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Thesis

RFID in the Finished Vehicle Logistics

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Table of Contents

1. The automotive logistics industry ..... - 2 -
   1.1 The specification of the finished vehicles logistics ..... - 3 -
   1.2 Barcode system, actual process analyze ..... - 3 -
   1.3 The Radio Frequency Identification (RFID) ..... - 3 -
2. The concurrence strategy according to Michael E. Porter ..... - 4 -
   2.1 Cost Leadership strategy ..... - 4 -
   2.2 Differentiation strategy ..... - 4 -
   2.3 Focus strategies ..... - 4 -
3. RFID specifications ..... - 5 -
   3.1 Active Transponder ..... - 5 -
   3.2 Passive Transponder ..... - 5 -
   3.3 Hybrid Transponder ..... - 6 -
   3.4 Operating frequency ..... - 6 -
   3.5 Reader ..... - 6 -
   3.6 Antennas ..... - 6 -
   3.7 Middleware ..... - 7 -
   3.8 Recommendation Smart Label ..... - 7 -
4. Finished vehicle logistics and RFID SWOT analysis ..... - 8 -
   4.1 Strengths (Finished vehicle logistics) ..... - 8 -
   4.2 Weaknesses (Finished vehicle logistics) ..... - 9 -
   4.3 Opportunity (RFID) ..... - 9 -
   4.4 Treats (RFID) ..... - 10 -
5. The economical investment check ..... - 13 -
   5.1 Business case calculation ..... - 13 -
   5.2 Economical potential of RFID ..... - 13 -
   5.3 Economical potential of RFID ..... - 14 -
   5.4 Net present value method ..... - 15 -
   5.5 Break-Even analysis ..... - 17 -
6. Conclusion ..... - 18 -

List of figures ..... - 20 -

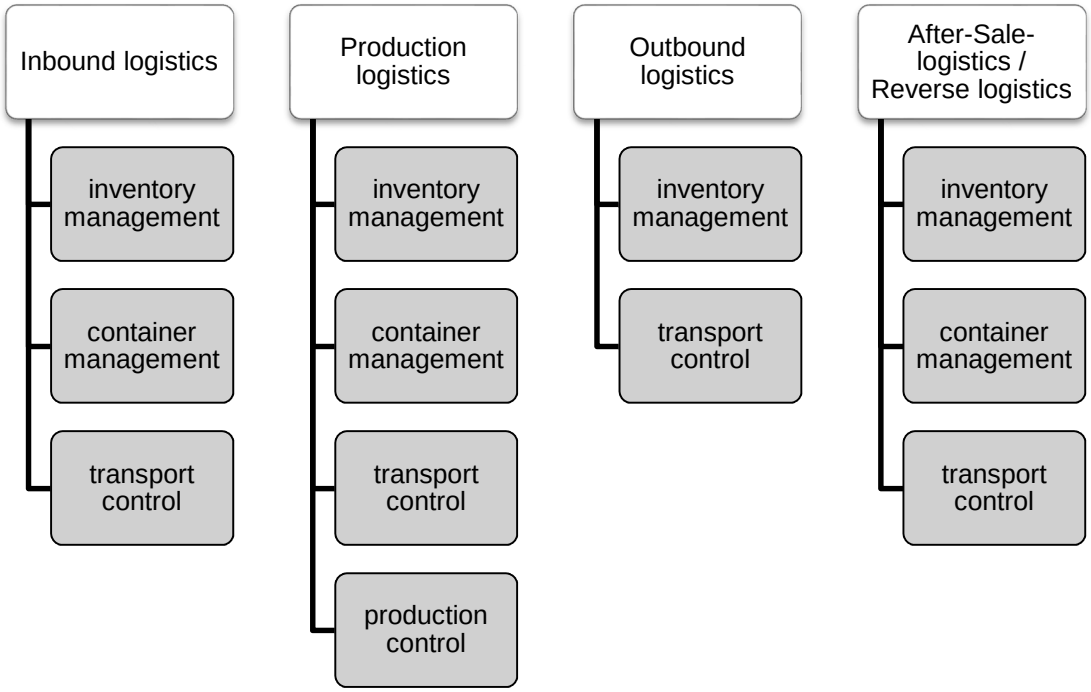
List of tables ..... - 20 -

Abbreviations ..... - 20 -

Literature ..... - 21 -

1. The automotive logistics industry

Logistics in the automotive industry has one of the most important function. The American council of Logistics Management defines logistics as “the process of planning, implementing and controlling the efficient, cost effective flow and storage of raw materials, in-process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customers’ requirements”. The objectives of logistics are to reduce the inventory, the transport costs, to maximize the reliability and consistency in delivery performance, to minimize the damage of products and to react faster against the exigency of the customer. We can differentiate 4 types of logistics in the automotive industry.



Supply Chain in the automotive industry

The inbound Logistics is about the production from subcontractors of finished modules, equipment that should be delivered to the production plant in just in time or just-in-sequence frequency.

Logistics related to the production phase by the OEM is about all the activity related to the production of vehicles. In order the save capital, the brands are producing vehicles in centralized plants, near qualified working forces and infrastructures. The vehicles are been produced in production line in order to control the production time, standardize the production process, and finally achieve a better quality.

The outbound logistics is been related to the distribution of finished vehicles. Most of the time the vehicles are been picked up in the production plant and are distributed via compound to the dealers. The outbound logistics concerns also the distribution of used vehicles and the execution of value-added-services in the compound of the supplier.

The reverse logistics is been related to the recycling of spare parts and all activities concerning a vehicles after its destruction.

1.1 The specification of the finished vehicles logistics

One of the major specification of the distribution activities in the automotive sector is the lack of differentiation possibility from one provider to the other. Every provider is offering the same service, in fact generally a transportation service and it should not been differentiated by the quality but only by the price. Regarding the finished vehicles logistics the providers has also the possibility to offer value-added-services like storage activities, pre-delivery inspection etc.

1.2 Barcode system, actual process analyze

The actual system, which is been used in the finished vehicle logistics for track and trace the vehicles or provide some value-added-services to the vehicle, is the barcode.

Every single movement of the vehicles, every services that have been done in the vehicles are been documented with the barcode.

Identification prozess in the automotiv logistics

1.3 The Radio Frequency Identification (RFID)

The Radio Frequency Identification (RFID) is expected to increase the efficiency and the transparency in the automotive supply chain regarding the data management. The lack of data standards in the automotive industry has been identified as one of the principal problem and it makes the business from the suppliers more difficult. Every supplier has to develop working methods customized for every single OEM needs. There is no standards available and in fact for every supplier the relation as well as the needs from any OEM are interdependent. Most of the time in order to perform the resource capacity and create a better network the supplier from the outbound logistics industry has to combine loads from different OEM which are not working in the same way. The challenge is to find a common solution for different working ways. RFID could be used also as a common standards regarding the data management from every single transported units. RFID could be an opportunity to facilitate to work of any actor in the automotive supply chain.

2. The concurrence strategy according to Michael E. Porter

The business strategy from Michael E. Porter is been related to different strategies, which should be involved by a company in order to get some concurrency advantages to finally get new market share and become the leader in a specific market.

2.1 Cost Leadership strategy

This strategy consist in proposing a similar offer like the concurrent but for a cheaper price. The reduction of the costs is possible due to a better use of production resources, or an optimization of these resources. The risk is that the concurrent will do the same and it will finally generate the bankruptcy of some company. A big investment capacity will be necessary. The market share increase do not mean automatically that the company is prosperous.

2.2 Differentiation strategy

The aim here is to propose an offer with different characteristics from the concurrent and to create a new need or a competition. There is two type of differentiations: The sophistication or upward differentiation. It consists of offering a more elaborated offer than the reference offer from the concurrence. Finally, this offer, which is more elaborate, will be sold for a higher price. The idea is to increase the price more than the costs in order to generate a higher profit. The purification or down differentiation. It consists in proposing a less elaborate offer than the reference offer, such products of services will be sold for a lower price. Ideally should be the costs more reduced than the price, in order to generate a higher profit. The differentiation strategy oblige the protection in order to avoid the imitation of the competitors.

2.3 Focus strategies

This strategy consists of concentrating most of its efforts on a small market segment, in order to avoid the confrontation with the most powerful competitors. This is also been called a “niche strategy”. This is the positioning of most of the company focused in the luxury sector.

	Uniqueness perceived by the customer	**Low Cost position**
Industrywide	Differentiation - Quality / Performance - Uniqueness	Over All Cost Leadership - Price / Costs - Standard Product
Particular Segment Only	Focus Differentiation - Specific needs	Focus Costs - Limited needs

Concurrence strategy according M. E. Porter

The RFID implementation in the finished vehicle logistics could follow at the same time a cost leadership strategy and a differentiation strategy according to Michael E. Porter theory.

3. RFID specifications

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. Unlike a barcode, the tag do not need to be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture.

Barcode	RFID
Susceptible to external influences such as dirt or wetness	Resistant to external influences such as dirt, dust or oil
Not rewritable	Non-contact (re) writable
Low storage capacity	Large storage capacity
Time-intensive scanning Sequential scanning	Fast readout Possibility of power capture
Visual contact required	No visual contact required
No identification of individual objects	Identification of individual objects
No localization of objects possible	Localization of objects possible

Specification RFID and Barecode

3.1 Active Transponder

Active transponders have their own energy source, their own battery. They periodically send their stored data or a previously stored data set. It is particularly interesting for logistic applications that the possibility exists to locate the transponder. The localization is carried out by means of transit time or field strength measurement of the regularly transmitted transponder signals, which are received by in each case a plurality of the antennas and reader combinations arranged in a wide area. Gates or further passages can optionally be equipped with additional technology so that the system can be used, for example, an entrance clearly distinguished from a pre-flight, via an anti-collision system. The respective vehicle locations can be displayed on a terminal plan. The advantage of this solution variant is the high degree of automation of the vehicle position detection. The main disadvantage of the available systems lies in the high expenditure on hardware and infrastructure. A high cost factor is the electronic area illumination with antennas / readers which is necessary for the localization. This results in a higher investment requirement or higher capital costs and regular maintenance. The battery in the transponder must be changed every six months.

3.2 Passive Transponder

Passive transponders do not have their own energy source and use the energy received by the reader antenna to generate an answer signal. Depending on the design of the tag, a tag identity or previously stored data is transmitted. The small size makes it possible to combine the tag with a paper tag (Smart Tag). The use of passive tags is particularly suitable for checking at passages. At each pass, the vehicle equipped with a passive day is identified by an antenna at the gate.

The determination of the direction of travel of the respective vehicle is made possible by the use of two antennas arranged one behind the other or by the use of light barriers or motion detectors. These solutions are useful for entry / exit checks in the technical areas of the compounds (de-conserving line, workshop etc.) or fenced storage areas of the support point. It is not possible to locate passive transponders in the area using today's technology. The main advantage is the low cost of fitting the vehicles with the transponders. Furthermore, the transponders do not require regular maintenance. One disadvantage is the lack of the possibility of automatically locating vehicles on the large parking areas.

3.3 Hybrid Transponder

Semi-active RFID transponders have their own energy source in the form of a small battery or a solar cell. However, this energy is only used to operate the microchip. These transponders are often also referred to as active or semi-passive transponders in the literature. Semi-active RFID transponders are not able to generate and communicate their own high-frequency signal. Due to their own energy source for reading the transponder, however, they require less energy from the reader and thus they have a weaker electromagnetic or magnetic field for data transmission. This allows a higher communication range of up to 15 meters. Semi-active transponders are generally "active" when a reader accesses them to save power. Because of the battery, however, these transponders are larger and more expensive than the passive ones and thus are not suitable for mass-based article identification. This technique has not yet been put into practice. According to research, there is no suitable application for automobile logistics.

3.4 Operating frequency

Basically, the transmission frequencies for RFID systems can be roughly differentiated between a low, medium and high frequency range. The selection of the frequency range is not arbitrary, but depends on the desired application. The desired range plays the biggest role besides the cost question. An RFID system consists of four components: Reader, Antenna, Controller or middleware, Transponder. These components must be present in order to use the RFID system.

3.5 Reader

The reader, which is supplied with radio signals or electromagnetic waves by means of the transponder. Reading out the data of the transponder and inputting data to the internal memory is realized by the generated waves. One differentiates between mobile and stationary devices in reading devices. The performance of the RFID reader is to be combined with the corresponding antenna so that optimal reading ranges can be defined. For example, readers can be handhelds or Gates RFID controllers.

3.6 Antennas

The RFID antenna is a key element of the system. Readers and transponders each have their own antenna. They serve the purpose of increasing the reception or transmission signal strength of the respective component as well as modulating the respective signal. Most mobile readers contain their own RFID antenna.

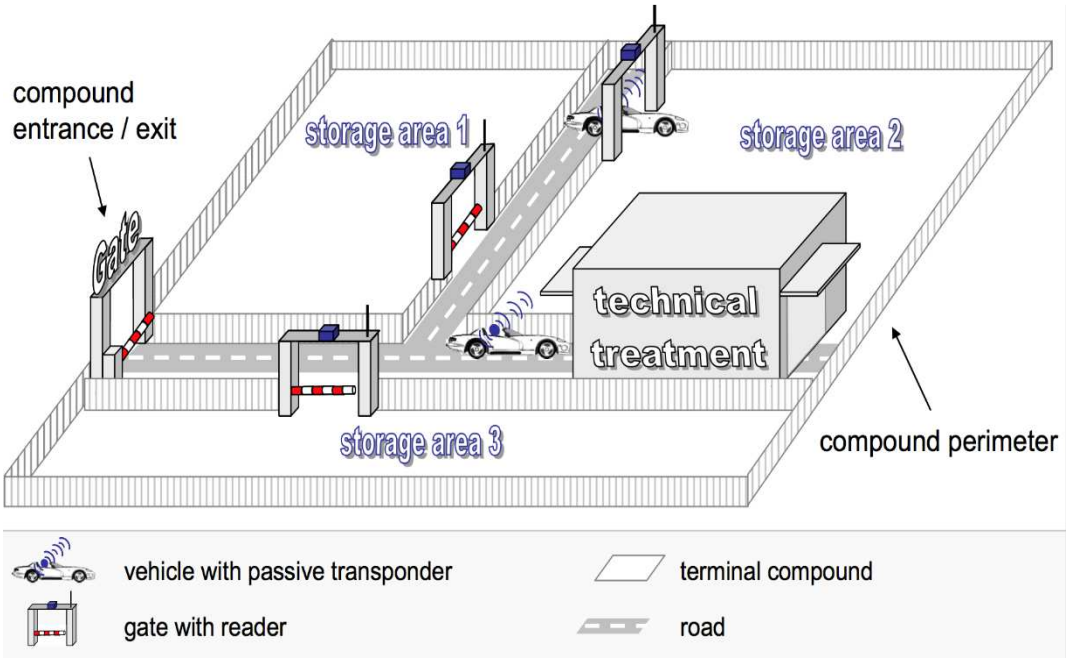
In order to cover as wide a range as possible, the reading devices require external antennas. The data of the RFID chip are supported by an antenna during the acquisition process within long distances. Depending on the type of transponder, the frequency of the antenna or range will differ. Thus, two kinds of antennas are distinguished:
Integrated antennas. They are integrated into the reader (especially in the low frequency range recommended) External antennas. They are not part of the reader therefore they are more powerful and have a wider range.

3.7 Middleware

The computer evaluates and prepares the transponder data. The Middleware is a software module which transfers the data from the reader to the information system. The processed data are then transferred to other application systems and can be viewed, modified and evaluated by the user. By using computers, other electronic devices such as motion and directional sensors as well as barriers, traffic lights and printers can be networked with RFID systems and communication between the devices can be ensured.

3.8 Recommendation Smart Label

In logistics, Smart Label is used to represent open systems. A paper label with integrated passive tags. This recommendation does not take into account the following: A transponder permanently installed in the vehicle would open up possibilities for automatic access authorization, etc. for end users, vehicle rental companies, vehicle purchasers or users. However, inclusion of this option in the present recommendation is, for the time being, excluded from ethical and ecological considerations and for reasons of data protection.



Passive rfid automotive compound

4. Finished vehicle logistics and RFID SWOT analysis

Thanks to a SWOT analysis we will determine which strategies should be implemented regarding the RFID with the analysis of the strengths and the weaknesses of the finished vehicle logistics sector internally with the opportunities and the threats of its environment related to the implementation of RFID technology externally. We will determine the parameter which should be taken into consideration by the implementation of RFID in the finished vehicles logistics to gauge an organization or a sector and its environment. SWOT stands for strengths, weaknesses, opportunities and threats. Strengths and weaknesses are internal factors related to the finished vehicle logistics sector and companies. Opportunities and threats are external factors related to the RFID, so environment oriented.

In order to create a SWOT analysis we will firstly consider the following:

Strengths of the vehicle logistics sector, what are the advantages? What are the resources and contacts? What recognitions? What are the assets? What are the positive aspects?

Weaknesses: what are the lack of the finished vehicles logistics? What are some of the gaps that need to be addressed? What should be avoided?

Opportunities: regarding the implementation of RFID for the finished vehicles logistics, what are the specific opportunities? What are the opportunities facing the finished vehicles logistics regarding the implementation of RFID? What are the trends that might open new opportunities?

Threats: What obstacles regarding the implementation of RFID need to be faced? What is the competition up to? Are the requirements for the finished vehicles logistics changing? Can RFID seriously threaten the vitality and longevity of the finished vehicles logistics business?

4.1 Strengths (Finished vehicle logistics)

End-to-end delivery: Finished vehicles logistics providers offers an end-to-end delivery of vehicles. That means there are taking vehicles from the production plant and delivering these vehicles to the end customers. There is an interdependence between the OEM and the FVL. One could not exist when the other is not existing as well.

High collaboration between logistics providers: Vehicle logistics is a complex task focusing punctuality and quality in the vehicle distribution. In contrast to other logistics, the processes are highly unique due to the damage handling and hold management. Additionally, a car is often "work in progress" as it receives its accessories or full customization close to the customer´s location. In order to optimize their prices and network the logistics provider are obliged to work together.

4.2 Weaknesses (Finished vehicle logistics)

Lack of services differentiation: All suppliers are offering the same services, the only differentiation concerns the prices. Truck and Rail transports are always in competition and finally the only way to determine which provider will get the contract is determined by the quality of its assets and the prices he has offered.

Depending on the Automobile industry and the economic environment: As already communicated, the finished vehicles logistics business is considered as a niche market and is focused on a specific type of goods. Depending on the conjuncture and the number of vehicle sold from the OEM, the supplier could believe different situations. FVL providers has no possibility to switch or change the market.

Lack of up to date IT Infrastructure: Most of the FVL suppliers do not use any up to date IT Infrastructure due to a lack of investment and difficulties to provide any change in their company.

4.3 Opportunity (RFID)

Growing need and focus on reducing costs and improve utilization: Although RFID technology has been around since the 1970´s, its initial high costs restricted usage to larger businesses, many of whom developed proprietary systems. Although costs are falling, RFID systems are still typically more expensive to set up and use than alternative systems such as barcode scanning. However, RFID systems bring their own cost benefits, such as reduced vehicle handling and improved labour working efficiency. A Large potential for improvement is realizable, reducing paperwork and mandate tasks. In order to determine the optimization potential in the use of RFID in the operational sequences, manual acquisition processes are particularly interesting, which can be automated by the use of reader gates:

- Elimination of long-term positions for passage control (attention: quality controls are often carried out by employees at the same time).
- Elimination of recording activities during the check-in and check-out of vehicles in operational areas such as provisioning areas, inspection halls, etc.

Large potential to reduce human errors: RFID should not only be used as a track and trace technology which allow to know in real-time where the good is but this technology avoid also the human error, which could be also really expensive. For the realistic assessment of operational errors it is recommended to identify and quantify potential sources of error such as:

Input error in manual entry of the chassis number.

Error during the documentation of completed process steps (Invoicing of vehicle).

Incorrect entry or incorrect inscription of the parking space such operational errors result in verification activities, manual data corrections and searches in the compound.

The sum of these activities and the costs arising from them can often only be estimated in practice, since a corresponding data collection is complex.

Potential for collaboration with other suppliers and exchange know-how and share costs: RFID should not only be considered as a cost reducing instrument but also as a potential for collaboration with other suppliers, partner or customers. The purpose will be to increase the communication within the supply chain and in the same time decrease the schedule time in order to develop the logistics network and increase the client satisfaction by decreasing also the costs.

4.4 Treats (RFID)

High fixed costs and investment: The required detection technology depends on the number of fixed hall entrances, gates and mobile (truck / driver, check personnel) identification points. The number of smart labels required depends on the size of the vehicle throughput of the examined logistics environment as well as whether the smart labels are already passed on in the process chain or whether the smart labels have to be generated at the vehicle entrance and inserted into the vehicle.

Security issues: There are numerous types of attacks and malfunctions that can adversely affect the reliability and effectiveness of an RFID system. The content and identity of a transponder can be corrupted by the lack of contact. This must be prevented or reduced to a minimum by safety measures. For example, for the data backup, the system must be partially configured with a kill mode. The standard Gen2 contains these safety measures and offers the possibility to delete the data contained in the transponder. The disadvantage is that the data protection regulations are unclear and the compatibility with the different systems is not guaranteed. The experience was only made on the basis of pilot projects. Only when these two problems are eliminated, RFID systems will really be deployed.

Lack of standardization**:** Common standards and standards are necessary to help new technologies become broad, world-wide. This is especially true for RFID technology, which is predestined for use in global cross-company networks. Standardization bodies, associations and organizations develop or define appropriate standards and standards. The predecessor was auto-id in the 80s in the United States. A standard is a guidance document approved by a recognized normalization institute. It defines specific features and the voluntary rules applicable to the activities. A standard provides a standard that the stakeholders can hold. It makes a common "language" among the economic involved, manufacturers, producers, users and consumers possible. A quality standard is defined by a standard as well as safety standards or the ecological objectives of a product or service. The processes, in general, are clarified with the help of standards and harmonize the processes or processes of one company versus another. In contrast to regulation, the standard has a voluntary character. Only standardized products can communicate across borders and form the basis for networked systems.

The lack of standardization of technology is constantly being improved by various associations and institutes that have already developed standards and standards for specific areas. The Association of the Automotive Industry (VDA) has already developed a standard for the identification of vehicles along the distribution chain. The new Recommendation 5520 of the German Association of the Automotive Industry describes a standardized ultra-high frequency / UHF smart label for the identification and control of finished vehicles in the distribution chain. Thus, an essential prerequisite for the comprehensive introduction of RFID in automotive logistics was fulfilled.

Poor interoperability between different RFID solution providers: There are many different suppliers on the market. Companies, e.g. IBM, Motorola and Siemens, are already offering many different and complete RFID solutions on the market, which are applicable for all areas of activity. The multiplicity of providers should ensure that the prices will be cheaper in the future. It has been found that the RFID providers are divided into two groups: the market leaders are the large companies (large suppliers) such as: Zebra, Siemens, IBM ... The small-scale providers in the market are diverse. Your advantages are that you are very innovative and competitive.
The advantage of small vendors is to develop innovations in order to offer the customer a suitable RFID system and stand out from the competition. The RFID business has changed significantly in the past five years and the range has become multifaceted. The quantity of providers has increased considerably, which makes the choice of the provider more difficult. Different criteria must be taken into account when selecting: Reliability, capacity (e.g., technician), technical skills, customer support, project management. In order to refine the selection of RFID manufacturers, one also has to compare the different offers. Guarantee comparison: certifications, written obligations, relevant references, maintenance contracts.

RFID-Technology / Finished vehicles logistics companies	**Opportunities** Growing need and focus on reducing costs and improve utilization Large potential to reduce human errors Potential for collaboration with other suppliers and exchange know-how and share costs	**Threats** High fixed costs and investment Security issues Lack of standardization Poor interoperability between different RFID solutions providers
Strengths End-to-end delivery High collaboration between logistics providers Automotive big Market in volume	**SO-Strategy** Implement RFID in the Finished Vehicle logistics in order to reduce error and save costs.	**ST-Strategy** Convince the OEM to invest in the RFID technology in order to provide a better service (only possible in good conjuncture).
Weaknesses Lack of service differentiation Depending on the Automobile industry and the economic environment Lack of up to date IT infrastructure	**WO-Strategy** FVL investing in the IT infrastructure in order to increase the collaboration with other supplier and offer a better service to the OEM.	**WT-Strategy** Create a workshop to define RFID standards for the FVL as well as a common IT infrastructure for the global supply chain.

SWOT Analyse RFID investment in the FVL

As already explained with the SWOT Analysis, RFID is a huge investment for any logistics provider. This investment do not make any sense if only one logistics provider want to be a part of. The global automotive supply chain has to invest in the same or in a compatible RFID technology in order to get the benefice of this technology. In order to implement RFID some standards are requested in order to give prerogative for investment and utilization. There is a lot of different RFID technology with different characteristics. The Smart Label Tags actually match with the requirements of the finished vehicle logistics. There will be for sure in the future even better developed solutions for the automotive industry, for example with hybrid tags. The first step should be to convince the OEM as well as the suppliers about the advantages of RFID.

One of the biggest reluctance actually regarding this technology is for sure the investment costs. In order to determine these costs we will, in the last part, talk about money and check the potential of RFID regarding savings and costs.

5. The economical investment check

5.1 Business case calculation

A business case examines a specific business scenario in terms of profitability. It serves to present and weigh the projected financial and strategic effects of the investment. A comparison of different action options takes place. By analyzing benefits, expenses and risks, the company's resources are used for the promising projects.

5.2 Economical potential of RFID

The working hours as well as the labor costs of foreign personnel were taken as the target for the determination of savings. With the aid of a stopwatch and the observation of the process cycle time, the following erg potentials were imparted.

The savings potential consists of the following sub processes: Manual recording of the data in the vehicle Attachment / removal of the dispatch card in the vehicle for each service, the average process time is approx. 1.5 minutes.

Process	Vehicles a day	Wage Labour	RFID	Barcode	Saving	Wage saving p.a.
			In minutes per vehicle	In minutes per vehicle	In minutes per vehicle	
Vehicle compound in / detection	410	16,00 €	0	1,5	1,5	39 360,00 €
Transport protection removal / detection	80	16,00 €	0	1,5	1,5	7 680,00 €
Warehouse / detection	200	16,00 €	0	1,5	1,5	19 200,00 €
Workshop handling / detection	40	16,00 €	0	1,5	1,5	3 840,00 €
Paint shop / detection	6	16,00 €	0	1,5	1,5	576,00 €
Refuel / detection	134	16,00 €	0	1,5	1,5	12 864,00 €
Vehicle finish / detection	55	16,00 €	0	1,5	1,5	5 280,00 €
Vehicle washing / detection	30	16,00 €	0	1,5	1,5	2 880,00 €
Vehicle compoudn out / detection	438	16,00 €	0	1,5	1,5	42 048,00 €
Total Handling Vehicle per day in a compound	**1393**				**Summe**	**133 728,- €**

Saving potential in compound

Explanation calculation: Vehicles on the day * Hourly wage * (time saving per vehicle / 60) * 240 (working days per year) = savings per year.

5.3 Economical potential of RFID

The gates, hand-held devices, printers, middleware, antennas and cabling can be amortized because it belong to fixed assets. Depreciation is used to record the impairment of assets, between the tangible and intangible assets, in the accounting department. With an investment of € 542,114.00 into the system conversion, you will be expected to make an annual deposit surplus of € 133,728. The cost of foreigners can fall hypothetically because an RFID system works automatically. The originally used foreign staff on the square is thereby saved. Due to the high fluctuations in the automotive sector, the use of outside staff at the branches is very high.

Cost determination	Number	Price per unit	Total Price
One-time investment cost			
Gates reader Stationary	24	4 496,00 €	107 904,00 €
Hand reader	30	750,00 €	22 500,00 €
Label printer	2	2 500,00 €	5 000,00 €
Assembly & installation of the readers and printers	1	20 000,00 €	20 000,00 €
Middleware	1	41 710,00 €	41 710,00 €
Antennas	24	5 500,00 €	132 000,00 €
Wages system integrator (1 year)	3	50 000,00 €	150 000,00 €
Cabling / WLAN	1	28 000,00 €	28 000,00 €
System integration & interface configuration	1	30 000,00 €	30 000,00 €
Employee training	1	5 000,00 €	5 000,00 €
Total investment cost :			***542 114,- €***
Annual operating costs			
Transponder cost year 1	106400	0,20 €	21 280,00 €
Transponder cost year 2	98400	0,18 €	17 712,00 €
Transponder cost year 3	98400	0,16 €	15 744,00 €
Transponder cost year 4	98400	0,14 €	13 776,00 €
Transponder cost year 5	98400	0,12 €	11 808,00 €
Transponder cost year 6	98400	0,10 €	9 840,00 €
Maintenance	1	5 000,00 €	5 000,00 €
Yearly average operating cost			***20 026,67 €***

Investment per compound

The prices for the various components are average and were issued by the company Accenture (a technology consulting company) as well as the CNRFID (Le Center National RFID from France). It is therefore a matter of average prices, as the exact prices can only be determined by means of a process record and the exact requirements for hardware and infrastructure. For this work, the need for the IT infrastructure was estimated and justified on the basis of company knowledge.

	Acquisition cost	Periode of use	Depreciation linear
Stationary gates reader	107 904,00 €	7	15 414,86 €
Hand reader	22 500,00 €	3	7 500,00 €
Label printer	5 000,00 €	3	1 666,67 €
Middleware	41 710,00 €	4	10 427,50 €
Antennas	132 000,00 €	4	33 000,00 €
Cabling / WLAN	28 000,00 €	7	4 000,00 €
		Total amortization first year	**72 009,02 €**

Amortization per anno

5.4 Net present value method

Use of the net present value method. The capital value is calculated by discounting all incoming and outgoing payments related to the investment to the reference date. An investment is advantageous if its capital value is positive (absolute advantage). In an alternative comparison, the investment project is pre- pared with the higher positive capital value (relative profitability). The net present value method is one of the most comprehensive methods of dynamic investment calculation. The examination of the advantage of investments is carried out by means of the comparison of all the in- and out-payments of an object. For this purpose, all payments and disbursements are to be discounted against the calculation interest rate at the beginning of the investment (time zero). The difficulty of the net present value method is to choose the right factor. The investment costs have been clearly defined. The savings potential in the use of RFID is due to the personnel costs, since they can be measured in money units, as well as the savings that can be made in the resolution of dispo cards.

$$K_0^n = -A_0 + \sum_{t=1}^{n} \frac{e_t - a_t}{(1+i)^t}$$

Formula

K_0^n	Net present value for a period of n periods
A_0	Acquisition cost
$\boldsymbol{e_t}$	Income / saving in period t
a_t	Expenditure in period t
i	Calculation rate with t = 1,…

Calculation rate of 5% 123 (i = 0.05)

4 years (n = 4)

The service life is four years for the entire RFID system. According to research, it was found that today's interest rate is 5% according to the Bundesbank. The investment is considered to be enforceable.

$$K_0^4 = -542.114{,}00\,€ + \frac{(205.737{,}02\,€ - 21.280{,}00\,€)}{1{,}05} + \frac{(205.737{,}02\,€ - 22.712{,}00\,€)}{1{,}05^2} + \frac{(205.737{,}02\,€ - 20.744{,}00\,€)}{1{,}05^3} + \frac{(205.737{,}02\,€ - 18.776{,}00\,€)}{1{,}05^4} = +\mathbf{105.644{,}17}\,€$$

When it comes to investing in RFID, it can be assumed that with a market interest rate of 5% per anno and within four years, the RFID investment would yield a cash benefit of € 105,644.17.

The difficulty of the net present value method is to choose the right deposit factor. Some factors, e.g. the productivity increase or the overall quality improvement are difficult to measure in advance.

The calculation shows that the net present value is positive only after four years. This means that there is an advantage of the investment. In addition, the investment results in a profit, since the capital value is greater than zero. However, the profit is fictive because the interest rate can change within these four years. A return on investment takes place only after approximately three and a half years as shown in Tables 14 and 15. Assume that the interest rate remains constant. The fictitious investment is € 542,114.00 and the savings achieved (cumulative) will reach € 494,427.24 after eight years.

5.5 Break-Even analysis

Costs	Year 1	Year 2	Year 3	Year 4
material Invest	542 114,00 €	0,00 €	0,00 €	0,00 €
maintenance	0,00 €	5 000,00 €	5 000,00 €	5 000,00 €
transponder	21 280,00 €	17 712,00 €	15 744,00 €	13 776,00 €
global costs	**563 394,00 €**	**22 712,00 €**	**20 744,00 €**	**18 776,00 €**
Personal costs	133 728,00 €	133 728,00 €	133 728,00 €	133 728,00 €
depreciation	72 009,02 €	72 009,03 €	72 009,03 €	62 842,36 €
Global save	**205 737,02 €**	**205 737,03 €**	**205 737,03 €**	**196 570,36 €**
Savings cumulated (5 % interest)	**-366 470,64 €**	**-200 431,55 €**	**-40 627,61 €**	**105 644,24 €**

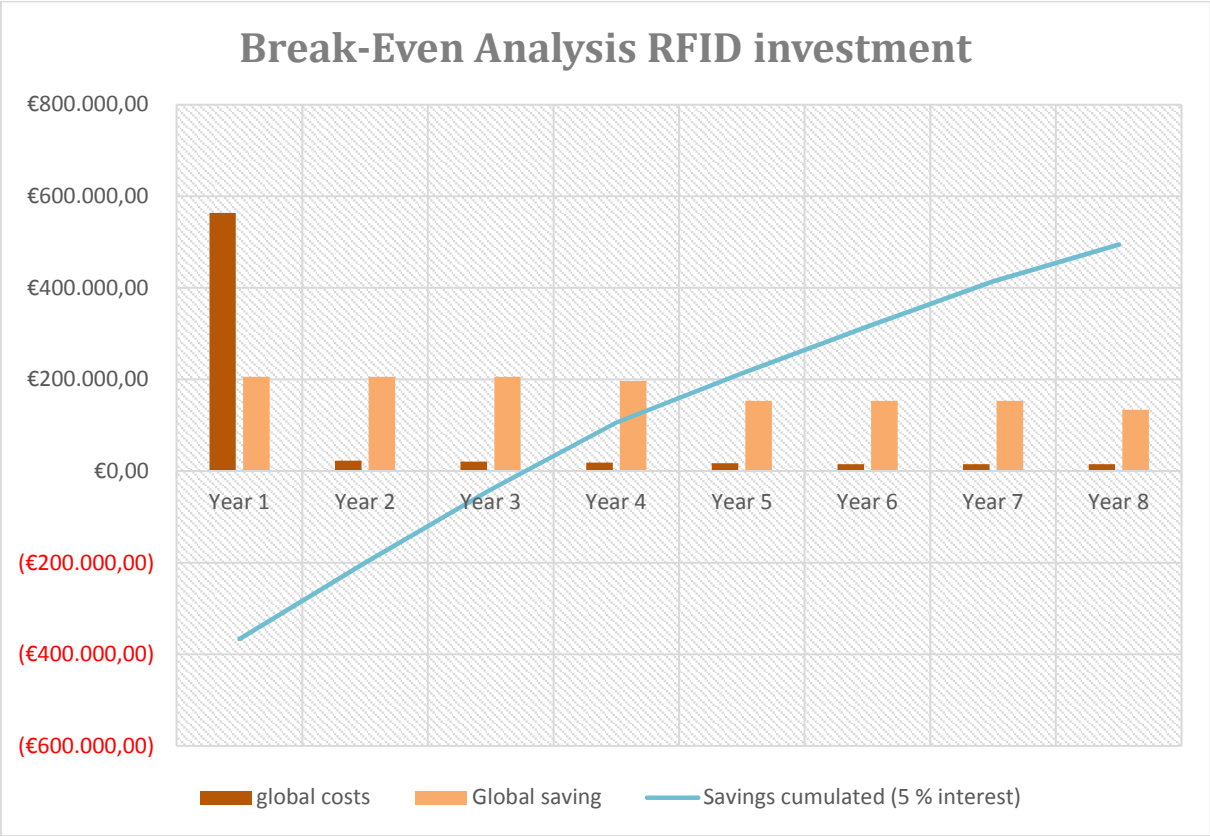
Break-Even Analysis 1/2

Costs	Year 5	Year 6	Year 7	Year 8
material Invest	0,00 €	0,00 €	0,00 €	0,00 €
maintenance	5 000,00 €	5 000,00 €	5 000,00 €	5 000,00 €
transponder	11 808,00 €	9 840,00 €	9 840,00 €	9 840,00 €
global costs	**16 808,00 €**	**14 840,00 €**	**14 840,00 €**	**14 840,00 €**
Personal costs	133 728,00 €	133 728,00 €	133 728,00 €	133 728,00 €
depreciation	19 414,86 €	19 414,86 €	19 414,86 €	0,00 €
Global save	**153 142,86 €**	**153 142,86 €**	**153 142,86 €**	**133 728,00 €**
Savings cumulated (5 % interest)	**212 466,17 €**	**315 669,89 €**	**413 959,16 €**	**494 427,24 €**

Break-Even Analysis 2/2

The savings potential as well as the investment costs have already been established. Savings would be calculated with regard to processing time requirements and external wage costs. The investment costs were determined with the help of the company Accenture and own thoughts.

6. Conclusion



Graphic Break-Even

Although this model of dynamic investment calculation could be supplemented with further models, such as the internal interest rate method, also known as the internal interest rate method, which is used to calculate the present value of a series of payment flows as a rule in connection with a project with an initial investment and a Positive cash flow or the annuity method. This model of dynamic investment calculation shows that a consideration is worth. Calculation was conceived by means of fictitious numbers, but theoretically the procedure and possible numbers corresponded.

Finally, this model demonstrates that the cost leadership strategy of Michael E. Porter would be feasible with the introduction on the assumption that vertical cooperation takes place (suppliers, manufacturers and logistics service providers).

We can conclude that the RFID technology is nowadays mature and that solutions for the automobile transports are already offered. There is a wide range of technical solutions for the automotive image distribution sector. It is the task of the system supplier to put the system together on the spot according to customer requirements. Successfully implemented installations are characterized by a high degree of customer acceptance and a return on investment. RFID systems are usually found in manageable, controllable, closed systems. A pilot test helps to determine the need for corrections in an application at an early stage.

A process and subsequent cost-benefit analysis (before / after) is mandatory at the earliest within the scope of the pilot test or pilot project. Almost all required standards (ISO standards, GS1) are already available and should be used. It makes no sense to wait for future, supposedly cheaper or better systems. A system will always be "better" in the next generation. RFID technology will continue to develop as already explained.

List of figures

- Supply Chain in the automotive industry
- Identification prozess in the automotiv logistics
- Passive rfid automotive compound
- Formula
- Grafic Brea-Even

List of tables

- Concurrence strategy according M. E. Porter
- Specification RFID and Barecode
- SWOT Analyse RFID investment in the FVL
- Saving potential in compound
- Investment per compound
- Amortization per anno
- Break-Even Analysis 1/2
- Break-Even Analysis 2/2

Abbreviations

Auto-ID	Automatic identification system
DGPS	Differential Global Positioning System
EPCglobal	Electronic Product Code global
ERP	Entreprise-Resource-Planning
FVL	Finished vehicle logistics
GPS	Global Positioning System
GS1	Global System One
ISO	International Standards Organisation
IT	Information technology
Mhz	Megahertz
OEM	Original Equipment Manufacturer
RAN	Radio Access Network
RFID	Radio-frequency Identification
UHF	Ultra-high frequenz
WLAN	Wireless Local Area Network

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Word of honour statement

I declare that I have written the thesis with the title

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on my own. Information from other sources or ideas from other persons are marked.

Wolnzach, 2017.03.15

Signature

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