AUTO–ID LABS

# An Adoption Strategy for an Open RFID Standard

## *Potentials for RFID in the Automotive Aftermarket*

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# Management Summary

This paper presents an adoption strategy for an open RFID standard for the automotive industry and points out why to differentiate between open and closed loop systems for RFID applications.

The automotive industry is facing multiple challenges simultaneously. Firstly, vehicle manufacturers (VM) and their suppliers are struggling to save costs in an unfriendly industrial economy. Secondly, the automotive industry has to invest in new technologies like RFID in order to meet the requirements of new laws and regulations. Furthermore, the industry has to satisfy emerging demands of their customers for new and more services in order to retain customers' loyalty.

In closed loop systems RFID is already in use. The well-known example for container tracking and management clearly shows the value of RFID applications for the automotive supply chain. The payback period is less than one year and a positive return on investment of more than 350% is be generated after three years of implementation.[1] For closed loop systems there is no initial need for an open and global standard. For the use of RFID in internal operations and 1:1 relationships with suppliers the number of users/participants is small enough that it is possible for the automotive industry to develop an own data structure and to manage the number range for these applications.

In contrast to closed loop systems, RFID applications in open loop systems as in the automotive aftermarket require an open and global standard because of the global scale. In order to meet the demands of the upcoming laws and regulations of the European Commission the vehicle manufacturers will have to establish an open standard anyway. In addition to that, the enormous number of users, associations, and manufacturers all over the world will make it unreasonable and costly to develop and to manage a proprietary standard while an open and global standard already exists.

In contrast, the use of an open and global standard in open loop systems will lead to decreasing costs for hardware and software (tags, readers, etc.) supporting the selected standard. From a mid-term perspective it would than make sense to apply the same equipment, and possibly the standard as well (because subscription/license fees are already paid), also to closed loop systems. This would save additional costs of RFID adoptions.

In conclusion the adoption strategy for an open RFID standard should not be to approach closed loop systems but rather to go for applications in open loop systems like the automotive aftermarket. Resulting savings for hardware and software by an increasing number of users/participants could establish closed loop applications without exerting an influence.

[1] See Henke, M.; Binder, S. (2005), p. 29.

# 1. Scope

This paper is intended to give an abstract overview of the German automotive value chain with a strong focus on the automotive aftermarket. The scope is to identify its structure, recent trends, new regulations and laws and the resulting consequences for the automotive industry. The study aims to develop an adoption strategy for an open RFID standard for the automotive industry. The main questions this paper has to answer are:

- What does the automotive value chain look like (abstract view)?
- How is the aftermarket structured in Germany (detailed view)?
- Where is the market potential for an open standard in this framework?

Section B describes the entire automotive value chain in an overview. After that it gives a survey of the corporate finance and recent mergers in the automotive industry section. The strategic challenges for the industry are described as well as the strategic importance of RFID. Finally, the relevance of RFID for the automotive industry is illustrated using the results of a market study.

Section C focuses on the automotive aftermarket. After a detailed description of its structure, trends in the market and the resulting consequences for the automotive industry are analyzed. This section closes with the key findings.

In Section D the outcomes are summarized and recommendations for further action are provided.

# 2. The Automotive Industry

## 2.1. Automotive Value Chain

The value chain for the automotive industry in Germany can be structured into seven steps (see figure 1).

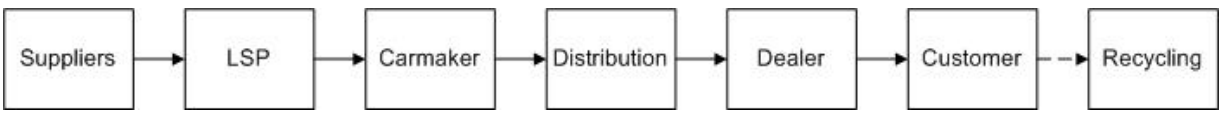


**Figure 1: Automotive Value Chain.**

In the following, the elements of the value chain are described briefly. Section C will provide a closer look at specific elements.

**Supplier**

A supplier is a manufacturer of (preliminary) products or modules for the vehicle manufacturer (e.g. Bosch, Continental, etc.). Suppliers can be split up into tier 1, tier 2, tier 3, etc. suppliers. This segmentation depends on their proximity to the production of their customers and that of the carmaker.

**Logistics Service Provider (LSP)**

LSPs are responsible for the transport, warehousing, picking and other logistics services and value-added services between suppliers and carmakers. There are different types of LSPs (see table 1).

| Type of LSP | Characteristics | Examples |
|---|---|---|
| Traditional LSP | • Transportation services, provision of carriers<br>• Own assets<br>• Strong competitive pressure<br>• Highly efficient processes and low costs of services | Freight forwarders (air, rail, road, sea) |
| 3PL and 4PL | • Global supply chain management<br>• Value-added services<br>• Transportation business mainly outsourced to subcontractors<br>• Many traditional LSPs grow into 3PLs | DHL, Excel Kühne&Nagel, TPG |

**Table 1: Different Types of LSPs (Source: Fleisch, E. et al. (2004a), p. 5).**

The traditional LSPs offer transportation services to their customers and provide carriers. They own the assets in most cases. They face a strong competitive market environment and have therefore developed highly efficient processes.

Third- and fourth-party logistics service providers (3PL, 4PL) manage global supply chains for their customers. In addition, they offer value-added services. The transportation business is mainly outsourced to subcontractors. Many traditional LSPs evolve into 3PLs, which provides for higher profits in the logistics market.

**Carmaker**

The final products, i.e. passenger cars or commercial vehicles, are built at the carmaker's manufacturing plant. Suppliers deliver shipments to their customers with the help of the LSP.

The goods are labeled with the Global Transport Label (GTL) which includes different barcodes and plain text to identify the shipment. The logistics processes are mainly steered by barcode systems. Data between suppliers and carmakers is exchanged via EDI.

At present, RFID is often used in internal operations (e.g. tagging of cable looms) or in closed loop systems including suppliers (e.g. reusable containers). In the far-distant future it is foreseeable that the GTL will be replaced by RFID tags.

**Distribution**

Cars are distributed from the manufacturer's plant to dealers around the world. The vehicles are picked up by truck or loaded onto special trains for transport. In most cases the cars are transferred to regional logistics hubs. From here, the journey proceeds by truck, train or ship.

Pickup by the customer is an exception. In the case of Volkswagen, buyers of a new car can choose whether they want the vehicle delivered to the local dealership or prefer to pick it up themselves in the "Auto City" at the VM's facility in Wolfsburg, Germany. The "Auto City" is a theme park of all brands of Volkswagen AG with hotel, restaurant, etc. The distribution process at the "Auto City" is already controlled by RFID.[2]

**Dealer**

Authorized dealers offer customers new cars of a given brand in their showrooms. Carmakers have certain specifications in respect of how the showrooms should look and which models of a brand a dealer is allowed to sell. For example, a dealer's showroom will need to have a specific visual appearance and size for the presentation and purchase of convertibles. If it does not fulfill these requirements the dealer will not be able to order these models from the carmaker.

The dealer's staff can advise potential customers of a new car. They are able to provide specific information about models and options of a brand, supply technical information and help with special issues, e.g. leasing and financing.

**Customer**

The customer buys new cars from an authorized dealership and used cars from a dealership or a private individual. The customer acquires additional services from the dealer's garage or other workshops and spare parts dealers.

**Recycling**

In the European Union in particular there are clear and strict regulations regarding the end-of-life management of cars. With the "End-of-Life Vehicle (ELV) Directive", for example, the European Commission has set a 2015 recycling and recovery target of 95% for the components of old/used cars . Consequently, being able to monitor and track the origin of cars and parts is set to become far more important than it is today.

[2] See Wessel, R. (2005).

The next chapter provides an overview of the recent mergers and acquisitions in the automotive industry to give an impression of the situation in this global market and the concentration of activities.

## 2.2. Global Market Overview

In "Corporate Finance – Insights 2004/2005 – Automotive Sector", Price Waterhouse Coopers gives an overview of the situation in the global automotive industry.[3] Consolidation is still a major issue, with merger and acquisition activities increasing by 24% to a total of $26 billion in 2004 from $21 billion in 2003.

Consolidation continues to focus on the components sector of the automotive industry in particular. In 2004, 211 deals with a value of $9.1 billion were completed (2003: 262 deals, $12.8 billion). Component-related transactions in 2004 accounted for 41% of total merger and acquisition activities (2004: 45%). The biggest deal was completed in the United States (Cooper Standard Automotive) for $1.2 billion while all other transactions took place in the mid market. After years of dominating the global automotive components market the business of the large US groups is influenced by the situation of Ford and General Motors (GM).[4]

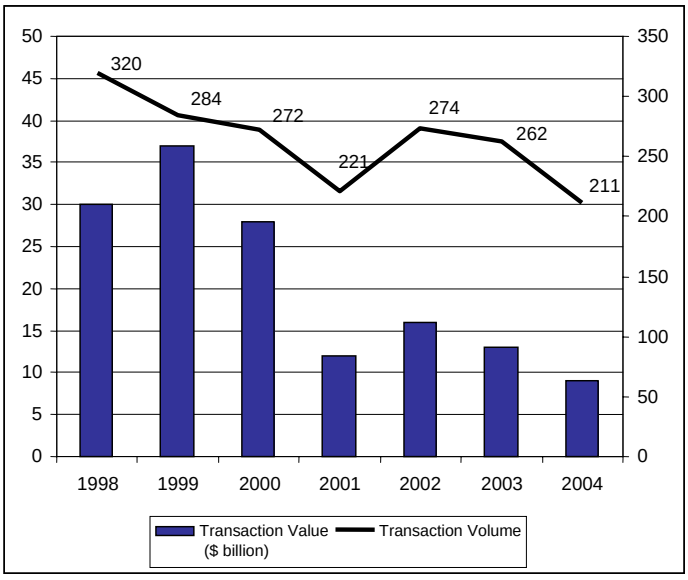


**Figure 2: M&A Activity in the Automotive Supplier Sector 1998-2004 (Source: PWC (2005b), p. 2.).**

The merger and acquisition activities of the vehicle manufacturers themselves are way behind those of the supplier sector. In 2004, most deals were focused on South-East Asia,

[3] See PWC (2005b).
[4] See PWC (2005b), p. 2.

especially China and Japan. The value of transactions in 2004 fell by 36% to $2.3 billion from $3.6 billion in 2003. PWC predicts that the major consolidation in the VM market has already taken place and that carmakers will be aiming to fill strategic gaps in the next few years. Only two of the top ten transactions were in car production and both involved domestic Chinese deals. The biggest deal in 2004 was the $489 million purchase of Mitsubishi Fuso Truck & Bus by DaimlerChrysler. Table 2 shows the top ten transactions of vehicle manufacturers in 2004.[5]

| Rank | Target | Target Nation | Buyer | | Buyer Nation | Deal Value ($ million) | % acquired |
|---|---|---|---|---|---|---|---|
| 1 | Mitsubishi Fuso Truck & Bus | JPN | DaimlerChrysler | Trade | DEU | 489 | 22 |
| 2 | Sea Societa' Europea Autocaravan | ITA | Bridgepoint Capital | Financial | GBR | 241 | 60 |
| 3 | Aprillia | ITA | Piaggio | Trade | ITA | 196 | 100 |
| 4 | Transbus International | GBR | Alexander Dennis | Financial | GBR | 161 | 100 |
| 5 | Beijin Automobile Investment | CHN | Shanghai Matsuoka | Trade | CHN | 133 | 16 |
| 6 | C&C Distributor | USA | Thule | Trade | USA | 120 | 80 |
| 7 | Dennis Eagle | GBR | Bridgepoint Capital & ABN Amro | Financial | GBR | 94 | 100 |
| 8 | MV Augusta Motor | ITA | Proton Holdings | Trade | MYS | 84 | 55 |
| 9 | Jerr-Dan Corp | USA | Oshkosh Truck Corp | Trade | USA | 80 | 100 |
| 10 | Jiangling Automobile Group | CHN | Chongqing Changan Automobile | Trade | CHN | 60 | 50 |

**Table 2: Global Top Ten Disclosed Vehicle Manufacturer M&A Transactions, 2004 (Source: PWC (2005b), p. 6.).**

In the vehicle retail, aftermarket and rental/leasing segment, 239 deals were completed in 2004. In 2003, there were 259 deals but the transaction value increased by 215% from $4.6 billion to $14.5 billion in 2004. Seven of the top ten transactions took place in the aftermarket business (see table 3).[6]

| Rank | Segment | Target | Target Nation | Buyer | | Buyer Nation | Deal Value ($ million) | % acquired |
|---|---|---|---|---|---|---|---|---|
| 1 | Aftermarket | Automobile Association | GBR | CVC and Primira | Financial | GBR | 3,184 | 100 |
| 2 | Rental/Leasing | LeasePlan Corp. | NL | Volkswagen | Trade | DEU | 2,520 | 100 |
| 3 | Aftermarket | Autoteile Unger | DEU | Kohlberg Karvis Roberts & Co | Financial | USA | 1,818 | 100 |
| 4 | Aftermarket | Automotive Aftermarket Group (Dana) | USA | Cypress Group | Financial | USA | 1,025 | 100 |
| 5 | Aftermarket | Thule | SWE | Candover | Financial | GBR | 695 | 83 |
| 6 | Aftermarket | IMO Car Wash Group | GBR | JP Morgan Chase & Co | Financial | USA | 627 | 100 |
| 7 | Aftermarket | Grupo Imsa (Batteries Div.) | MEX | Johnson Controls | Trade | USA | 525 | 51 |
| 8 | Rental/Leasing | Elcon Finans | NOR | Banco Santander Central Hispano | Trade | SPN | 521 | 100 |
| 9 | Retail | CD Bramali | GBR | Pendragon | Trade | GBR | 425 | 100 |
| 10 | Aftermarket | Douglas Dynamics | USA | Aurora Capital Group | Financial | USA | 260 | 100 |

**Table 3: Global Top Ten Disclosed Automotive Retail, Aftermarket, Rental/Leasing and Wholesale M&A Transactions, 2004 (Source: PWC (2005b), p. 8.).**

[5] See PWC (2005b), p. 6.
[6] See PWC (2005b), p. 7.

The rental and leasing segment of the automotive industry saw increasing deal values due to the Volkswagen acquisition of LeasePlan in the Netherlands ($2.5 billion). As a consequence, the transaction value rose to $3.3 billion from $1.3 billion in 2003. The overall deal volume increased from 27 in 2003 to 36 in 2004.[7]

Consolidation in the vehicle retail market is still ongoing. After 135 transactions last year with a value of $689 million, this year saw the completion of 100 deals with a value of $1.6 billion. The largest was the $425 million acquisition of CD Bramall by Pendragon. The Pendragon Group is the largest vehicle dealership in the UK. However, consolidation activities fell short of expectations. The revised block exemption regulation of the European Commission (see C.2), which governs the relationship between vehicle manufacturers, dealerships and repair shops, came into force in October 2003. From then on franchised dealers have been allowed to purchase parts from sources other than the OEM.[8]

Table 4 provides an overview of all merger and acquisition activity by sub-sectors in the year 2004.

| M&A Activity | Deal Value ($ million) | Total Number of Deals | Average Disclosed Deal Value ($ million) | Number of Disclosed Deals | Number of Disclosed Deals % of Total | % of Total Deal Value | % of Total Number of Deals |
|---|---|---|---|---|---|---|---|
| Vehicle Manufacturer | 2,304.2 | 65 | 64.0 | 36 | 55.4 | 8.9 | 12.6 |
| Component Supplier | 9,053.6 | 211 | 81.6 | 111 | 52.6 | 35.0 | 41.0 |
| Retail | 1,617.6 | 100 | 38.5 | 42 | 42.0 | 6.2 | 19.4 |
| Aftermarket | 9,438.5 | 105 | 242.0 | 39 | 37.1 | 36.5 | 20.4 |
| Rental/Leasing | 3,322.7 | 27 | 415.3 | 8 | 29.6 | 12.8 | 5.2 |
| Wholesaler | 145.4 | 7 | 48.5 | 3 | 42.9 | 0.6 | 1.4 |
| **Total** | **25,882.1** | **515** | **108.3** | **239** | **46.4** | **100** | **100** |

**Table 4: Automotive Merger and Acquisition Activity by Sub-Sector in 2004 (Source: PWC (2005b), p. 9.).**

Europe took over the leading role in respect of transaction activity. In 2004, 255 deals worth $15.2 billion were completed. This accounts for 58% of the overall global M&A activities. In the United States the development trend was the reverse. Last year, 136 deals with a combined value of $6.6 billion were noted, which is 27% of the total deal value. The different development compared to Europe is explained by the lack of mega-deals in the region. In Asia both the volume and value of deals declined to 90 deals with a combined value of $3.1 billion. Table 5 shows the development of the different regions over the last few years.[9]

[7] See PWC (2005b), p. 8.
[8] See PWC (2005b), p. 9.
[9] See PWC (2005b), p. 10.

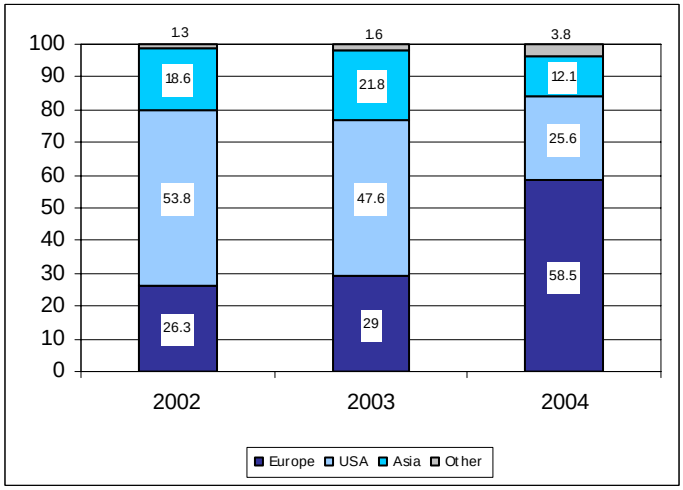


**Figure 3: Disclosed Deal Value by Region in % 2002-2004 (Source: PWC (2005b), p. 10.).**

The described situation has as well a strong influence on the strategic challenges the automotive industry is facing at the moment as the next chapter will show.

## 2.3. Strategic Challenges

The automotive industry is facing six major strategic challenges and trends in their supply chains at the moment (see figure 4).


**Figure 4: Strategic Trends in Supply Chain Management (Source: Fleisch, E. et al. (2004b), p. 5.).**

- Demand chain (shift from push to pull): To be able to react rapidly to customer orders, manufacturers are shifting their production planning from long-term production planning to flexible short-term planning. This modification changes the entire supply chain. Each link in the chain places orders with its supplier based on current demand. It is therefore necessary to achieve efficiency in these processes in order to increase collaboration and information exchange between supply chain players.

- Customer focus: To maximize their value creation, manufacturers in the automotive industry are looking for new ways to offer more and improved services to their customers. For example, they are offering more value-added services like telematics, entertainment, vehicle financing services, or improved and faster after-sales services. Better maintenance and repair services and improved availability of spare parts are the main focus of the vehicle manufacturers (VM).
- Outsourcing/Decentralization: VMs are still outsourcing upstream activities to suppliers and LSPs. The result is a downward shift along the automotive value chain. Examples are the production of entire systems or even vehicles, in-house logistics, information services and tracking & tracing services. This means that suppliers and LSPs provide larger parts of the value generation and thus need to achieve higher system and vehicle knowledge. The requirements for information exchange are increasing in order to maintain visibility and control over the supply chain.
- Mass customization: There is a growing tendency for customers to order new cars which are equipped to meet their individual choice. The number of different variants and the related complexity of in-house logistics and assembly processes are increasing with every new model. For example, a customer who orders a new VW Golf is theoretically able to customize the car from 2.8 billion different variants.[10] The challenge is to achieve high process flexibility while also maintaining an efficient supply chain that supports just-in-time (JIT) and just-in-sequence (JIS) manufacturing.
- Total Quality Management (TQM): Today, high quality is required by customers and increasingly enforced by law. To ensure the safety of cars, these new laws require the documentation of certain assembly processes and the traceability of parts. Deficits in quality will lead to claims and recall actions which are very expensive.
- Life cycle compression: The life cycle of vehicle models is still decreasing. BMW will offer an average of 3.7 new models a year by 2010. In the 1970s the average was 0.7.[11] This means that there is less time to set up or change production layouts and logistics processes. These changes are a potential source of errors during the ramp-up of new vehicles and can increase time-to-market, which will leads to a loss of sales.[12]

## 2.4. Strategic Importance of RFID

The strategic challenges mentioned in B.2 are the starting point for showing the strategic relevance of RFID technology for the automotive industry. RFID enables significant improvements in sensitive processes: an RFID implementation will lead to improved handling efficiency through reliable automatic identification without manual/human intervention as well as providing bulk reading and higher data granularity due to real-time and accurate product related data (see table 5).[13]

[10] See Software Forum Bayern e.V. (2003), p. 13.
[11] See Software Forum Bayern e.V. (2003), p. 13.
[12] See Fleisch, E. et al. (2004b), p. 6.
[13] See Fleisch, E. et al. (2004b), p. 7.

| Strategic Challenge | Critical Processes | Features of RFID Used | Contribution of RFID |
|---|---|---|---|
| • Customer focus | • Production control<br>• Distribution<br>• Maintenance | • Unique identification<br>• Real-time information about product | ***Supportive,*** improvements in after-sales services, but no main driver for value generation |
| • Demand chain | • Planning<br>• Inventory management<br>• Production control<br>• Distribution<br>• Tracking & tracing | • Handling efficiency<br>• Accurate data<br>• Real-time information | ***High*****,** RFID enables a new dimension in process efficiency, reliability and flexibility |
| • Outsourcing | • Asset management<br>• Tracking & tracing | • Accurate data<br>• Real-time information | ***Supportive,*** improved process reliability but no major driver for outsourcing |
| • Mass customization | • Production control<br>• Quality control | • Unique identification<br>• No manual handling | ***High*****,** management of complexity, reliable and efficient |
| • Total quality management | • Production control<br>• Quality control | • Handling efficiency<br>• Accurate data | ***High*****,** efficient error avoidance |
| • Life cycle compression | • Planning<br>• Production control (warm-up)<br>• Tracking & tracing | • Accurate data<br>• Handling efficiency | ***Supportive*****,** improvements in operations, but not for planning or product development |

**Table 5: Support of RFID for Critical Processes and Strategic Challenges (Source: Fleisch, E. et al (2004b), p. 8).**

### Customer Focus

In order to increase value creation in the business-to-customer (B2C) relation, it is necessary to identify customer needs. With this information, car manufacturers will be able to offer new and improved services. A first step toward improving customer service would be the implementation of the demand chain with a more reliable delivery process. A possible application could be the ability to set up a fixed date for the delivery of the customer's new car.

It is essential to know the exact configuration of the customer's product if the manufacturer is to react with specific service offerings in after-sales to meet the customer's needs,. With RFID it would be possible to store information on the complete lifetime of the product. Using this information, manufacturers or authorized dealers and shops would be able to offer improved maintenance and support. For example, the serial numbers of spare parts could be stored automatically during assembly.[14]

### Demand Chain

As already mentioned, product lifetime is decreasing and therefore the main challenge is to deal with shorter planning cycles. Orders are dependent on master plans and these plans are made in the short term based on customer needs. This calls for flexibility from the manufacturer as well as from the suppliers in order to adapt to changes in demand in the short term as well, beginning with the tier 1 to the tier 2 supplier and so on throughout the

[14] See Fleisch, E. et al. (2004b), p. 9.

value chain. An alternative to the costly excess stock would be a flexible or agile supply chain. These supply chains require efficient and reliable planning, inventory management, production, and distribution processes.

If production plans are to be reliable, it is absolutely essential to have accurate inventory data to avoid the risk of running out of parts. RFID can help to realize this inventory visibility thanks to its ability to automatically track check-ins and -outs at warehouses or any desired location in the manufacturing plant or in the supply chain. RFID makes it possible to prevent mix-ups of parts though errors in the production processes as well as in distribution through automatic control of shipments. Thus incorrect replenishments on the customer's side can be eliminated.[15]

**Outsourcing**

Outsourcing is still an ongoing trend in nearly all industry sectors. Logistics in particular are no longer seen as a core competency by many manufacturers and therefore outsourced to logistics service providers. Outsourcing always increases the risk of quality deficits. Manufacturers therefore develop exacting service level agreements with clearly defined key performance indicators (KPI) to minimize these risks. If manufacturers are to capture trusted data of this type for KPIs they must be able to monitor their processes and the performance of their service providers.

At present, there is no technology in practical use which is able to provide this high quality data. As an extension to a common IT infrastructure, RFID would deliver the necessary visibility and would also help in controlling outsourced processes. With the ability to track processes automatically, RFID reduces the risks of outsourcing. [16]

**Mass Customization**

As mentioned before, products are increasingly being differently equipped for each individual customer. The challenge is the efficient assembly of different products and variants on the same production line according to customer orders. The greater the number of variants assembled on the same production line, the higher the risk that parts of these variants will be mixed up. This risk is even higher if a necessary part is missing and the sequence of parts that are delivered on a JIS basis suffers as a result. Wrongly configured cars either need to be repaired or in the worst case scrapped. This requires additional effort to ensure correct part identification, careful comparison of serial numbers and variant numbers as well as quality checks.

RFID could easily fulfill these requirements for identifying parts and therefore reduce the risk of parts being mixed up. Cable trees are an example where carmakers already use RFID for automatic identification.[17]

[15] See Fleisch, E. et al. (2004b), p. 8.
[16] See Fleisch, E. et al. (2004b), p. 9.
[17] See Fleisch, E. et al. (2004b), p. 10.

**Total Quality Management**

Today, high quality is absolutely essential to meet customer requirements. But quality is not only expected as a basic service it is also required by law. If products fail, manufacturers may face long and expensive lawsuits. As a consequence, many quality checks are implemented during the assembly of a car to prevent mistakes. Errors which are nonetheless discovered during these checks and the costs for these quality checks have a significant impact on total production costs. As described previously for mass customization, the automatic identification of parts with RFID during assembly can be used to achieve a higher level of quality control integration as part of the production process to prevent such errors.

If errors are discovered after delivery to the customer, products may need to be recalled in some cases. Reasons for a recall of products include errors in the design of the product or quality defects in individual components. It is always important to act as quickly and efficiently as possible in the case of a recall action. Such operations are very expensive. Besides the loss of public brand image, the task of identifying and addressing the correct customers is costly. Data on where the affected products and parts have been used could help in limiting recalls by pinpointing the customers concerned.

RFID might well be the solution to this problem. Configuration data recorded during the assembly process could be linked to the customer's contact details after purchase. Leaving privacy issues aside at this point, this recorded data would be helpful when starting smarter recall actions without negative publicity for the manufacturer.[18]

**Life Cycle Compression**

Flexible supply chains and production processes are increasingly required for the ever shorter product life cycles. The ramp-up for new models is always a challenge for supply chain management and production processes. RFID can support process execution, as described above, on condition that the planning of the new processes has been performed carefully.

Vehicle manufacturers are currently facing another challenge in spare parts management and distribution. Spare parts need to be stocked for a minimum of ten years after the last model of a series has been sold. Due to the increasing number of variants and their customization, the number of parts is increasing at a breathtaking pace. Life cycle compression also applies to the parts themselves. Today, nearly 30% of the parts in a car are electronic. When changes are made to the design of these parts or in the case of software updates, etc., is extremely critical for VMs to store the correct amount of spare parts to ensure subsequent availability. Knowledge about the configuration of purchased cars and their maintenance history could be used for improved forecasting of quantities of parts needed and could be provided by RFID.

RFID will be a key supporting technology to address these challenges. Even for the automotive supply chain, which has the reputation of being quite efficient compared to other industries, there is still a potential for improvement. Carmakers are dependent on their

[18] See Fleisch, E. et al. (2004b), p. 10.

suppliers for a large number of parts, components and modules and therefore have a considerable interest in improved supply chain visibility and information accuracy.[19]

## 2.5. RFID in the Automotive Industry

The previous paragraphs summarized current trends in the automotive industry. But what do decision-makers think about RFID today? And what examples of RFID pilots and implementations already exist? This section will provide a short overview.

Together with Booz Allen Hamilton (BAH), the M-Lab of the University of St.Gallen and the ETH Zürich conducted a survey of RFID strategies and their adoption in the automotive industry.[20] In this survey nearly 50% of all companies interviewed stated that RFID has a strategic relevance for them. Applications as described above are nonetheless a long way off. The RFID applications that can be found today are more or less closed loop systems for internal operations or at most include one supplier. However, half of the companies see themselves as innovators in adoption, which supports the importance of RFID (see figure 5). On the other hand, the RFID teams in the automotive industry are in most cases not positioned at corporate level and in no case was a clear strategic RFID roadmap mentioned. The benefits of a RFID implementation are often seen on the operational level of individual production plants and sub-processes. That is why many players along the automotive supply chain are acting from an operational perspective only, and as yet do not realize the strategic opportunity of RFID.[21]

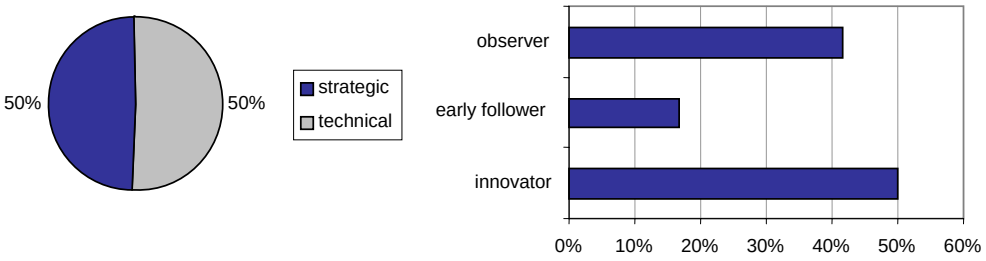


**Figure 5: Attitude toward RFID (Source: Fleisch, E. et al. (2004b), p. 13.).**

RFID has been used for more than a decade for production control, e.g. for work-in-progress tracking, asset tracking or container tracking. Improving local process efficiency is the main goal of these applications which are not related to the strategic perspective of RFID. Figure 6 gives an overview of the rate of concepts, pilots and operative applications.

[19] See Fleisch, E. et al. (2004b), p. 11.
[20] See Fleisch, E. et al. (2004b).
[21] See Fleisch, E. et al. (2004b), p. 13.

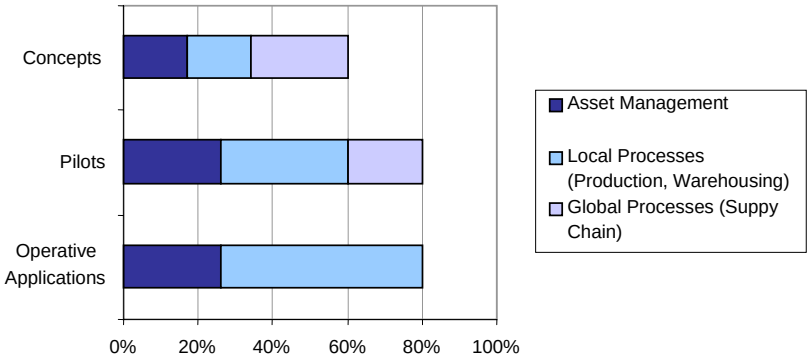


**Figure 6: Concepts, Pilots and Operative Applications (Source: Fleisch, E. et al. (2004b), p. 14.).**

The automotive industry is already well advanced in the adoption of RFID, as the study shows. 80% of the companies have at least one operative application, 80% have started no less than one pilot project and 60% have applications in the concept phase.

### Motivation for the Use of RFID

The motivation for using RFID is to improve the efficiency of operational processes such as inventory management, production and distribution. New service offerings and new products related to RFID are possible, too (see figure 7). Some manufacturers even see the attachment of product-related data as a value-added service.

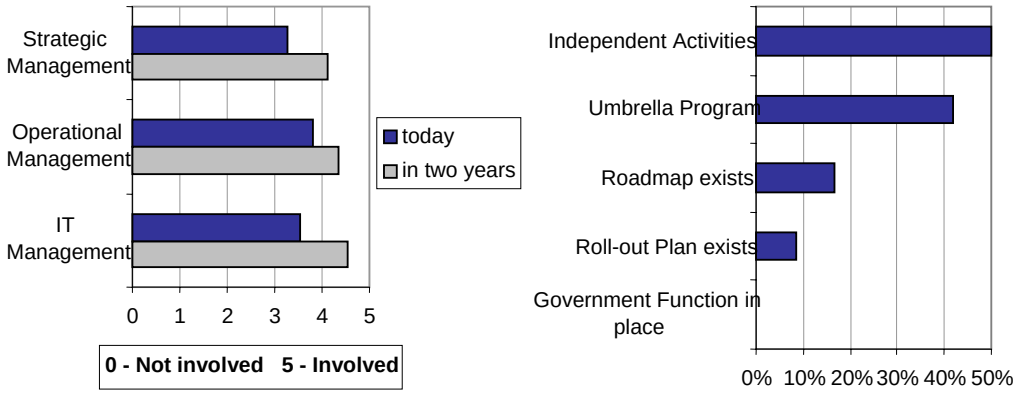


**Figure 7: Internal vs. External Motivation for RFID (Source: Fleisch, E. et al. (2004b), p. 16.).**

The monitoring and visibility of supply chains seems to be the most important issue for companies. Therefore, the ability to track & trace with RFID technology would seem to have the greatest potential. The availability of accurate data could be used to forecast critical situations on the supply side. Improvements in local supply chains and internal operations

like check-in and check-out at warehouses, inventory management, and distribution are mainly driven by enhanced handling efficiency and the avoidance of errors. Other important issues are asset management, production control, after-sales and services and security-related RFID applications (see figure 8).


**Figure 8: Priority of RFID Applications (Source: Fleisch, E. et al. (2004b), p. 17.).**

At present, most pilots are focused on track and trace. Good examples of RFID implementations in vehicle distribution come from Identec Solutions whose customers Volkswagen, BMW and Toyota are already using the system. Active RFID tags in cars help locate the vehicle in the parking lot. From there, the cars are moved to the predelivery process. Through labor savings and higher productivity, Volkswagen recovered the costs of the system after one year and also gained 20% more space in its holding lot by moving the cars through the system faster. Volkswagen plans to adopt the system for dealer delivery as well.[22]

# 3. Focus: Automotive Aftermarket

Possible RFID applications with a positive ROI such as container tracking and asset management are at present closed loop systems. The parties involved are the VM and a small number of suppliers who are already connected via EDI, WMS, etc. Why should these stakeholders invest in an open standard in addition to the hardware and software costs of a RFID implementation? There is no need for a global standard or the ability to track and trace via the Internet.

[22] See Wessel, R. (2005).

As far as implementing RFID on the production side of the supply chain is concerned, the statement is clear: more automation is not forthcoming at the moment. “There is not a lot of spare cash around to be spent on a new technology.”[23] Carmakers want to enforce cost savings down the value chain in particular.[24] At present, most processes on the supply side work with barcode systems. The automotive industry invested a lot of money in these processes which have an error rate of about 1%. Making large investments in RFID technology to eliminate a 1% error rate might seem nonsensical. At the moment, VMs fail to realize the additional opportunities of RFID adoption throughout the whole supply chain.

It would therefore appear advisable to focus on the aftermarket for future RFID implementations. On the one hand because 50% of the VMs profits are made in this still growing market and on the other hand because of upcoming regulations and laws. The third and most important reason is customer satisfaction and brand loyality because this is the principle reason for success in competition. Customers demand for high quality products and services. Therefore RFID could help to reduce delivery times and error ratios in the spare parts market. Additionally the ability to track and trace on item level would establish the possibility for a better recall action management with lower damage of the companies image.

Spare parts and vehicles are delivered all over the world when they leave the closed loop systems of VMs and suppliers. For this reason it is not merely of interest but in fact necessary to be able to track parts wherever they appear in the world and to obtain information about these parts e.g. via the Internet. In contrast to closed loop applications open loop systems require a global and open standard and there is no room for national solo attempts.

**Starting Point**

In the German automotive industry strong competition has already resulted in lower profit margins on traditional new car sales. Today, VMs are generating 50% of their profits through the aftermarket and franchise dealers receive up to 90% of their overall profits though after-sales services. BAH predicts that these profits will probably be reduced by 30-50% in the next three to five years, e.g. due to the block exemption regulation of the European Commission (BER) and additional economic factors. That is why vehicle manufacturers have started to focus more strongly on the aftermarket and to save their profits by advancing customer service and therefore strengthening brand and dealer loyalty. Thus, segment II automobiles, i.e. cars that are five to seven years old, are becoming a very interesting market for manufacturers. Carmakers are trying to maintain dealer loyalty by leveraging their logistics system for spare parts through the speed and frequency of delivery, technical support and price. With additional guarantees, financing and service contracts for used cars, VMs will be able to build stronger ties with the owners of older vehicles.[25]

VMs react to customer demand: 92% plan to increase their investments in new models (2002: 95%) and 94% in new technologies (2002: 88%) which are recognizable for the customers or generate a higher product value.[26]

[23] See KPMG (2004), p. 6.
[24] See KPMG (2004), p. 8.
[25] See BAH (2004).
[26] See KPMG (2004), p. 9.

This study focuses on the aftermarket of the automotive industry including distribution and vehicle end-of-life management (see figure 9).

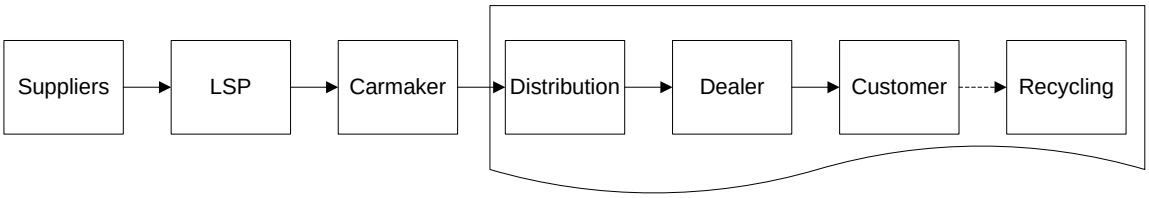


**Figure 9: Analyzed Section of the Automotive Value Chain.**

## 3.1. Structure of Analyzed Section

### Distribution

After assembly and predelivery checks, finished cars are distributed to dealerships all over the world. For this purpose, carmakers use logistic carriers which transport the cars by truck and/or train.

### Dealer and Customer

The relationship and service offerings between dealer and customers can be structured in more detail, as shown below (see figure 10).

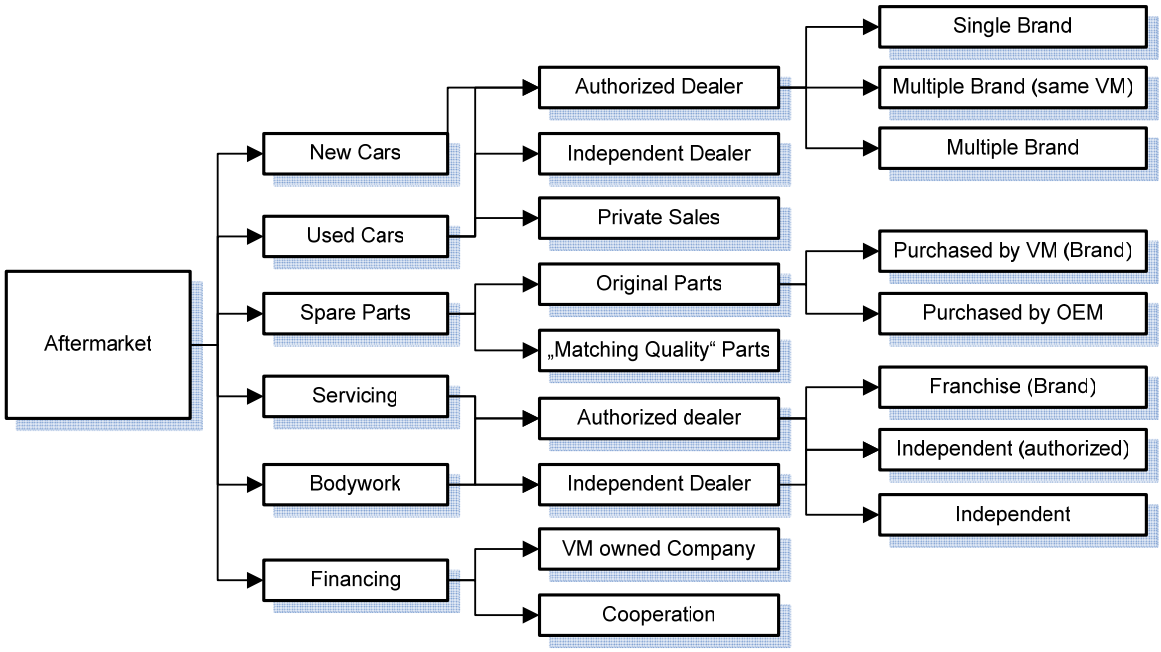


**Figure 10: Structure of the Aftermarket.**

An initial classification of the automotive aftermarket and respectively the offered products and services is possible as follows:

- New cars
- Used cars
- Spare parts
- Servicing
- Bodywork
- Financing

**New Cars**

New cars are sold by authorized dealers. These dealers usually sell one brand, sometimes more than one brand but of the same carmaker (e.g. Volkswagen and Audi; Toyota and Lexus, Chrysler and Dodge), or multiple brands from different manufacturers. The latter constellation is new in the European automotive market. The "Block Exemption Regulation (BER)" of the European Commission aims to ensure that customers are able to compare products and get better deals. Under the previous regime authorized dealers were not allowed to sell different brands in one showroom. If they wanted to sell cars from different carmakers they had to set up different showrooms. That is why 75% of all dealerships sell only a single brand. Now dealers are allowed to sell competing products in the same showroom, although vehicle manufacturers can insist that their brands are displayed in a "brand-specific" area and represent up to 30% of the supply of new cars.[27] Dealers are also allowed to sell their cars through intermediaries like supermarkets, brokers and internet operators.[28]

**Used Cars**

Used cars are sold by authorized dealers, independent dealers or by private individuals. There are no special regulations relating to the sale of used cars.

**Spare Parts**

Spare parts are sold from authorized dealer's garages or from independent shops (e.g. ATU Germany). Most shops offer repair and assembly services. Spare parts can be purchased as "original parts" or as "matching quality" parts. "Original part" means that the part is produced by the OEM and the vehicle manufacturer's supplier and is the same part which is used during assembly of the car at the manufacturing plant. These parts are normally labeled with the carmaker's brand and/or the supplier's name or brand (e.g. BMW, Bosch). "Matching quality" parts are produced by third-party manufacturers which are not suppliers to the vehicle manufacturers.

[27] See PWC (2003a), p. 4.
[28] See PWC (2003a), p. 3.

**Servicing and Bodywork**

Servicing and bodywork are offered by authorized dealers as well as by independent garages. Authorized dealers are garages of the vehicle manufacturer's brand, in most cases the car dealers (franchise system). However, independent garages (e.g. ATU Germany) can also become authorized by the manufacturers. This is a new regulation adopted by the European Commission.

**Financing**

Today, many customers do not pay for their car in cash but finance or lease the vehicle. This applies to individual people and a single car as well as to companies and entire fleets. Most of the vehicle manufacturers run their own leasing and financing companies (e.g. BMW's Alphabet) or their own bank (e.g. Volkswagen Bank). In addition, there are many offers from vehicle manufacturers in cooperation with independent commercial banks.

## 3.2. Trends and Consequences

As well as industry development and economic factors, new regulations and laws have impacts on the automotive industry. The block exemption regulation (BER) became effective on October 1st, 2003, and governs the way manufacturers distribute their products. This regulation is designed to promote intra-brand competition and the harmonization of prices across Europe as well as giving dealers more independence from the carmakers and liberalizing the provision of after-sales services and the procurement of spare parts. As a consequence, the relationship between carmakers, dealers, automotive technology providers, spare parts suppliers and last but not least customers has altered. With the BER, the European Commission aims to ensure that customers also get better deals and better services after buying a new car. The costs for after-sales services currently account for about 40% of the total cost of owning a car over its lifetime.[29]

**Block Exemption Regulation (BER)**

The BER will stimulate competition in the automotive aftermarket. It will therefore reduce the number of existing dealerships in the European Union. Price Waterhouse Coopers (PWC) predicts that by 2010 the number of dealerships will be reduced by 50%. As a result, there will be much greater intra-brand and inter-brand competition.

Effects of the BER can already be observed: the VMs are competing to retain control of the spare parts market. Some manufacturers have repriced their parts, extended the warranty periods or offered better services to authorized repair shops to encourage loyalty. Volkswagen reacted by increasing the number of traveling salespeople. Other carmakers offer rapid overnight delivery of original parts to authorized dealers only, while some vehicle

[29] See PWC (2003a), p. 4.

manufacturers have set up their own repair brands (Renault “Minute”, Volkswagen “Stop and Go”, DaimlerChrysler (France) “Service Factory”).[30]

Greater competition will improve and require higher performance standards. Vehicle manufacturers will demand higher performance from authorized dealers and retailers. In turn, best performing dealers/retailers will be able to leverage their size and market position and as a consequence will be able to demand higher standards from the carmakers as well. Carmakers will be encouraged to engineer cars that need less frequent servicing and are therefore less subject to inconsistencies in the quality of the after-sales service.[31]

The BER affects after-sales service in particular. Since carmakers have to authorize independent garages if they fulfill the VM’s technical requirements, they have to bear higher risks. The vehicle’s warranty will continue to apply regardless of where the car was bought or serviced as long as this was done by an authorized repairer.[32]

The improvements in car design and production have turned after-sales service into a very important business for the automotive industry. The technical performance of vehicles and the cost of ownership of used cars has become a key selling point for carmakers. Because the life cycle of a car is getting longer, a car now has four owners as opposed to three owners ten years ago. This in turn means that the repair business is becoming more important for VMs and their value creation. Today, many customers who own cars outside the warranty period have their cars repaired at independent garages and fast-fit operators to save money. As the competition to service used cars grows in intensity, after-sales servicing is likely to become a major battlefield.[33]

80% of cars that are less than four years old and 40% of older cars are serviced by authorized dealerships. 20% of the spare parts used during repair and service are made by the carmakers themselves, the rest are bought in from authorized spare part producers and sold. VMs manage the entire distribution of spare parts; they have invested a great deal in parts procurement, logistics, cataloguing and IT systems. In return, they take a gross margin of as much as 65% for performing this role. With the advent of the BER, this situation changed because authorized repairers can now buy spare parts directly from authorized manufacturers as well as from the carmaker itself. They are also allowed to purchase “matching quality” spare parts if the customer is paying for the repair. Independent repairers can buy spare parts from any one of these three sources. This means that the original parts business can be short-circuited and the VMs stand to lose a big portion of their after-sales service business.[34]

**Cross-Border Sales**

Another problem is cross-border sales within the European Union. It would be possible for parts belonging the same manufacturer’s network to be in competition with one another. In the past, VMs were able to adjust their prices to reduce the impact of factors like different tax regimes and different economies. That was possible because cross-border sales were

[30] See PWC (2005a), p. 7.
[31] See PWC (2003a), p. 2.
[32] See PWC (2003a), p. 5.
[33] See PWC (2003a), p. 5.
[34] See PWC (2003a), p. 5.

relatively rare. However, parallel importing is now increasing since customers can buy parts in countries were list prices have been kept low due to high taxes.[35]

**New Sales Channels**

Furthermore, there will be an increasing workload for developing new retail formats including internet sales, shipping and support, after-sales and accessories services. PWC presumes that in the future dealers could work with the same concepts that retailers use today. Vehicle manufacturers might purchase floor and shelf space for cars and spare parts to ensure that their models are properly displayed and spare parts are available for customers. Different carmakers would then have to compete both for space and for the most favorable locations and product displays in the store.[36]

**End-of-Life Vehicle (ELV) Directive**

Additional requirements relating to a transparent vehicle and part history stem from the "End-of-Life Vehicle (ELV) Directive" of the European Commission. Car manufacturers have to guarantee the recycling of a certain percentage of all parts and materials used in a vehicle. This means that they have to take back old cars and recycle the vehicles at their own expense. It would therefore be profitable to know how many cars of what age and condition including what parts (e.g. hazardous materials which are no longer in use) are in circulation so that recycling capacities can be planned accordingly.[37] At present, the only data available to the manufacturers relates to car deregistration . However, it is a much more difficult task to track whether these cars eventually become ELVs in the European Union (e.g. exports to Eastern Europe).[38]

**Consequences**

All these changes and new distribution models call for better information about cars, parts and customers. At the moment, VMs only obtain information about a car and a customer when a new car is sold, through a financial relationship, e.g. leasing, and if the car needs maintenance during the warranty period. After that the VM is not able to obtain any further information. Many carmakers have started to use vehicle identification numbers to track the cars. All manufacturers are eager to glean more information both on the life cycle of the cars and the customers who have bought them as a minimum to be able to promote new models and to strengthen brand loyalty. At the same time, customers would also benefit from a better exchange of information. At present, a repair shop which is not the customer's usual garage has no information regarding the car's service history. A better exchange of information would make it possible for that information to be globally available.[39]

[35] See PWC (2003a), p. 6.
[36] See PWC (2003a), p. 4.
[37] See PWC (2002), p. 3/6.
[38] See PWC (2002), p. 8.
[39] See PWC (2003b), p. 4.

## 3.3. Key Findings

At present, most RFID applications and pilots in the automotive industry are focused on closed loop systems. These applications complete the payback-period within a year with a positive ROI after three years of 364%.[40] Because these systems are closed there is no outright need for a global standard. Furthermore, VMs and suppliers are not willing to invest in another technology on the production side at the moment because of cost saving goals and the general economic environment.

RFID applications in the aftermarket are rare. Many ideas are visions, some are at the stage of pilot studies but many of them could become reality because they are qualified to support the carmakers' strategies regarding improved after-sales service and customer loyalty. A Soreon study enumerates possible RFID applications for spare parts/original parts, anti-theft security, warning systems, pay systems (pay per use), access control, fleet management, recycling, warranty issues, product recalls, etc. for the automotive aftermarket.[41] The payback-period is predicted to be finalized in the second year after implementation in garages and a positive ROI of 102% for spare parts tagging.[42]

The requirements resulting from the market situation and the BER and ELV regulations are clear. Vehicle manufacturers need higher transparency in their aftermarket supply chain if they are to monitor the history and movement of cars and parts in this market. Revisiting Section 2.3, RFID could be very supportive with regard to the strategic challenges, customer focus, demand chain, total quality management and life cycle compression for the automotive industry. By implementing RFID, VMs and dealers would be able to offer more and improved services to increase customer loyalty and satisfaction.

# 4. Conclusion

This paper presents an adoption strategy for an open RFID standard for the automotive industry and points out why to differentiate between open and closed loop systems for RFID applications:

The automotive industry is facing multiple challenges simultaneously. Firstly, VMs and their suppliers are struggling to save costs in an unfriendly industrial economy. Secondly, the automotive industry has to invest in new technologies like RFID in order to meet the requirements of new laws and regulations. Furthermore, the industry has to satisfy emerging demands of their customers for new and more services in order to retain customers' loyalty.

In closed loop systems RFID is already in use. The well-known example for container tracking and management clearly shows the value of RFID applications for the automotive supply chain. The payback period is less than one year and a positive return on investment

[40] See Henke, M.; Binder, S. (2005), p. 29.
[41] See Henke, M.; Binder, S. (2005), p. 22/27.
[42] See Henke, M.; Binder, S. (2005), p. 30.

of more than 350% is generated after three years of implementation.[43] For closed loop systems there is no initial need for an open and global standard. For the use of RFID in internal operations and 1:1 relationships with suppliers the number of users/participants is small enough that it is possible for the automotive industry to develop an own data structure and to manage the number range for these applications.

In contrast to closed loop systems, RFID applications in open loop systems as in the automotive aftermarket require an open and global standard because of the global scale. In order to meet the demands of the upcoming laws and regulations of the European Commission the vehicle manufacturers will have to establish an open standard anyway. In addition to that, the enormous number of users, associations, and manufacturers all over the world will make it unreasonable and costly to develop and to manage a proprietary standard while an open and global standard already exists.

In contrast, the use of an open and global standard in open loop systems will lead to decreasing costs for hardware and software (tags, readers, etc.) supporting the selected standard. From a mid-term perspective it would than make sense to apply the same equipment, and possibly the standard as well (because subscription/license fees are already paid), also to closed loop systems. This would save additional costs of RFID adoptions.

In conclusion, the adoption strategy for an open RFID standard should not be to approach closed loop systems but rather to go for applications in open loop systems like the automotive aftermarket. Resulting savings for hard- and software by an increasing number of users/participants could establish closed loop applications without exerting an influence.

[43] See Henke, M.; Binder, S. (2005), p. 29.

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