto Beisheim as a wholesale business serving commercial customers by opening the first Metro Cash&Carry store. After the rapid expansion in Germany in 1968 backed by Franz Haniel & Cie and the Schmidt-Ruthenbeck family, the company expanded in Europe in the 1970s. Metro AG was incorporated in 1996 after a merger of Metro Cash&Carry, Kaufhof Holding AG and Asko Deutsche Kaufhaus AG and went public the same year. The group very soon started the international expansion with sales abroad reaching 7.1% of total sales in 1997 rising to 39.2% in 1999. Nowadays Metro is more and more investing in emerging markets in Asia, such as China and India. Nearly 60% of Metro is owned by the founder Otto Beisheim and the other families (Hoover's Company In-Depth Records: 2004).

Metro AG operates worldwide with about 250,000 employees and 2,400 stores in 30 countries. 53% of the sales in 2003 were generated in Germany, the rest in other European countries, China, India, Japan, Morocco, Russia, Turkey, Ukraine and Vietnam.

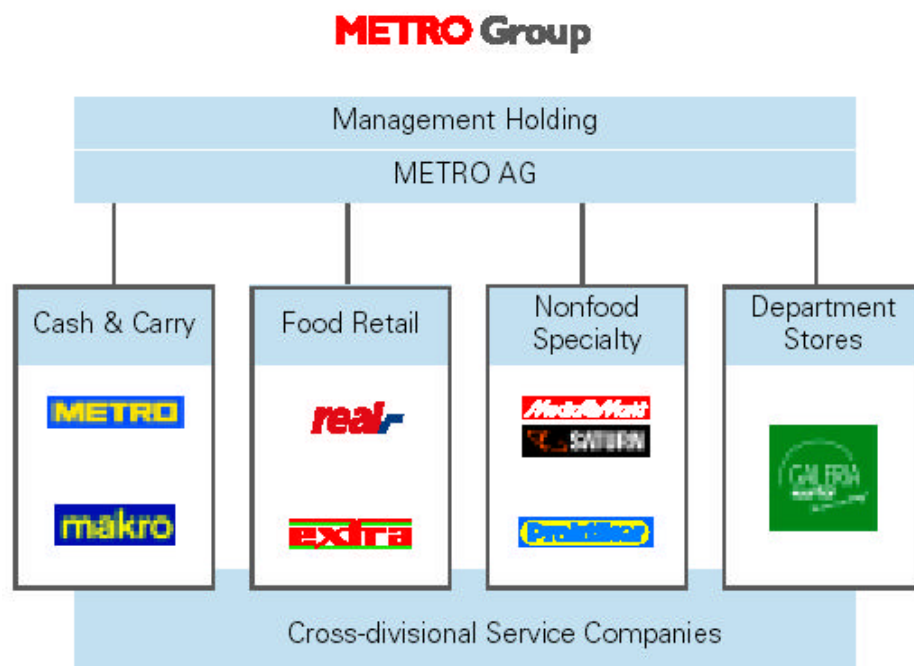


Figure 20: „Metro Group Structure“. Source: Metro Group International Profile (2004c)

## Implementation of RFID at Metro – The case study

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Metro AG is actually the holding company for the Metro Group and manages corporate policies, represents the group on the capital markets and is responsible for human resource development. Six different sales divisions are independently run with the cross-divisional service companies offering services to all entities within the group. The sales divisions are the Metro/Makro Cash&Carry, Real, Extra, Media Markt/Saturn, Praktiker and Galeria Kaufhof. Metro Group is the fifth biggest retailer in the world in terms of sales. About 47% of Metro's revenues are earned from its Metro Cash&Carry and Makro wholesale outlets. Those shops sell grocery and non-grocery items to business and institutional customers. Furthermore, Metro runs 750 hypermarkets (Real) and supermarkets (Extra), primarily in Germany and consumer electronics chains (Media Markt, Saturn), department stores (Galeria Kaufhof) and home improvement centers (Praktiker).

With the new corporate identity developed in the first years of existence until 2002, the company positioned itself as a modern, success oriented and international company. The brand message: "METRO Group - The spirit of Commerce" should underline that.

<b>Sales data</b>	2003 Sales, % of total
Cash & carry	47
Nonfood specialty (consumer electronics & home improvement chains)	25
Food retail	21
Department stores	7
Total	100

Table 6: Sales data of Metro. Source: Hoover's Company In-depth Records 06/17/2004

<b>Financials</b>			
Fiscal year ends Dec.			
	2004	2003	2002
Sales (€billion)	56.4	53.6	51.5
Net Income (€mil.)	933	571	502
Net Profit Margin	1.6 %	1.07 %	0.9 %
Employees	251,556	242,010	235,283

Table 7: Financial Data of Metro. Source: Hoover's Company In-depth Records 06/17/2004



### 7.2. Internal reasons for implementation



Metro's initiative to implement RFID throughout the supply chain is part of a conviction to new technologies and innovation in the retail sector. For Metro it is a necessity to stay in the forefront of innovation. In the following sub-chapters, two projects of the "METRO Group Future Store Initiative" will be presented. The initiative's aim is to promote different technological innovations in retailing and test them in the field. As Dr. Hans-Joachim Korber, Metro's CEO put it: "In the future, the use of innovative technologies will be one of the crucial competitive factors in our industry. With the Future Store Initiative, the METRO Group will push the modernization of retailing" ("RFID Success Story": 2004). Nevertheless, the author thinks that the implementation of RFID was the main reason to start this initiative and test the technology in trial phases. Metro showed farsightedness as the company not only employed RFID in the tests but also other technologies that will change retailing in the near future. The difference to other retailers is that Metro has been involving and informing consumers as well as employees far more than others about testing new technologies.

In Europe there is also another reason why some industries are pushing RFID. In January 2005, the European Union issued a directive demanding that the retail sector and industry fully trace foodstuffs and feed throughout the supply chain. The aim is to be able to quickly and effectively recall such products with undesirable substances. RFID is not the only way to comply with that directive but it is the most effective one. The technology makes it possible to track and trace tagged products through the whole supply chain and always know where the products in question are located (Metro Group: 2005b).

### 7.2.2. Extra Future Store

In 2002 Metro Group launched an initiative together with SAP, Intel, IBM as well as other companies from the consumer goods and information technology industry called “METRO Group Future Store Initiative”. The first project of this initiative was the opening of the “Extra Future Store” in Rheinberg (North-Rhine-Westphalia, Germany) on 28 April 2003. The objectives of the initiative were to “promote innovations in retailing on a national and international level. The initiative shall be understood as a platform for technical and process-related developments and innovations in retailing” (Metro:2003). In the future store RFID and other technologies as well as their interaction should be tested under real life conditions. The aim was to reach market maturity of currently realizable technologies that would change the future of retailing.

In the Future Store, five key areas of technology are tested:

- Comfort Shopping
- Smart Checkout
- In-Store Information
- Inventory Management
- Infrastructure (Metro: 2003b)

**Comfort Shopping** includes the **Personal Shopping Assistant (PSA)**, a small portable hand held like computer similar to a tablet PC. The PSA shows the consumer an electronic shopping list after scanning the products via the integrated barcode scanner (RFID-application possible in the future). It calculates the current total price and the total savings through discounts. At the checkout, the PSA transmits the data directly to the POS and the consumer can directly pay. Moreover it is possible to show special advertisements or discount offers.



Figure 21: Personal Shopping Assistant. Source: Future Store

At the beginning of the initiative, comfort shopping also included the **loyalty card** equipped with an RFID-chip for easier self-checkout and to connect it to the PSA. The loyalty cards are not equipped with an RFID-chip anymore after concern was raised by privacy groups.

**Info terminals** in the sales room can be used by consumers with a loyalty card to obtain further information on a product such as production, ingredients, information about wine or meat, dietary information, tips for recipes etc. and even have it printed out via a terminal printer. The info terminal works like a PSA with touch-screen, has a keyboard and Microsoft Windows XP operating system and is connected to the store IT infrastructure via WLAN. In the Future Store it is used for meat, wine, baby care, fruit and vegetables, hair coloration and multimedia products.

**Electronic advertising displays** are used in the future store to show videos about products and special offers. The 19" plasma screens access clips from a database via WLAN and can be controlled within seconds from a central point.



Figure 22: Wine info terminal.

Source: Future Store



Figure 23: Electronic Advertising display.

Source: Future Store

Another part of comfort shopping is the **intelligent scale**. It works automatically via optical identification, the consumer does not have to select the appropriate item of the fruit or vegetable anymore. A camera and a special identification software recognize the right product through its characteristics such as shape, surface, color and size. The consumer just has to confirm the right product identification. The intelligent scale could also be used to weigh meat, fish and cheese in addition to fruit and vegetables.



Figure 24: Intelligent Scale.

Source: Future Store

## Implementation of RFID at Metro – The case study

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The products in the store are equipped with RFID-tags. Together with about 37,000 electronic price labels it is possible to always accurately display the price of the product. **Electronic shelf labeling (ESL)** works via radio frequency transmission with the price being directly supplied from the NCR System “RealPrice” and it interacts via WLAN with the communication base stations installed in the ceiling of the store. The updating of prices is done centrally by Metro’s store merchandize management system, automatically transmitted via the computer radio system and therefore, the price at the shelf is always identical with the price at the checkout. The electronic labels are equipped with a receiver and a tiny antenna as well as a compact battery. As battery power is only needed to change information of individual display elements, the service life of the battery is five years or even more.



Figure 25: Electronic Shelf Labeling. Source: Future Store

The **Smart Checkout** part of the Future Store Initiative consists of different checkout systems, such as self checkout, as well as comfort payment and checking out via the PSA. The Future Store still has **typical checkout counters** with barcode reading devices and conventional payment. Those counters are in addition equipped with touch screens for employees and an RFID reader to book the products out of the RFID goods flow control system. The RFID-tags are then deactivated by a separated reading/writing device and won’t initiate the alarm when leaving the store.

Another system is the **comfort payment/checking out via the Personal Shopping Assistant (PSA)**. As the consumer has constantly scanned the products he put in his cart

via a barcode with the PSA, at the checkout he can release the “Pay&Go” process. The data is then transferred from the PSA server to the checkout system. The consumer will be able to pay after a sales slip is printed out without even unloading his/her cart and putting the products on the conveyer belt.

The third option is the **self checkout**. Automatic FastLane checkout machines make it possible for the consumer to scan the products him- or herself without a cashier. The self checkout is furthermore equipped with a user-friendly touch screen and a payment terminal. When the consumer scans the products and puts them in the shopping bag, the weight of the shopping bag is compared with the scanned goods and in case of discrepancies, an employee of the store is alerted automatically. Payment can be made either cash or with an EC or credit card just like at an ATM.



Figure 26: Self Checkout.

Source: Future Store

**In-Store Information** includes the “mymetro” employee portal and Personal Digital Assistants (PDA) for employees, tablet PCs and in-store communication. The “mymetro” portal can be accessed by employees via kiosks. It offers information about the company such as press news, current sales figures as well as important customer information and current sales promotions. Employees can also access discussion forums and on the intranet. In the future it may also be possible for them to manage personal data, recall personal work organization information or even use it for e-learning schemes.



The **Personal Digital Assistant (PDA)** used by employees are equipped with software for e-mail operations (Outlook), a calendar, the management of contacts and even the telephone function is tested. The PDA makes it possible for employees to check current inventory levels, access the central merchandise management system. They don't have to check every shelf anymore but can obtain the information through the PDA which is linked to the system via WLAN. **Tablet PCs** which are fully operative computers include an accumulator for up to 5 hours work in the store and an input pencil for easy use. **In-store communication/telephony** among employees works through the internet protocol (IP). IP telephones are installed in certain points at the store and later every employee will be equipped with a portable IP-phone so that he or she can be called at any time.

**Inventory management** in the Future Store also encounters major changes to past business practices. **RFID** is hereby the main initiator and driver. The technology is not only used as anti-theft measure, a new RFID goods flow control system improves inventory management significantly through better visibility and new potential solutions.

All pallets and crates that leave the warehouse of Metro Group Distribution Logistic (MDL) are equipped with an RFID-tag. RFID-readers at the exit and entry zones of warehouses and stores record the flow of goods with the possibility of reading a large number of packages in one turn. In the backroom areas of the stores and in the warehouse RFID-tags will be put on each storage place in the future. By reading the tag with the hand held device of an employee, the exact amount of pallets and individual packages is entered into the RFID goods flow control system. This should provide accurate data about the inventory level and more importantly the storage place where the goods can be found. When the goods leave the backroom area to the store, RFID-gates also encounter the transaction and pass it on to the goods flow system.

A big advantage of the RFID-tag in comparison to the barcode for Metro is the additional product information that can be stored on the tags. Possible information is of "product origin, e.g. date of production or harvest, transport data, delivery destination, supplier, internal article number, data about storage temperature, best-before date, batch numbers through to recycling information. It would then be possible to recall at any

moment the entire history of certain goods from their production through to recycling or disposal” (Metro: 2003b). Of great use for retailers will be temperature loggers for fresh or frozen produce. Real time inventory checks could be feasible through an employee passing by with a hand-held RFID-reader.

So called **Smart Shelves**, shelves with an integrated RFID-reader, will recognize the products placed in them. They will therefore diminish out-of-stock situations by registering inaccurately placed and missing items. In the future, the system could be able to have early warning functions analyze replenishment of shelves even at the right time through availability of the goods in the warehouse, value of the article, urgency of the order or duration of being out-of-stock. An OOS-situation would hardly occur anymore and the shelves will always be labeled with the right price for the product.

The **infrastructure** in the Future Store is updated with a **Wireless Store Network WLAN**. A non-public WLAN based on IEEE 802.11b is the central element for data and language communication in the store. The central server infrastructure is linked to PSAs, PDAs, tablet PCs, info terminals and advertising displays. The frequency used is 2.4 GHz making a data stream of up to 11 Mbit/s possible, much more than a customary modem. Stationary devices are linked via Ethernet (IEEE 802.3).

The **server hardware** is based on the new BL20p technology, a performance dual processor blade server optimal for permanently changing business requirements and dynamic scaling. The **“content bus”** is the central information source for the applications and output media in the store (Metro: 2003b).

After the first year of pilot testing in the Future Store Initiative, Gerd Wolfram, project manager for the initiative, announced the first results. Metro believed, that process efficiency rose by 12 to 17 per cent, theft and losses decreased by 11 to 18 per cent and merchandise availability increased by 9 to 14 per cent with RFID. The pilot phase was nevertheless not without its problems. Mainly on item-level, the on-shelf RFID readers had some blind spots and problems especially with liquid and metall products. Metro also mentioned high cost of tags, readers, engineering and cabling necessary for a full RFID implementation throughout the whole supply chain, that was prohibitive even for big retailers. Metro calculates with labor reductions of 17 per cent, pointing out that no



jobs would be lost but workers would be reassigned to different duties (“RFID: What one of the...”: 2004).

### **7.2.3. RFID Innovation Center**

In order to provide support for Metro’s industry partners, the company opened the “RFID Innovation Center” on 7 July 2004 in Neuss near Cologne/Germany. The aim was to cooperatively do research on RFID-technology. A remodeled warehouse offers suppliers the possibility to test in collaboration with IT companies in 30 different systems. Additionally, Metro is offering consulting services for partners as well as training seminars and guided tours in the “RFID innovation center”.

RFID is tested and presented in five areas:

- RFID in picking
- RFID in warehouse management
- RFID in the department store
- RFID in the supermarket
- RFID in the private household

#### **RFID in picking:**

Picking is part of the operation of a DC as the right articles have to be assorted to be shipped to individual stores from the DC. RFID-tags on transport units and goods increase efficiency and accuracy of picking. An example is the equipment of hanger goods with RFID-tags so that the hanger goods sorter is able to allocate each good to the respective destination. Such a sorter can commission between 4,000 to 6,000 clothing products on hangers per hour.



Figure 27: Hanger Goods Sorter. Source: Metro Group

### **RFID in warehouse management:**

In the warehouse it is mainly the process of checking incoming and outgoing goods as well as the monitoring of stock levels. RFID-gates at warehouse entries as well as hanger goods conveyor systems for incoming goods help with these operations. Other advantages that come along with RFID are the easier way of sorting pallets into the high shelves and reading pallets through ultrahigh-frequency handheld readers at a distance of up to four meters.

### **RFID in the department store:**

The use of intelligent information systems based on RFID technology will offer more service to consumers in the store. The “Intelligent Change Room” offers additional information to the products brought into the change room by reading the RFID-tag. Furthermore, if a consumer picks a product from the shelf, a multimedia display shows relevant information and advertisements and the sales staff is informed if the product runs low in the shelf. A “Virtual Catwalk” recognizes the product selected by the consumer and gives a virtual fashion consultation. In the department store, the check-out will be effected via RFID check-out gates with deactivating the anti-theft alarm.



Figure 28: Virtual Catwalk.

Source: Metro Group

### **RFID in the supermarket:**

Tests in this area include many of the already above mentioned innovations present in the Future Store. Those applications are smart shelves, intelligent scales, multimedia displays, self-checkout as well as the de-activator. In addition to that, the innovation center tests scales with RFID for staff use where the RFID-bracelet worn by the employee assigns the sale to this employee. A special information terminal informs about the exact supply chain a meat product went through from breeding to sale.

### **RFID in the private household:**

The idea behind this initiative is to keep fresh-groceries in stock at all time. Electronic stock management in the household should make planning and shopping at the store easier. The tools used to reach this goal are the smart fridge and the intelligent freezer. Together with a smart fridge, the consumer can state the minimum amount and selection of products that should be in the fridge. The consumer is warned automatically if a product approaches the expiry date and the system generates an electronic shopping list with the items to be replenished in the fridge. The intelligent freezer makes it possible to view all products and their location in the freezer even via the internet as the consumer can label the products with reusable smart chips (“Metro Group – RFID Innovation Center”: 2004).



Figure 29: Intelligent fridge.

Source: Metro Group

### **7.3. Future Plans**

One of the main aims of Metro concerning the RFID-implementation is undoubtedly item-level tagging. Interestingly, the time frame for the future start of item-level tagging at Metro is viewed more optimistically over time. Dr. Gerd Wolfram said in 2004 that it would not be in place before 10 to 20 years (“RFID: What one of the...”: 2004). In an interview published on the homepage of Metro in 2005, Wolfram talks about another 10 to 15 years. When prices go down from the current 20 to 30 Eurocent below 5 Eurocent a roll-out on item-level is imaginable. Until now, Metro’s plans don’t include this possibility of tagging.

Dr. Gerd Wolfram further announced that after reaching the first goals with the roll-out starting in November 2004, the company would be looking for more industry partners joining the initiative and increase the number of warehouses and stores in the implementation (Metro Group: 2005c).

### **7.4. Measurement of success**

The question of how Metro measures the success of the RFID implementation can be seen from statements of Metro officials. The company said they saw the potential of RFID very soon, that the technology could help them to do business more cost-effectively, more efficiently and more transparently. Metro mentioned early on, that in the first pilot tests they encountered major savings of warehouse costs of 11 percent, OOSs diminished by 14 percent and merchandise losses decreased by 18 percent. Those

savings “encouraged the Metro Group to start a scheduled market launch of RFID in Germany” (Metro Group 2005c). Metro is mentioning that manufacturers, retailers and consumers will benefit equally from an RFID-implementation.

### **7.5. Timeline of the implementation**

As already mentioned in the chapter of the reasons for Metro to implement RFID, the start of the RFID-initiative of Metro can be dated back to 2002 when the “Metro Group Future Store Initiative” was launched. On 28 April 2003, the “Extra Future Store” was opened in Rheinberg/Germany where tests with RFID in the field were started. As another part of the initiative, on 7 July 2004, Metro opened the “RFID Innovation Center” in Neuss-Norf, Germany with the objective to “intensively prepare the planned roll-out of the RFID technology within the company together with the partners of the Metro Group. Moreover, the center will display innovative RFID applications that will facilitate shopping in the future, and shape it” (Metro Group: 2004)

In May 2004, Metro invited 168 suppliers to inform them about Metro’s RFID roll-out plans at a convention in Cologne. Metro chose 20 suppliers for the roll-out on 2<sup>nd</sup> November 2004 including big companies such as Procter&Gamble, Nestlé, Kraft Foods, Johnson&Johnson, SCA and Gillette (see Appendix IV). After this first wave of implementation, the aim was to gradually extend the roll-out to about 100 suppliers, eight central warehouses and 269 stores of METRO Cash&Carry, Real and Kaufhof in Germany as well as Metro Group Logistics (“RFID: What one of the...”: 2004). At the beginning of 2006 the top-300 suppliers would have to ship tagged cases and pallets to Metro’s DCs.

The first phase then really started on 2<sup>nd</sup> November 2004 with the selected 20 suppliers putting RFID-tags on pallets as well as hanging goods deliveries (garments). RFID-readers were placed in individual warehouses and stores at the goods arrival and delivery points. Phase 2 of the implementation should begin at the end of 2005 with the start of tagging cases by the suppliers who should only use “EPC Class 1/Generation 2” standard from then on.

## Implementation of RFID at Metro – The case study

Project manager Dr. Gerd Wolfram announced, that the implementation will start on pallet-level as well as for transport packages followed by cases later on. “The tagging of consumer goods units is not part of the roll-out” was stated by him (“Metro verpflichtet Hersteller auf RFID”: 2004). An interesting fact in the Metro implementation was, that it’s consumer electronics stores could not be integrated in the first phase of the roll-out as their EDI was not yet fit enough.

100 days after the roll-out in November 2004, Metro announced that the first interim balance was predominantly positive. Some minor problems occurred but reusable transport packages were read with 90% accuracy and the reading rate of hanging goods and stackable goods conveyors was even up to 99%. Metro expected further improvements with the mid-2005 available generation 2 tags with additional functions, cheaper production costs and enhanced performance. Zygmunt Mierdorf, member of the management of Metro, further announced that the company will start the second phase of the implementation in late 2005 with the tagging of all boxes with Gen 2 RFID-smart chips (Metro Group: 2005).

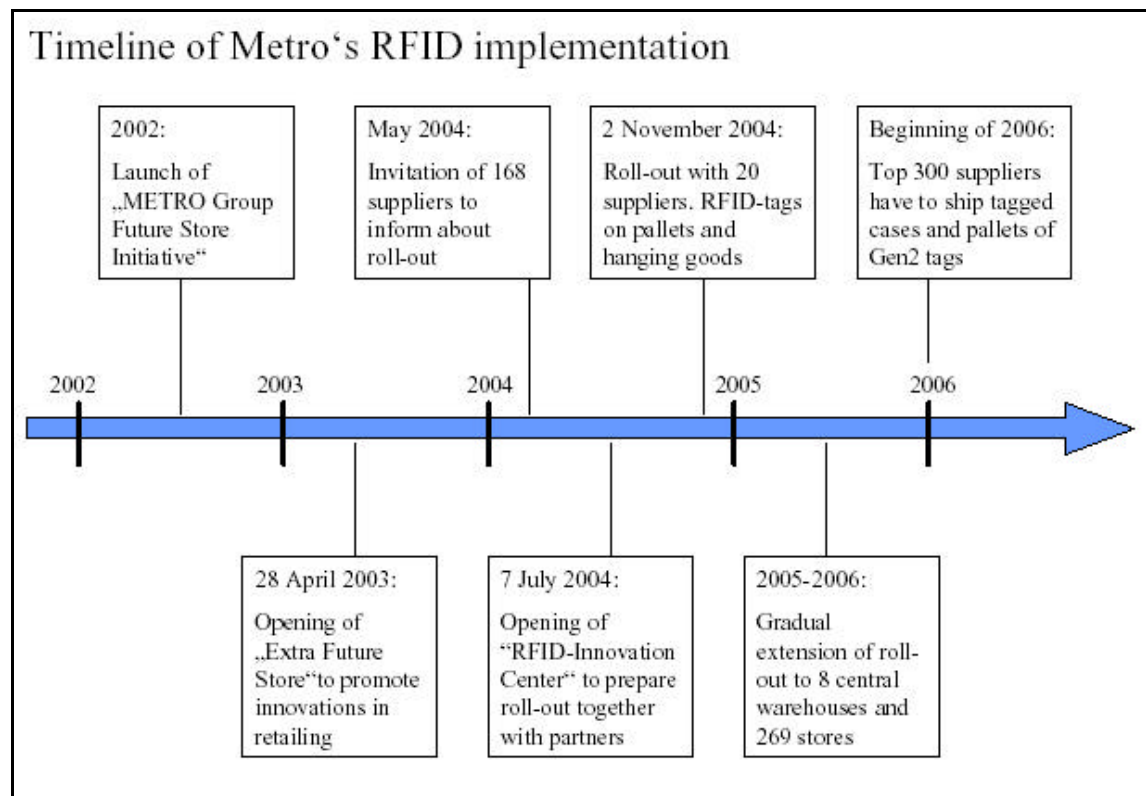


Figure 30: Timeline of Metro's RFID implementation.

Source: Own drawing

### **7.6. Technical Requirements**

Metro Group is a member of the Board of Governors of EPCglobal alongside with Wal-Mart and other retailers and is therefore convicted to international standards set by EPCglobal. Metro demands from its suppliers to adapt the “Serial Shipping Container Code” (SSCC) standard or EPC-SSCC-96 as well as the EPC-SGTIN-96. The company requires “EPC Class1/Generation 2” tags being ultra-high-frequency 96 bit tags. The frequency band used is the 865 to 868 MHz for smart chips on pallets and cases (Metro Group: 2004b). The EPC Generation 2 standard were just set in the beginning of 2005 and Metro together with Royal Philips Electronics and Intermec Technologies Corp. tested the new “Gen 2”-label in real-world as he first in the industry in Metro’s RFID Innovation Center in April 2005.



Figure 31: Metro – IC-Technik Gate. Source: Future Store

### **7.7. Internal and external communication**

The history of problems of Metro with privacy concern groups can be described with the following example where even U.S. anti-RFID campaigners joined European counterparts to publicly organize the “fight” against RFID. On 29 January 2004 privacy campaigners found RFID loyalty cards during a tour of the Metro Future Store in Rheinberg/Germany. Metro announced just one day before the presentation that they are going to stop testing RFID loyalty cards denying that this had anything to do with the concerns raised by privacy concern groups. Before these incidents at Metro it looked like opposition to RFID would be limited to the U.S. but this was proven to be wrong. It was mainly the activism of CASPIAN and the visit of their spokeswoman Katherine

Albrecht to Germany joining this presentation that FoeBuD and representatives from 13 other German privacy, civil rights and citizen organizations started protesting against the RFID implementation.

One month later a demonstration in front of Metro's Future Store in Rheinberg was held with protesters showing signs and shouting slogans like "1984 Orwell, 2004 Metro", "Hands off Privacy" or "Stop RFID". Metro repeatedly mentioned that they are just using RFID to track and trace products from the manufacturing plant to the store and shelf but not further. Albrecht von Truchsess, Metro Spokesman, pointed out that „it's about product data, not customer data“ and that "Metro is not the CIA" ("Shutting Shopping Bags to Prying Eyes":2004).

During a symposium about RFID at the Hilton Hotel in Düsseldorf on 3 Mai and 4 Mai 2004 organized by the newspaper "Das Handelsblatt", protesters of the "Chaos Computer Club" and the German privacy organization "FoeBuD" gathered in front of the hotel and then traveled to the Future Store in Rheinberg by bus. They wanted to call attention to the risks involved in the use of RFID. They demanded:

- "No uncontrolled implementation of RFID
- A stop of RFID trials for the time being

Companies who experiment with RFID, who have plans to implement it or those who are involved in any other way should subsidize a committee which adopts rules and regulations that are compliant to society and democracy" ("Anonymer Netzplatz: 2004")

In a press release on 28 February 2004, updated on 20 April, Metro tried to explain that RFID-chips were only integrated into customer loyalty card for youth protection matters. Young consumers under 16 were not given an "Extra Future Card" with which the purchase of movies rated 12+ or 16+ (minimum age of movie consumer) was allowed. Metro assured that the smart chip (RFID-chip) had no other purpose than that, it was not read at any other place in the store, not even at the multimedia display. The test nevertheless discontinued "in order to counter any reservations made with respect to Smart chips in the Extra Future Cards... Irrespective of the confirmation of the legality



of the chips, this is to dispel any doubts even if they are chiefly of an emotional origin and to objectify the discussion about RFID” (Metro press release of 28 February 2004).

Furthermore, Metro announced in a press release that after the purchase the tag would lose its function and there would be no connection to the database of Metro Group anymore. They assured that product data would be linked to personal customer data through RFID at any time. The “De-Activator”, an absolute novelty developed by the Metro Group allows the consumer to delete the numerical code stored on the tag after purchase.

Metro always tries to assure that the company takes concern of privacy advocates and consumers seriously and pointed out frequently, that it informs its customers transparently and openly about its use of RFID. It assures that whenever RFID is in use, it would be indicated and that no customer data is stored on RFID-tags on products, only product data. Moreover, RFID-tags can not be used by the Metro Group outside the Future Store (Metro press release of 28 February 2004). Furthermore, the De-Activator, developed by Metro, gives consumers the ability to overwrite the information stored on the RFID-tag, thus deleting it. The company points out, that this demonstrates, that one of Metro Group’s top priorities is data privacy.

Information of the public and partner companies about RFID at Metro includes:

- The Metro Future Store Initiative
- The Metro Group RFID Newsletter
- The Metro Group RFID Innovation Center
- The Metro Group RFID Net (Information for partners only about the progress in the RFID-implementation) (Metro: 2005)

Internal communication of the RFID-implementation to Metro’s employees is mainly focused on the “mymetro” portal which was developed in 2002. It is used as a working platform that not only includes electronic work progress and programs but various information about the company and it’s initiatives. Special training for employees should supply them with the necessary information to inform consumers in the best way possible.

### **7.8. Metro's Supply Chain**

In order to manage the own business processes more effectively throughout the supply chain, Metro has “outsourced” some operations such as purchasing, logistics, IT, advertising or waste and environmental management. They are not really outsourced as the companies executing those operations are within Metro Group, thus belonging to Metro. In order to take advantage of synergy effects across all sales divisions, Metro founded so called “cross-divisional service companies” (Metro Group: 2005d). Some of them will be mentioned later on to better explain operations within Metro's supply chain.

Metro followed an aggressive way of expansion to international markets all over the world. One of the reasons was the stagnation of the home market in Germany. The company is struggling to a high degree with competition from discounters and their low-price strategies. To fight those developments Metro restructured and modernized it's stores, closed down unprofitable ones and broadened the merchandise mix. In the globalization of it's operations, Metro managed to adapt to regional differences although a standard outlet model was used (Euromonitor: 2004b).

Metro Group works together with more than 8,000 **suppliers**. Metro requires high **flexibility** from its suppliers and has relative **power** over them because of the information advantage.

#### **Product Sourcing:**

Purchasing within the Metro Group is effected by the cross-divisional service company MGB, Metro Group Buying GmbH. This company is responsible for the procurement of food and non-food products in Germany and internationally. It pools purchasing volumes to guarantee the best price and conditions. MGB works closely together with the sales division and has defined consistent quality features and uniform criteria for quality assurance in the whole Metro Group. It has own subsidiaries in Hongkong, Russia, Poland and Turkey ([www.metrogroup.de](http://www.metrogroup.de)).

In terms of **product selection**, Metro introduced many private-label products to be able to compete with real discount retailers. On the basis of a strategic, consumer-oriented product selection policy, category management helps Metro to improve operations. In the Metro Group category management is situated between the purchasing and sales department.

**Inbound transportation** as well as **outbound transportation** at Metro Group are managed by the cross-divisional service companies responsible for logistics. MGL, Metro Group Logistics GmbH, and MDL, METRO Group Distribution Logistics GmbH & Co. KG. MGL organizes and handles all merchandise movements by order of all sales divisions. It coordinates every shipment from manufacturers to the Metro Group stores. Together with 4,300 suppliers, an average of 38,500 parcels, 35,000 pallets and 400,000 individual consignments are moved every day. They are either shipped directly from the manufacturer to each store or via central warehouses and transshipment points. MGL also takes care of furniture haulage for all employees of Metro group who move and it offers warehouse management services. The innovative logistics concept of MGL was awarded the German Logistics Award in 2002 by the German Bundesvereinigung Logistik.

The aim of Metro is to efficiently and environmentally friendly organize the most rational transport mode and routes. It chooses carriers so that the fewest possible individual shipments arrive at the stores and warehouses every day. MGL's locations are in Germany, Poland, Austria and Turkey. The cross-divisional service company MDL is specialized in **warehouse management** as well as shipment of goods from the central warehouses to the stores of the different sales divisions. MDL as well as MGL serve more than 2,300 stores in 28 countries with about 50,000 pallets, equivalent to 1.2 million units each day ([www.metrogroup.de](http://www.metrogroup.de)).

### **Outbound transportation:**

MDL takes care of food logistics within the group, working mainly for the retail divisions Real and Extra. It operates seven central warehouses for dry foods, fresh produce, fruit and vegetable and frozen food and in addition two warehouses for non-food items ([www.metrogroup.de](http://www.metrogroup.de)). Only in March 2005, Metro announced that MDL

will change its name to MGL warehousing. The company operates an own truck fleet and warehouses for the Real hypermarkets and Extra supermarkets in Germany. This move has the aim to standardize warehousing and logistics operations and platforms in across its sales divisions in 30 countries (“Metro Group restructures logistics”: 2005).



Figure 32: Outbound transportation at Metro. Source: Metro Group

Metro Group’s **store operations** differ between the various sales divisions. **In-store IT-devices** are more common in the consumer electronics divisions than in the other retail division. However it is to say, that such devices are still rather rare. To make the check-out more customer-friendly, Metro introduced some self-checkout terminals at its Real stores in Germany. **Accuracy and availability** of check-out data and therefore prospected future demand is still dependent on barcode scanning.

### **Consumers:**

In the German retail industry the **power of consumers over retailers**, especially over the Metro Group is definitely higher as discount retailers are putting a lot of pressure on traditional retailers. Discount retailer such as Aldi and Lidl in Germany are following an aggressive expansion. They are successful in convincing consumers that the low price does not mean low quality and that’s why they are gaining market share.

## Implementation of RFID at Metro – The case study

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One initiative of Metro in terms of customer relationship management (CRM) is the **loyalty card program** “Payback” of the participating sales divisions Real and Kaufhof. With nearly 25 million members it is the biggest program in Germany. With every purchase, the consumer receives “bonus points” on the loyalty card and can benefit from special discounts and target group specific offers. Metro sees it as a very important approach to establish customer loyalty and guarantee long term success in the retail business.

As a summary, the following figure shows the characteristics of the Metro supply chain typology. Generalizations had to be made as Metro relies on various retail concepts with the biggest extinction between the food retailing branch like Real and the consumer electronics retailers Media Markt and Saturn. Generally it can be said, that the power of Metro over retailers is rather high, the number of SKUs and their average value is also high. Metro relies nearly entirely on the own fleet of trucks. In-store IT-devices are in place and the company is pushing such technologies to a great extent also in light of the implementation of RFID. Most of Metro’s retail chains do have loyalty programs. The power of consumers is rather high, what can be seen from the great threat that comes from discount retailers.

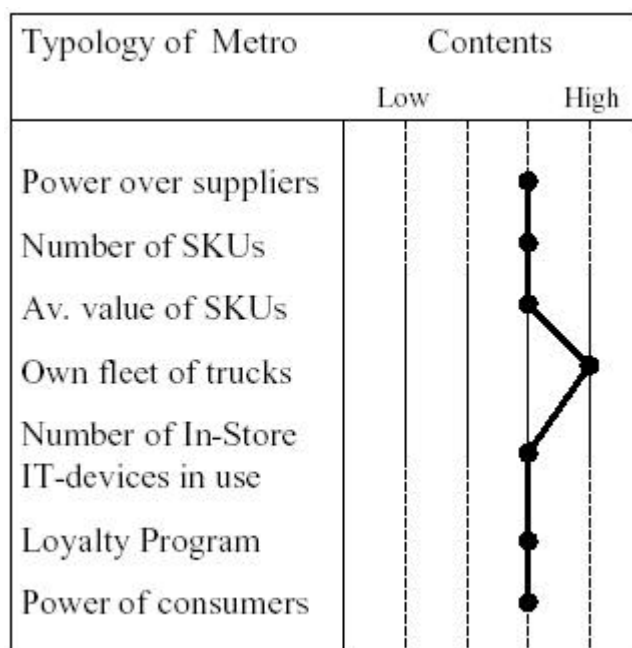


Figure 33: Typology of Metro

### 8. Implementation of RFID at Wal-Mart – The Case Study



#### 8.1. *Company profile Wal-Mart Stores Inc.*

Together with his brother “Bud” Walton, Sam Walton opened the first Wal-Mart Discount City in Rogers/Arkansas in 1962. Before that, Sam Walton owned 15 Ben Franklin Stores (under franchise contract) under the “Walton 5 & Dime” name. In 1970 Wal-Mart Stores went public with 18 stores and sales of \$ 44 million.

Wal-Mart is a true discount retailer always trying to offer lowest prices. The main difference in the strategy compared to competitors in the 1970s such as Sears, was that Wal-Mart opened stores in small and midsized towns and it was a low-cost competitor right from the beginning. By 1980, the 276 Wal-Mart stores generated \$ 1.2 billion of sales. Throughout the 1980s Wal-Mart encountered rapid growth e.g. by opening SAM’s Wholesale Club in 1983 which is a concept of cash-and-carry, membership-only stores. Moreover, Wal-Mart expanded by acquiring other retailers and forming Joint-Ventures not only in the U.S. with the first one in Mexico in 1992, in the year that Sam Walton died. In the 1990s expansion to Canada, China, Germany, Brazil, South Korea, the UK and other countries followed pathing the way for Wal-Mart to become the biggest company in the world.

In 2000, Lee Scott was appointed as the new CEO and runs operations until now. An important year in the company’s history was 2002 when Wal-Mart opened more than 230 new stores around the world. It was awarded America’s largest corporation by the Fortune magazine. Wal-Mart entered the Japanese market and acquired the biggest supermarket chain in Puerto Rico in 2002 but had to close stores in Germany again due to considerable problems in that market mainly in coping with unions.

By the end of the fiscal year 2004 (January 31, 2004) Wal-Mart had 4,872 stores and sales of more than \$ 250 billion. The number of stores even increased to 5,319 as of March 31, 2005. WM’s retail divisions include “Wal-Mart Stores”, “Supercenters”, “Sam’s Clubs”, “Neighborhood Markets”, the international divisions as well as the

## Implementation of RFID at Wal-Mart – The case study

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internet portal walmart.com. In addition, WM runs speciality divisions such as “Tire&Lube Express”, “Wal-Mart Optical”, “Wal-Mart Pharmacy”, “Wal-Mart Vacations”, “Wal-Mart’s Used Fixture Auctions” and “Wal-Mart Alaska Bush Shopper”. It is the world’s biggest retailer, bigger than the 4 following retailers combined and WM is the 18<sup>th</sup> biggest economy in the world if you compare sales to national GDPs (see Appendix). 19% of sales are generated outside the USA (“Wal-Mart Stores Inc.” Hoover's Company Records 2004). Wal-Mart International runs 1,300 units in 9 different countries with about 303,000 employees. Total sales are divided as one can see from Table 4 and Table 5 showing financial data of the last years.



Wal-Mart Supercenters range from 100,000 square feet to more than 280,000 square feet and offer shoppers a wide variety of goods and services.

Figure 34: A Wal-Mart Supercenter.

Source: Wal-Mart Stores Inc.

With its 1.5 million employees WM is the world’s largest private employer. More than 20 million shoppers visit its stores every year and at least one purchase was made by 82% of U.S. households at Wal-Mart during the year 2002 (“Is Wal-Mart too Powerful?” 2003). The Fortune magazine ranked WM as America’s most admired and largest company in 2003.

The family Walton still owns about 39 % of Wal-Mart stock. Sam Walton’s widow, Helen, the sons Jim, Bob and Rob Walton, who is the company’s chairman and the daughter Alice therefore possess stock worth some \$ 90 billion (about € 70 billion). They are the richest family in the world, equivalent to the GDP of Singapore or the

## Implementation of RFID at Wal-Mart – The case study

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wealth of Bill Gates and Warren Buffet combined. They still influence operations of Wal-Mart and as critics say, the whole US with their decisions (“The Waltons..”: 2004)

	2004 Sales, % of total
Grocery, candy & tobacco	26
Hardgoods (hardware, housewares, auto supplies, small appliances)	20
Softgoods/domestics	16
Electronics	9
Pharmaceuticals	9
Health & beauty aids	7
Sporting goods & toys	6
Stationery, One-hour photo, Jewelry and Shoes	7
Total	100

Table 8: Sales.

Source: “Wal-Mart Stores Inc.” (2004)

Financials: Fiscal year ends Jan 31	2004	2003	2002	2001
Sales (\$ mil.)	256,329.0	244,524.0	217,799.0	191,329.0
Net Income (\$ mil.)	9,054.0	8,039.0	6,671.0	6,295
Net Profit Margin	3.5%	3.3%	3.1%	3.3%
Employees	1,500,000	1,440,350	1,383,000	1,244,000

Table 9: Financial Data on Wal-Mart, Source: “Wal-Mart Stores, Inc.”(2004).

Employee Data on Wal-Mart from “Wal-Mart Stores Inc.” Euromonitor Company Profile April 2004

### **8.2. Internal reasons for implementation**

According to a presentation of, and an interview with Kerry Pauling, the Director of Information systems at Wal-Mart, the company is following their traditional strategy and vision of founder Sam Walton. In his book “Made in America” he described his life and Wal-Mart’s way to the biggest retailer in the world, mentioning his mission and vision which is now taken by Wal-Mart’s management to explain the reasons for the RFID-implementation: “We are agents of our customers ... we have to become the most efficient deliverer of merchandise..” (Walton, Sam: 1992). Everyday Low Price (EDLP) was and still is the main pricing philosophy of Wal-Mart and urges the company to pursue ongoing developments and new technologies in order to be able to offer what



## **Implementation of RFID at Wal-Mart – The case study**

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EDLP requires: “Everyday Low Cost”. It is “Wal-Mart’s obligation to implement RFID” which will “revolutionize how we all do business” and “deliver unimaginable benefits” (Pauling, Kerry: 2004).

There is high potential in RFID which the different applications and futuristic thinking show and Wal-Mart is for sure having further ideas on the technology’s use. At the beginning though, Wal-Mart’s announced aim of the RFID-initiative is primarily to reduce out-of-stocks (OOS) (Kerry Pauling: 2004). This means improved inventory management and the gain of better visibility into the supply chain as Pam Kohn, vice president of the company’s global supply chain operations mentioned it (“Wal-Mart to deploy Auto ID Tags..”: 2003).

Linda Dillman, the CIO of Wal-Mart announced, that the main aim of RFID was to increase product availability (which is the same as decreasing OOS) and therefore create more value for the customer. Besides improved customer satisfaction, RFID should help WM to control costs as the company wrote in a press release (Wal-Mart: 2004a).

According to an analysis of IBM Business Consulting Services of the business value that EPC will bring to corporations, the estimated initial savings for Wal-Mart through RFID will be:

- “\$ 6.7 Billion in reduced labor costs (no bar-code scanning required)
- \$ 600 Million in out-of-stock supply chain cost reduction
- \$ 575 Million in theft reduction
- \$ 300 Million in improved tracking through warehousing and distribution centers
- \$ 180 Million in reduced inventory holding and carrying costs
- ... this represents an \$ 8.4 Billion in annual savings” (IBM quoted in Rockwell Automation: 2004)

According to an A.T. Kearney report of November 2003 the RFID implementation would be an easy trade-off for Wal-Mart. WM has to calculate \$ 100,000 per store and \$ 400,000 per DC. Another \$ 35 million to 40 million will be needed for system integration for the whole company. The report notes, that those were only one-time

fixed costs and that only the benefits from reduced OOS would be about “\$ 700 million in annual revenues to companies for every \$ 1 billion in annual sales (A.T. Kearney quoted by InfoLogix 2005)

As the implementation is one part of an ongoing evolution at Wal-Mart as Kerry Pauling described it, the costs associated with it will be covered by the normal information system budget and no extra financing is necessary for Wal-Mart.

### **8.3. Future Plans**

At the beginning of Wal-Mart’s RFID-plans the company was thinking of an entire RFID-implementation also on item-level but after first meetings with their strategic partners and technology vendors the company soon realized that this would not be possible. The technology and the costs were and still are a too big limiting factor. That is why Wal-Mart came up with the requirement for it’s suppliers to tag cases and pallets only, shipped to the distribution centers beginning in January 2005.

Nevertheless, the potential of this technology as mentioned before in every part of the supply chain makes it inevitable to believe that each company engaged in an RFID-initiative will want to leverage all benefits possible. Concerning retailers, item-level tagging will be introduced in the future although the exact time can not be forecasted yet. Wal-Mart stated that it does not yet have any specific plans of when it requires suppliers to ship every single item with an attached RFID-tag (Pauling, Kerry: 2004). The current implementation on case- and pallet-level and the future developments on the technology side will show when this next step can be taken.

Industry insiders predict that the already existing collaboration of retailers and suppliers will be extended. Initiatives such as Vendor Managed Inventory (VMI) could be expanded and evolve into “Vendor Managed Shelves”. This very drastic but interesting approach could mean for suppliers that they have to pay for the shelves, attached readers, digital labels etc. in the retail stores where their products are sold. They are responsible for the replenishment of the products and special sales discounts in order to push sales. The retailer can of course intervene in the management of the store shelves

but this evolution will lead to great changes in retail supply chains with the first step being the current RFID-implementation on case- and pallet-level.

### **8.4. Measurement of success**

Measurement of success of an RFID-implementation is a critical thing and can be different for each member of the supply chain. In the Wal-Mart case, as the main goal is to reduce out-of-stocks, this was the first starting point for the retailer to evaluate the RFID-implementation. ROI and increased customer satisfaction have to be achieved as a consequence of the implementation as OOS help every member in the supply chain. Wal-Mart says that RFID will lead to a Win-Win situation for everyone. Customers benefit from always filled shelves, suppliers and retailers alike from increased sales (Pauling, Kerry: 2004).

### **8.5. Timeline of the implementation**

In late 2001 a three-phase trial started where small numbers of products and volumes were tested on the pallet level together with the Auto-ID Center and the Uniform Code Council (UCC). Participating companies were Procter&Gamble, International Paper, Unilever, Gillette, Johnson&Johnson and Kraft. In 2002 phase II started with higher volumes and more different products. The first tests were only good for research but after finding the business case and testing RFID-tags on cases and pallets Wal-Mart was committed to “take a brave step” (Linda Dillman, CIO of Wal-Mart). Phase III never really came into effect as the planned item-level tagging phase was scrubbed in 2003 for other initiatives (Kleist et. al. 2004: p. 90).

“The mandate for our top 100 suppliers (U.S. companies) in November (2003) was to evaluate their products to determine what made sense to tag, and come back to us by February (2004) with their merchandise-tagging plan. It took us a little longer to get through all tagging plans. Some suppliers will tag 100% of their product, and others 2%. In aggregate, the total volume will be a little more than 60% going through those facilities in January. It's three distribution centers--less than 3% of our distribution centers; and 150 stores, less than 5% of our stores and clubs. That felt like the correct amount to really give suppliers some incentive to review their organizations” (“Linda Dillman On RFID” 2004)

## **Implementation of RFID at Wal-Mart – The case study**

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In June 2003, Wal-Mart announced that in January 2005 its top 100 suppliers would have to start shipping cases and pallets equipped with RFID-tags. These first 100 mandated suppliers were joined by 37 “volunteers” to ship tagged cases and pallets by January 2005.

On April 30, 2004 Wal-Mart received the first shipments of tagged cases and pallets at the DC in Sanger/Texas. This was an initial trial with only 21 of the more than 100,000 products in a Wal-Mart Supercenter and the beginning of the roll-out of RFID-technology at Wal-Mart. From the 3 DCs participating in the trial the tagged products were shipped to seven local Wal-Mart Supercenters. WM said that they had been testing field equipment since mid-April but no single items had been tagged and were placed on store shelves (Wal-Mart: 2004a). Companies that participated in this test were Gillette, Hewlett-Packard, Johnson&Johnson, Kimberly-Clark, Kraft Foods, Nestlé Purina PetCare Co., Procter&Gamble and Unilever (“Wal-Mart begins RFID rollout”: 2004).

Wal-Mart admitted that although only seven stores in the Dallas/Fort Worth metroplex (see Appendix II) were equipped with readers, there might be tagged cases and pallets shipped to stores throughout the area served by the Sanger distribution center in North Texas and South Central Oklahoma. Furthermore, after increased efforts by suppliers it would be possible that tagged cases and pallets could be found in Wal-Mart stores in the whole U.S.. Even several tagged single-items such as electronics products could be found in WM stores but they would be marked with an EPCglobal symbol. Besides those 3 Hewlett-Packard products ( two printers and a scanner) the other 18 products are cat food, laundry detergent, paper towels, soap, shampoo, shaving cream, toothpaste, feminine hygiene products, lotion, deodorant, and peanuts (Wal-Mart: 2004a).

Only 18 days later Wal-Mart announced in a press release, that the initial roll-out of RFID would become a success and referring to a local TV-station broadcast in Dallas/Texas, the consumers would not be sceptical and are willing to “give EPCs a chance” (Wal-Mart: 2004b)

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Wal-Mart set the deadline for its 18 pharmaceutical suppliers to tag warehouse packs of Class II narcotics by March 31, 2004. After some of them didn't meet the deadline Wal-Mart rescheduled it to June 30 ("RFID Tests Wal-Mart Suppliers": 2004).

In mid-June 2004 Wal-Mart invited its top 100 and several days later the "next 200 suppliers" to the headquarter in Bentonville, Arkansas to "discuss" (according to Linda Dillman, executive vice president and CIO of Wal-Mart Stores) the RFID-implementation which was mainly a refinement of the initial strategy. At this meeting, the suppliers were informed about the plans of WM that RFID systems would be operating in up to six DCs as well as in 250 stores by June 2005. By October 2005, RFID-technology should be implemented in up to 13 DCs and 600 stores. The deadline for the "next 200 suppliers" to tag their cases and pallets shipped to WM would be January 2006 ("Wal-Mart details EPC rollout plan": 2004).

The work on the international rollout will be started after the January 2005 deadline and will probably be in effect not before 2007.

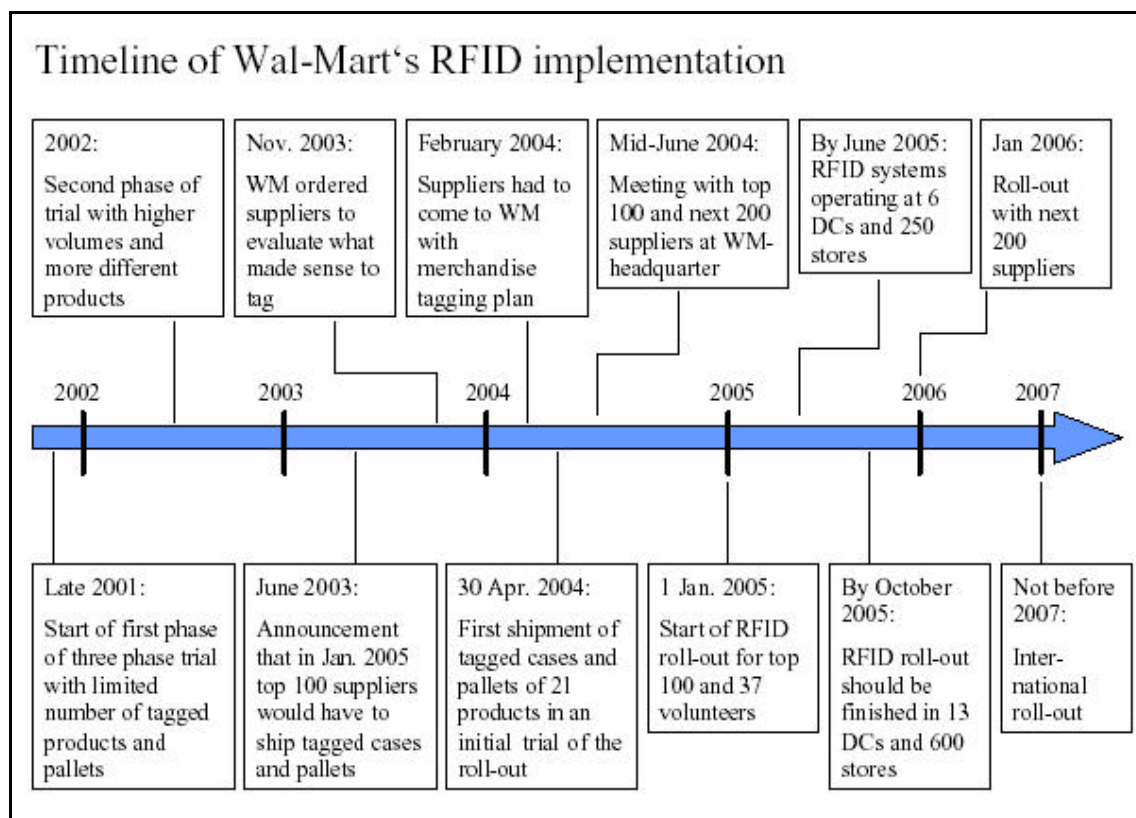


Figure 35: „Timeline of Wal-Mart's RFID implementation.

Source: Own drawing

One might ask why Wal-Mart chose Texas as their area to test the technology and implement it there first. The answer is, that in Texas there is a high density of all the different Wal-Mart stores as well as Sam's club-, Wal-Mart-, and their Pharma-distribution centers which qualified the region as the best to test and introduce RFID.

### **8.6. Technical Requirements**

Technical requirements issued by Wal-Mart to its mandated suppliers have caused communication problems as media coverage in various trade magazines and newspapers have interpreted the requirements differently. Wal-Mart stated from the first announcement on, that they were targeting 100 percent readability of pallet tags through their dock doors and 100 percent readability of individual case tags on their distribution center conveyor belts which runs at a high 600 feet per second (Wal-Mart: 2004a). Nevertheless, and that is probably what might have caused misunderstandings, Wal-Mart never said that they would require all companies to tag all the pallets and cases by their announced dead lines such as 1 January 2005 for the first 100 suppliers.

RFID-tags have “to be on both pallets and cases, including returnable containers, shrink wrapped bundles, bags and direct-to-store delivery trays. On full case pallet shipments, just the pallet tag will be read, not every case. A successful read of pallet tag is defined as a minimum 3 reads at a distance of up to 10 feet (appr. 3 meters) from antenna” (Kleist, et.al 2004: p. 92).

Concerning the technical requirements behind the implementation Wal-Mart stated that those requirements are not sophisticated at all. RFID-tags can be “durable, temporary or permanent read-only 96-bit Class 0 (factory programmed), Class 0+ (WORM version) or Class 1 (WORM<sup>2</sup>)” (Kleist, et.al 2004: p. 91-92). The tags have to be EPC compliant and the operating frequency range is in the UHF spectrum of 866-956 MHz. When the Generation 2 standard is feasible concerning costs, performance and availability, Wal-Mart expects its suppliers to switch to those.

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<sup>2</sup> „WORM-tag: Write Once, Read Many tag, using a type of non-volatile memory that can be written to only once, typically just before it is applied to product or container. Thereafter the information is fixed and can be read only. EPC Class 0+, 1 and UHF Gen 2.” (Kleist, et. al 2004: p. XIX)

Readers used by Wal-Mart have an average range of 15 feet (Wal-Mart: 2004a) and are so-called agile readers being able to handle multiple tag classes and frequencies. As part of the ASN (Advanced Shipment Notice) the EPC data has to be transferred to Wal-Mart ahead of the shipment. This happens via EDI when the packages and pallets are labeled and sealed. The order details in an ASN assigns case numbers with a specific pallet. This will be matched against the pallet ID code when read at the dock door of the distribution center or store. In a next step, the WMS verifies the receipt of the pallet and checks the shipment into inventory or cross-docking (Kleist, et.al 2004: p. 93).

### **8.7. Internal and external communication**

Problems for Wal-Mart concerning opposition by privacy groups started as early as January 2003, when the company announced it's first "smart-shelf" test in a store in Brockton/Massachusetts tracking the sale of Gillette razor blades. From this point on Katherine Albrecht of CASPIAN chased and discredited Wal-Mart. On June 6, 2003 she found smart shelves in use and took photos of them which was always denied by Wal-Mart ("Playing Tag with Shoppers' Anonymity":2004).

CIO Linda Dillman pointed out, that, as a charter member of EPCglobal and a member of the board of directors "Wal-Mart fully adheres to its core principles related to privacy issues, including consumer notice, consumer education and consumer choice. EPC education pamphlets will be available to interested parties at DFW-area [Dallas-Fort Worth] stores. Consumers may choose to retain or remove RFID tags after purchasing the tagged HP products" (Wal-Mart: 2004a). Every item with a RFID-tag sold at Wal-Mart stores will bear the EPC-labels issued by EPCglobal.

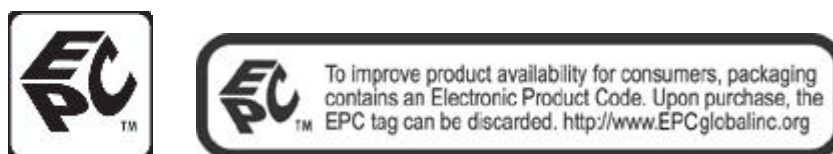


Figure 4: EPC-Labels.

Source: EPCglobal

External communication with suppliers was done in a special way. To better organize communication of Wal-Mart with their suppliers the company assigned an executiv

sponsor and a program sponsor to every supplier in order to keep contact with them (“Talking RFID with...”: 2004). Linda Dillman even stated when being asked what the biggest challenge would be during the implementation, that communication was the important issue. She was talking to the suppliers a lot as they would call every week or nearly every day after reading a new article making them more confused. To make it easier for the suppliers Wal-Mart worked together with Target, one of its biggest competitors in the U.S. retail business, in the project in Dallas using the same standards and requirements (“Linda Dillman On RFID” 2004).

Important is that Wal-Mart announced the pallet- and case-level implementation in the 2nd Quarter of 2003 (June) where it also defined the scope of the implementation. It took them until the 3rd and 4th Quarter of the same year to inform the suppliers on a direct basis, not via media.

### **8.8. Wal-Mart’s Supply Chain**

Wal-Mart uses multiple supply chain strategies. It “moves its goods using a mixture of DC’s, cross-docks and direct-deliveries, depending on the product ... and sells those goods using a combination of conventional, VMI, and consignment supplier relationships” (Taylor: 2004: p. 283). This overlapping strategy of Wal-Mart has not been in place for too long, it was merely an evolvement of a single strategy after seeking for efficiency to dominate the market.

#### **Suppliers:**

Wal-Mart has at least 21,000 suppliers all over the world with other sources even stating up to 68,000. The world’s biggest retailer has such great **power over its suppliers**, that it can enforce nearly everything it wants. Wal-Mart’s strategy to bring the lowest price to its customers is the announced reason for the company to force suppliers to constantly decrease prices. A policy for suppliers is: “On basic products that don’t change, the price Wal-Mart will pay, and will charge shoppers, must drop year after year” (“The Wal-Mart you don’t know”: 2003). This puts high pressure on the suppliers who are very much dependent on Wal-Mart. WM with its sales of more than \$ 250 billion is bigger than the next 4 retailers together. No supplier can neglect sales



generated by a retailer with about 20 million shoppers every year in more than 5,000 stores.

To illustrate the power of Wal-Mart in the supply chain and towards any company it is interesting to mention, that a McKinsey & Co. study found out, that about 12% of US productivity gains in the second half of the 1990s could be traced to Wal-Mart (“The Wal-Mart you don’t know”: 2003). Suppliers have to be incredibly **flexible** when doing business with Wal-Mart. Strict on-time delivery is only a small part of the flexibility a Wal-Mart supplier has to show, adjusting production volumes from one day to the other and shipping high amounts of merchandise to stores all over the US overnight are not rare.

### **Product Sourcing:**

In the mid 1980s a “Buy America” program was initiated by Wal-Mart founder Sam Walton to push the purchase of American-made goods. However, this strategy was abandoned in the 1990s as the company “would not relinquish its position as a low-price leader in order to stock domestic goods at a higher cost” according to CEO Lee Scott (“2005 end of quotas..”:2004). In spring 2004 Scott announced that Wal-Mart would buy from domestic suppliers if the price is not more than 10 percent higher than of a foreign supplier.

The global sourcing division of Wal-Mart, namely Wal-Mart Global Procurement, deploys about 1,000 workers in 24 countries with nearly half of the employees situated in China. In 2003, Wal-Mart imported goods worth a \$15 billion from China which represents nearly 10% of total U.S. imports from that country (“2005 end of quotas..”:2004). WM imports merchandise from about 70 countries, of 64 of those countries merchandise is imported directly. This shows how important global sourcing is for Wal-Mart. Every supplier to sell to WM Global Procurement must sign a **Supplier Agreement** guaranteeing to follow Wal-Mart’s supplier standards. This agreement is a legally binding contractual obligation with penalties if suppliers don’t comply with the agreement. As already mentioned, Wal-Mart uses different **sourcing types** comprising VMI, consignment supplier relationships and conventional relationships.

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The **product selection** at Wal-Mart also includes numerous private-label products which are either directly imported or bought from suppliers who produce and import them for Wal-Mart. A typical Wal-Mart supercenter has more than 70,000 units in stock.

### Inbound transportation:

In general, when the Wal-Mart Global Procurement division directly imports products from suppliers or factories abroad, this division also handles the transportation to WM stores. If a supplier imports the products, he also has to deal with transportation.

Wal-Mart runs a “Corporate Traffic Department” which provides for efficient transportation of merchandise under collect-payment terms from the suppliers to WM’s distribution centers by private carriers under contract or by WM’s own private fleet. Wal-Mart makes sure that it has enough **control over inbound transportation** by requiring suppliers to inform WM of ready loads via EDI or other measures. The supplier agreement specifies all responsibilities of suppliers that have to be abided by. In addition to that, suppliers have to provide detailed load forecast information to facilitate transportation in exceptional peak shipping seasons. This ensures WM to have the highest possible **accuracy and visibility** (Wal-Mart: 2005).

### Processing and Storage:



High-speed conveyor belts and state-of-the-art technology help move merchandise efficiently through the distribution centers, keeping Wal-Mart's nearly 3,000 stores in stock.

Figure 36: Inside a Wal-Mart DC.

Source: Wal-Mart Stores Inc.

## Implementation of RFID at Wal-Mart – The case study

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Wal-Mart operates about 80 distribution centers in the United States only. The company uses the latest **operation methods**. The “Supplier Agreements” by Wal-Mart are a very strict **vendor compliance program** stipulating many terms and conditions.

### **Outbound Transportation:**

Wal-Mart has an own fleet of more than 5,000 trucks and 23,000 trailers with which it supplies its stores usually twice a week. The trucks and trailers travel more than 700 million miles a year to the more than 3,000 stores in the U.S. Through cross-docking, Wal-Mart orders full-truckload shipments and achieves economies of scale (Simchi-Levy et al. 2000, p. 114). One of Wal-Mart’s most important features on the way to supply chain excellency was the own satellite information system.



Wal-Mart's private fleet of 5,000 trucks and 23,000 trailers travel more than 700 million miles a year, delivering everything from groceries to garden tools to the company's nearly 3,000 stores.

Figure 37: Outside a Wal-Mart DC.

Source: Wal-Mart Stores Inc.

### **Store operations:**

**POS-data processing** used to be done by employees with no self-checkouts being installed in the stores. Before the RFID-implementation Wal-Mart faced severe visibility problems in the store backrooms. Although Wal-Mart already invested a lot in the past into various supply chain technologies, the company had 0% visibility in its backroom as Simon Langford put it. That’s why Wal-Mart also installs RFID-readers at the box crusher and trash compactor in the backroom (“RFID is off and running at Wal-Mart”: 2005). **In-Store IT-devices** have been rather rare up to now.

## **Implementation of RFID at Wal-Mart – The case study**

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Wal-Mart has taken a leadership role in Collaborative Planning, Forecasting and Replenishment (CPFR). A huge data warehouse collects information from WM and suppliers making it possible to perform analyses and make informed decisions in real time. **Demand planning** has become much more accurate with WM's forecasting operations that turned into a competitive advantage. The data warehouse collects information such as inventory, forecasts, demographics, markdowns, returns and market baskets ("Forecasting..": 2001). Important to say is that at Wal-Mart stores and supercenters only shopping basket data can be gathered from every single purchase. At Sam's Clubs it is possible to link and analyse various purchases of one individual as the membership card clearly identifies the consumer.

### **Consumers:**

In terms of **loyalty programs** Wal-Mart is following a diverse strategy. On the one hand, as the company's philosophy is to offer "everyday low price" it states, that "Wal-Marts" will never offer loyalty cards to give frequent consumers extra advantages and discounts. WM states that this does not go along with the EDLP-strategy. Every consumer at Wal-Mart will get the best price and therefore doesn't need a loyalty card. It has to be mentioned that this is true for the WM discount stores and supercenters. As Sam's Club is a membership club, every customer has to have such a membership card. It is true that this is not a pure loyalty program with extra discounts for some consumers but as the important thing about such programs is to record sales behavior of certain consumers it does in this respect meet the criteria.

**Power of consumers** over Wal-Mart is really low as the company with its discount strategy is offering incredibly low prices in comparison to competition. Every other retailer knows that there is no way to compete with Wal-Mart over price. There are strong anti-Wal-Mart movements with arguments that WM is destroying the domestic industry in the US, WM is only offering minimum wage jobs, not letting employees join unions etc. Nevertheless it is always mentioned that consumers would have the chance to stop Wal-Mart's success just by not buying there anymore. However, the EDLP strategy of Wal-Mart with unbeatable prices let consumers shop at Wal-Mart. As long as the company can maintain its price leadership, the power of consumers will not be significant as the basis of the US-households with low to middle income will still shop at the cheapest retailer.

## Implementation of RFID at Wal-Mart – The case study

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Wal-Mart's supply chain typology has the following characteristics: Power over suppliers is very high, the number of SKUs is also immense. Average value of SKUs differs a lot although it can be seen as moderately high. Wal-Mart relies entirely on the own fleet of trucks in outbound transportation. There is not a high number of in-store IT-devices yet and Wal-Mart does not rely on loyalty programs except for Sam's Club. The power of consumers is rather low.

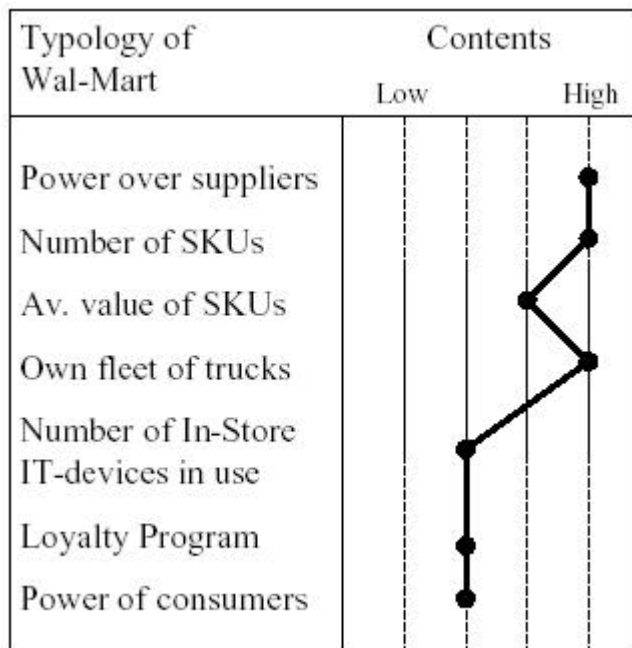


Figure 38: Typology of Wal-Mart

### **9. Analysis of RFID-implementation at the two retail chains**

In the following chapter 9.1., the similarities and differences in the RFID-implementations at the two retail chains are shown and some interesting issues that were discovered through this paper are mentioned. Chapter 9.2. then draws conclusions on the two different supply chain typologies of the retailers and analyses the connections to the a typology that would be beneficial to an RFID implementation.

#### **9.1. Differences in the two RFID-implementations**

First of all there are some differences in the organizational structure of the two retailers. Metro has a separated consumer electronics division, conventional supermarkets as well as supercenters with all kinds of merchandise. Wal-Mart is basically offering the superstore concept with a very broad selection of merchandize. Although both companies do have some successfully proven retail practices in common such as the shop-in-shop concept or the no-frills hypermarket concept. The not-yet existing standardization of operations in the different divisions at Metro led to difficulties during the roll-out. Namely, Metro's consumer electronics divisions could not be integrated in the implementation as their EDI system was not fit yet. It is difficult to say who was better prepared for the roll-out. Metro started the Future Store Initiative in 2002 but the company is far more open in giving out information to the public. Wal-Mart started testing RFID even earlier although it was done more secretly what lead to criticism and concern by privacy groups and consumers. Nevertheless it seems that Wal-Mart had a more holistic approach in the implementation and together with it's immense power it was easier to start such a roll-out.

The two retail chains were the first one to openly state their RFID roll-out plans, Nevertheless or maybe just because of that, a competition started of who would be the first retailer to implement RFID. After Wal-Mart announced the roll-out to start in January 2005, Metro released it's plan to require RFID-tagging from November 2004 on. None the less, the roll-outs were different. Although Metro first mentioned to require it's 100 top suppliers (just like Wal-Mart) to implement RFID already in 2004, there were only 20 companies that started tagging pallets and hanging goods. A gradual

## **Analysis of RFID-implementation at the two retail chains**

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extension throughout 2005 leads the way to the requirement of RFID-tagging on case- and pallet-level by January 2006 for the top 300 suppliers.

At Wal-Mart, the implementation started in January 2005 with the tagging of pallets and cases by the top 100 suppliers and 37 so-called volunteers. The next 200 suppliers were required to ship tagged pallets and cases by January 2006. Although Metro started the RFID-implementation with “only” 20 selected suppliers on pallet level. Nevertheless the company claims victory for itself announcing to be the world’s first retailer to implement RFID.

If one looks at the technical aspects of the implementations itself, it gets obvious that there are not really big differences in the way the two retailers organized the roll-outs. They both confine the implementation to the case and pallet level (although Metro is lagging behind at case level) with the main focus on the biggest hundred suppliers. They have set a similar timetable for the implementation with the same intentions behind it. Both companies require the tags to work in nearly the same frequency band with the same amount of data in the first roll-out.

There is actually a reasonable explanation for those similarities. Both companies are actively engaged in EPCglobal, the standard setting organization for the Electronic Product Code. Each of them has a representative in the Board of Governors, that’s why they openly support those standards and implement them in the course of the roll-outs. They are interested, that as many companies as possible in various industries adopt the EPC standard to install a global standard that will help the technology to succeed and simplify the use of RFID for all parties. Furthermore, many of the biggest suppliers that are engaged in the RFID-roll-out at both retailers are the same, such as Unilever, Procter&Gamble, Johnson&Johnson etc. This makes it a little bit easier for the retailers as well as for the suppliers who also do have a certain say in the implementation then. In addition, the technology companies helping the retailers are also quite often the same such as IBM, Intermec etc.

A huge difference that might be important for the success of RFID is the existence or loyalty card programs. Metro is offering it’s Payback-card in most of the stores being able to record the individual’s shopping history to create shopping profiles and analyze

the data in great detail. In the normal Wal-Mart stores and supercenters no such loyalty program is in place and there is no intention of Wal-Mart to implement such a program. Only at the Sam's Club stores the membership card is taken to record POS-data of every individual. Metro's intention is not only to analyze the shopping baskets of each consumer. The company also wants to use the loyalty card, which should be equipped with an RFID-tag then, for identification of the consumer at the entrance, as a measure to secure no underaged viewing of certain restricted material and many other applications. If consumers can be convinced in the future that they really only profit from such loyalty cards and a widespread implementation is possible, then Metro would gain a significant advantage over other retailers without such a program.

There is of course the difference in the company's strategies that have to be looked at. Wal-Mart wants to be a pure discount retailer with the lowest price at any time. If such an application of RFID would increase product costs just a little bit, they won't implement it as they can offer an even cheaper price compared to the competitor. Metro is definitely no pure discount retailer and is actually struggling with those competitors. What the company actually already does and will focus on even more in the future is to offer value-added services to the consumers. The RFID-loyalty card would be such a service if accepted by consumers.

Resistance against the RFID-roll-outs at the two retail chains more or less started in the United States. Privacy groups and other consumer lobbies are far more active in the US as the totally free market with hardly any interference of the state led to more scandals and awareness of the public. This does not mean, that there is no awareness in Europe for such issues but the outcry of some specific groups in the US is usually much earlier and more intensive than in other parts of the world. This could also be explained with the example of Wal-Mart and Gillette having secret tests on item-level tagging where consumers were even photographed. Resistance in the US to the "spychips", as they were named by the consumer privacy group CASPIAN, might be relatively higher with the CASPIAN's founder Kathrine Albrecht appearing on renowned national TV-channels and being invited to numerous panel discussions. They even call for boycotts with the famous example of [www.boycottgillette.com](http://www.boycottgillette.com).



Yet there is only a small number of US citizens that really care about the probable side-effects RFID could generate. The first wave of implementations is concentrated on the store backroom level as well as on the DC-level. It will take up to 10 more years that item-level tagging will be in place and then one can see if consumers will accept RFID. In addition, the power of Wal-Mart is so big with no real competitor in the price war that most of the consumers will continue to buy at Wal-Mart either because they don't care or they have to buy at the cheapest possibility. The problem for Metro could get more severe if the public does not accept RFID on item-level and in loyalty cards. The pressure from competitors is much higher for Metro. Both retailers have in common that they engage very much in educating consumers about RFID-technology. They know that it is important for them to have consumers on their side.

Finally it has to be said, that it is not yet clear if the implementations at Wal-Mart and Metro will be successful. Both retailers announced promising first results and are optimistic about the future. They have well integrated RFID in their logistics operations and seem to be prepared in the best way for further advancements of RFID in the supply chains.

### ***9.2. Analysis of the supply chain typologies***

In order to be able to draw a conclusion on the various supply chain typologies as they were made in chapter 5 for discount retailers, hypermarket retailers and consumer electronics retailers as well as for Metro in chapter 6 and for Wal-Mart in chapter 7, it is important to show the supply chain typology for a retailer that would be beneficial for an RFID-implementation.

The following figure shows that in order to successfully implement RFID and reap most benefits it is necessary to have great power over suppliers. This will help simplifying mandating suppliers and have them fulfil all requirements. If a high number of SKUs is necessary for a successful RFID implementation is not obvious although it is for sure beneficial to have a certain number to be able to realise economies of scale. The higher the value of the products, the faster an ROI can be generated. An own fleet is definitely beneficial for an RFID-implementation as control over transportation is kept inhouse

## Analysis of RFID-implementation at the two retail chains

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but it is not a necessity. A high number of in-store IT-devices and loyalty programs make it possible to reap a high number of benefits and make the implementation a fast success. The power of consumers over retailers is better to be rather low as difficulties during the roll-out and the first phases will hardly be existent then.

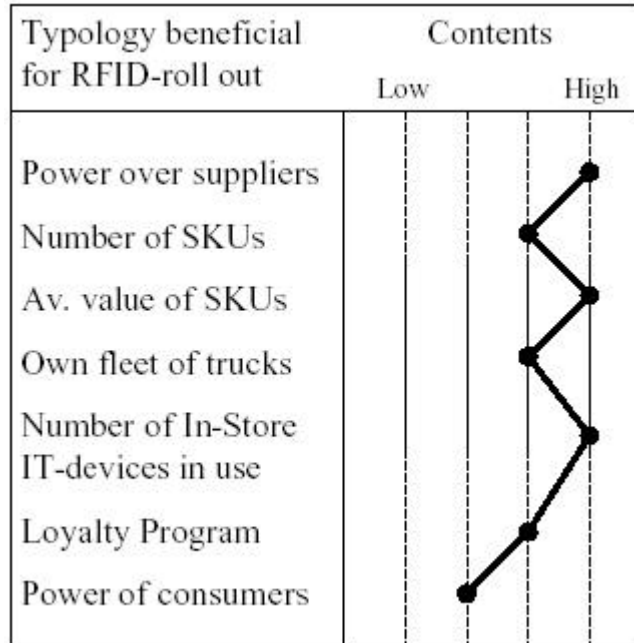


Figure 39: Typology beneficial for RFID-roll out

If one compares this master typology with the supply chain typologies of the three different retail concepts mentioned in chapter 5 it can be seen in figure 40, that discount retailing does significantly not correlate with the RFID-optimal one. The hypermarket concept as well as consumer electronics retailers do have great similarities or at least are very close in many parts to the optimum and could therefore be mentioned as good examples for an RFID-implementation.

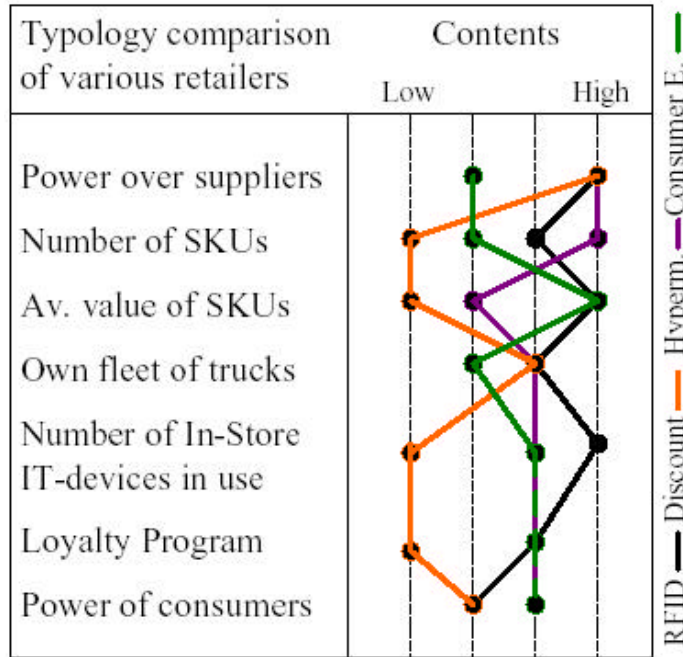


Figure 40: Typology comparison of various retailers

In order to best compare the Metro and Wal-Mart case and their supply chain typologies with the optimum it is necessary to mention some specific issues of the two retailers. Metro Group is a rather diversified retailer with two consumer electronics chains, a kind of hypermarket concept as well as a chain that could be seen as a soft discounter. This makes it very difficult to generalize Metros typology. Wal-Mart does not work with many different retail concepts but it is difficult to put the company into one of the categories. Wal-Mart openly states and emphasises that it is a discount retailer. Yet, by definition it can not really be put into that rather narrow and maybe too European definition. Wal-Mart is definitely not a hard discounter which can also be seen by the fact that the company is having more and more trouble on the home market in the U.S. with emerging hard discounters such as Aldi. It could be seen as a soft discounter as the company also relies on brand labels and offers a high number of SKUs. Wal-Mart might have to be seen as a combination of a soft discounter and a hypermarket. The retailer does meet a lot of criteria of a hypermarket such as the huge number of SKUs and the department store like concept in the supermarket. Figure 41 shows the nevertheless existing similarities of Metros and Wal-Marts supply chain typologies.

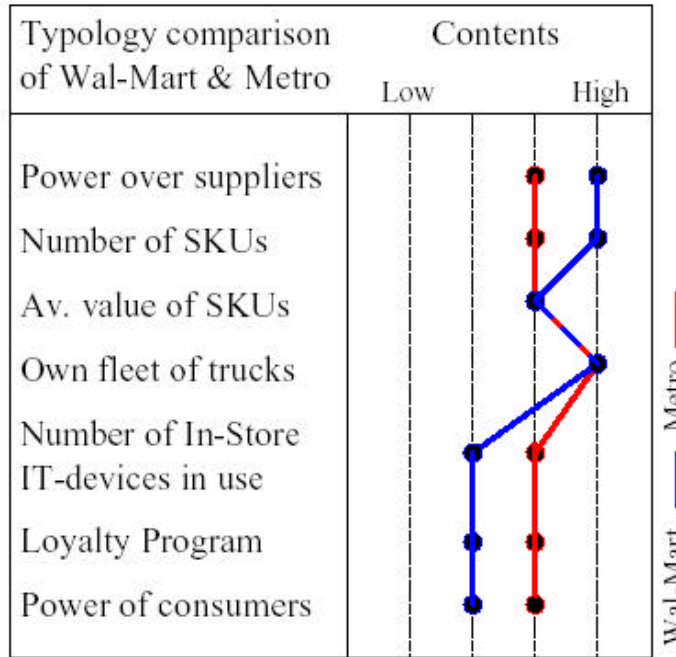


Figure 41: Typology comparison of Wal-Mart and Metro

Compared to the typology beneficial to an RFID-roll out it can be seen that Metro might be a little bit closer to the optimum especially in the in-store IT-device category but yet the two supply chains show great correlations with the optimum. Together with other important aspects that have to be considered such as the size of the supply chain, the willingness to apply new technologies and support innovations in retailing it can be said that Wal-Mart and Metro do have the requirements to successfully implement RFID.

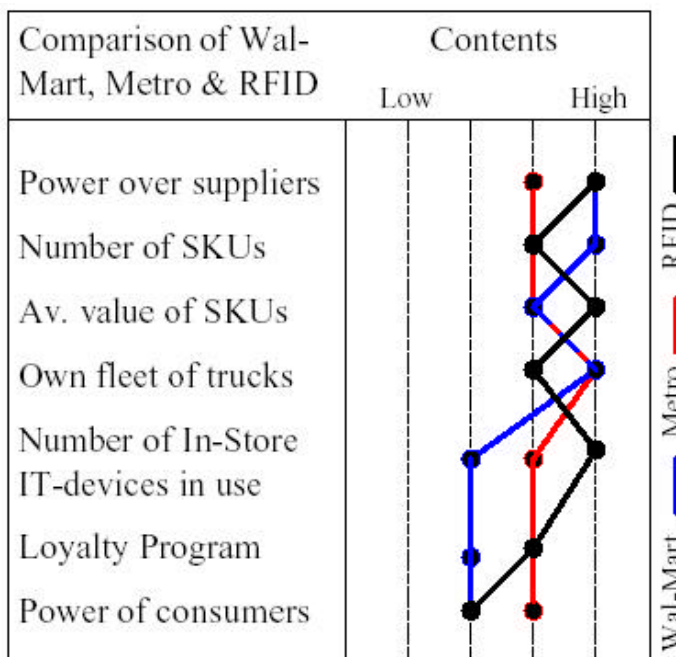


Figure 42: Comparison of Wal-Mart, Metro and RFID typology

### 10. Transferability of RFID-technology

This chapter assesses the possibility of transferring RFID-technology to other companies and industries. The author thinks, that it was made clear in this paper, that a certain size of a company is important to mandate the company's suppliers to implement RFID and ship only products with an attached RFID-tag. In the retail industry however, the power of retailers is generally much bigger in comparison to suppliers.

RFID can not be stopped anymore in this industry at least on case- and pallet-level and suppliers will have to comply with the requirements set out by the retailers. Suppliers should see the benefits they can generate from such an RFID-implementation, in their own business operations as well as in the whole supply chain. RFID-tags attached to transport units can increase visibility and decrease costs of lost units, warehouse management with RFID is another good reason to implement RFID. Primarily though, the suppliers should see the chance of getting some of the information back they lost to retailers through the POS operations with barcodes. As visibility in the whole supply chain increases, suppliers will get more accurate, real-time information on sales of their products.

It is the question of how those two implementations will have an effect on other industries. The difference in the size of the two retailers and their supply chains is an issue that has to be considered. An implementation like the one at Wal-Mart can not easily be copied. The DoD-implementation of RFID might be an equivalent but the scope of business is very different. The size of the supply chain shows similarities with the DoD having the biggest supply chain in the world and Wal-Mart is the biggest company in the world in terms of sale. It might even be that the DoD is the main powerhouse for the U.S.-wide breakthrough of RFID throughout all industries but those two roll-outs with their immense power over suppliers can not be easily duplicated.

Especially the two implementations of RFID at Wal-Mart and the DoD will have great effects on huge parts of the US industry. Thousands of suppliers have to implement RFID along their operations and will force again their suppliers to use the technology doing their business. Those side-effects will trigger a kind of a "boom", which will only

start in some years after a great number of suppliers have implemented RFID themselves. The greatest problem nowadays is actually the price of the technology. Tag prices of more than 20 Eurocent just don't legitimate a widespread adoption. Particularly such huge roll-outs with great amounts of RFID-tags needed push the price and make the technology more interesting for other companies and industries.

Furthermore, the role of privacy advocates and their power is not yet clear. It is not sure at this moment if consumers will accept the implementations without any objections as widespread roll-outs will take some more years.

Nevertheless, RFID itself has already made its way into many different industries as one could read in chapter 3.5. with various applications of RFID. Benefits don't have to be necessarily generated in the whole supply chain, companies can leverage the benefits of this technology internally by using the key advantages. Such advantages are the increased visibility of items equipped with RFID-tags, the ability to store great amounts of data on the tags as well as the reading of data via RF without line-of-sight.

Generally, an RFID roll-out requires a huge amount of trust between the parties. A new way of thinking of the management is necessary to leverage all the possible benefits from RFID. Collaboration is key and will decide about the success or failure of RFID in any industry or company.

In order to assess if a retail supply chain is beneficial to an RFID-implementation it is possible and advised to look at figure 39 and compare this typology with the retailer's one who is planning an RFID-roll out. It has to be said that many other aspects have to be looked at but as one could see from the comparison with Wal-Mart and Metro it can be taken as a guideline to the requirements of an RFID-implementation.

### 11. Conclusion

This thesis shows in a very memorable way the potential of RFID in the future and the way how the business of retailing will be evolved in the next years. Pressure on retailers is very high to decrease costs even further and leverage efficiency throughout the supply chain. That is why retailers are pushing actively new technologies and some of them see RFID as an answer to most of today's challenges in their business.

RFID definitely offers immense opportunities in the way retailing is conducted and the technology will shape the industry to a great extent over the next years. It is nevertheless not yet clear how exactly the industry will be effected in the long run. Furthermore it is not possible yet to put the benefits in numbers that retailers expect and will see from the roll-outs. Many open questions can not be answered at the time being and issues such as concern of the public has to be taken seriously and proactively to be able to make a real success out of RFID.

A certain size and power is needed for retailers to mandate suppliers to implement RFID, yet we will see that no retailer will be able to stay behind implementing such a technology that changes the way business is done to a huge extent. The current roll-outs, conducted only on case- and pallet-level, will not yet bring obvious changes for consumers and that's why it is necessary to wait some 5, 10 or maybe even 15 more years before it could get really interesting for consumers as well as for retailers.

It is undeniable, that already the current implementations at the retailers will bring huge benefits in the supply chain and as soon as reluctance of suppliers disappears entirely widespread roll-outs in many different companies and industries will make RFID as normal as barcodes became in the last 20 years. This paper showed that the supply chains of Wal-Mart and Metro do have the requirements that are beneficial to an RFID-implementation and there is a great chance that they will be successful in the end.

It will be interesting to see if all the visions of the future will come true as it was described in the introduction. Furthermore, will there be an "outsourcing of the supply chain" by retailers as it would be the case with vendor managed shelves? Many issues

are not clear yet, but it will only take a decade or two until we really can see the whole range of developments that RFID will bring and how our lives will be changed by that.



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### **Interviews:**

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## Appendix I:

## Top 200 Global Retailers

DT Rank	Country of Origin	Name of Company	Formats	2002 Group Sales* (US\$mil)	2002 Retail Sales (US\$mil)	2002 Group Income/(Loss)* (US\$mil)	Countries of Operation	5 yr Retail Sales CAGR% (Local Currency)	5 yr Net Income CAGR% (Local Currency)
1	US	Wal-Mart	Discount, Hypermarket, Supermarket, Superstore, Warehouse	244,524	229,617	8,039	Argentina, Brazil, Canada, China, Germany, Japan, South Korea, Mexico, Puerto Rico, UK, US	14.2%	17.9%
2	France	Carrefour	Cash & Carry, Convenience, Discount, Hypermarket, Specialty, Supermarket	65,011	65,011	1,314	Argentina, Belgium, Brazil, Chile, China, Columbia, Czech Rep., Dominican Republic, Egypt, France, Greece, Indonesia, Italy, Japan, Malaysia, Mexico, Oman, Poland, Portugal, Qatar, Romania, Singapore, Slovakia, Spain, S. Korea, Switzerland, Taiwan, Thailand, Tunisia, Turkey, UAE	18.7%	20.5%
3	US	Home Depot	DIY, Specialty	58,247	58,247	3,664	Canada, Mexico, Puerto Rico, US	19.2%	25.9%
4	US	Kroger	Convenience, Discount, Specialty, Supermarket, Warehouse	51,760	51,760	1,205	US	14.3%	23.9%
5	Germany	Metro	Cash & Carry, Department, DIY, Hypermarket, Specialty, Superstore	48,738	48,349	475	Austria, Belgium, Bulgaria, China, Croatia, Czech Rep., Denmark, France, Germany, Greece, Hungary, Italy, Japan, Luxembourg, Morocco, Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Spain, Switzerland, Turkey, UK, Vietnam	12.4%	9.6%
6	US	Target	Department, Discount, Superstore	43,917	42,722	1,654	US	9.0%	17.1%
7	Netherlands	Ahold	Cash & Carry, Convenience, Discount, Drug, Hypermarket, Specialty, Supermarket	59,292	40,755	(1,143)	Argentina, Brazil, Chile, Costa Rica, Czech Rep., Denmark, Ecuador, El Salvador, Estonia, Guatemala, Honduras, Indonesia, Latvia, Lithuania, Malaysia, Netherlands, Nicaragua, Norway, Paraguay, Peru, Poland, Portugal, Slovakia, Spain, Sweden, Thailand, US	12.5%	NM
8	UK	Tesco	Convenience, Department, Hypermarket, Supermarket, Superstore	40,394	40,071	1,451	Czech Rep., Hungary, Rep. of Ireland, Malaysia, Poland, S. Korea, Slovakia, Taiwan, Thailand, UK	9.7%	13.4%
9	US	Costco	Warehouse	37,993	37,993	700	Canada, Japan, S. Korea, Mexico, Puerto Rico, Taiwan, UK, US	9.8%	72.4%
10	US	Sears	Department, Mail Order, Specialty, e-commerce	41,366	35,698	1,376	Canada, Puerto Rico, US	-2.9%	3.0%
11	US	Albertsons	Drug, Supermarket, Warehouse	35,626	35,626	485	US	19.4%	-1.3%
12	Germany	Aldi Einkauf	Discount, Supermarket	33,837 <sup>f</sup>	33,837 <sup>f</sup>	n/a	Australia, Austria, Belgium, Denmark, France, Germany, Luxembourg, Netherlands, Rep. of Ireland, Spain, UK, US	15.2%	n/a
13	US	Safeway, Inc	Supermarket	32,399	32,399	(828)	Canada, Mexico, US	7.6%	NM
14	US	JCPenney	Department, Drug, Mail Order	32,347	32,347	405	Brazil, Puerto Rico, US	1.8%	-6.5%
15	France	Intermarche	Cash & Carry, Convenience, Discount, DIY, Food Service, Specialty, Supermarket, Superstore	31,688 <sup>e</sup>	31,688 <sup>e</sup>	n/a	Belgium, France, Germany, Poland, Portugal, Romania, Spain	9.2%	n/a

\*includes non-retail n/a - not available NM - not meaningful e - estimate  
CAGR - Compound Annual Growth Rate Name after forward slash is retail segment of parent company

Source: Deloitte 2004 : « 2004 Global Powers of Retailing »

<http://www.deloitte.com/dtt/newsletter/0,1012,sid%253D1010%2526cid%253D35911,00.html>.

Accessed on 09/23/04

**Appendix II:**

**The stores that participated in Wal-Mart's North Texas pilot were located in the communities of:**

The Colony  
Wal-Mart Supercenter  
4691 State Hwy 121  
The Colony, TX 75056

Decatur  
Wal-Mart Supercenter Store #421  
800 S US Hwy 81/287  
Decatur, TX 76234

Denton  
Wal-Mart Supercenter Store #467  
1515 South Loop 288  
Denton, TX 76208

Hickory Creek  
Wal-Mart Supercenter Store #3286  
1035 Hickory Creek Blvd  
Hickory Creek/Dento, TX 76210

Lewisville  
Wal-Mart Supercenter Store #217  
801 West Main  
Lewisville, TX 75067

Wal-Mart Supercenter Store #5092  
190 East FM 3040  
Lewisville, TX 75067

Plano  
Wal-Mart Supercenter Store #2883  
8801 Ohio Drive  
Plano, TX 75024

Source: Wal-Mart (2004d): "Radio Frequency Identification (RFID) Usage – FAQ"  
[www.walmartstoresinc.com](http://www.walmartstoresinc.com). Accessed on 09/29/04

**Appendix III:**

The following suppliers were involved in phase one of the RFID rollout at Metro:

- Colgate-Palmolive GmbH
- Dr. August Oetker Nahrungsmittel KG

- Esprit Europe Services GmbH
- Gerry Weber Service International GmbH
- Gillette Gruppe Deutschland GmbH & Co. oHG
- GlaxoSmithKline GmbH & Co. KG
- Hakle-Kimberly Deutschland GmbH
- Henkel Wasch & Reinigungsmittel GmbH
- Johnson&Johnson GmbH
- Kraft Foods Deutschland GmbH
- Lever Fabergé Deutschland GmbH
- Maggi GmbH
- Nestlé GmbH
- Pap Star Vertriebs GmbH & Co. KG
- Procter & Gamble GmbH
- SCA Hygiene Products AG / GmbH
- Schwartauer Werke GmbH & Co. KG
- Schwarzkopf & Henkel Cosmetics GmbH
- Triumph International AG
- Unilever Bestfoods Deutschland GmbH

Source: [http://www.future-store.org/servlet/PB/-s/1d6z2jduwij631tt1k1x1ar4aa11gzdbd/menu/1003975\\_12/1109168933503.html](http://www.future-store.org/servlet/PB/-s/1d6z2jduwij631tt1k1x1ar4aa11gzdbd/menu/1003975_12/1109168933503.html)