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Synergies across Companies in the Supply Chain Management through Cooperation between Non- Competitors – Using the Example of the Transport Division of Magna Powertrain

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AFFIDAVIT

I declare that I have authored this thesis independently, that I have not used other than the declared sources/resources, and that I have explicitly indicated all material which has been quoted either literally or by content from the sources used. The text document uploaded to TUGRAZonline is identical to the present master‘s thesis dissertation.

Date	Signature

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Abbreviations

DC	Distribution Center
eEPK	erweiterte Ereignisgesteuerte EventKette
EPC	Event-driven Process Chain
FMCG	Fast Moving Consumer Goods
FMEA	Failure Mode and Effects Analysis
FTL	Full Truck Load
JIT	Just In Time
LSP	Logistics Service Provider
LTL	Less than full Truck Load
MPT	Magna Powertrain
PI	Physical Internet
PFI	Partner from the Fashion Industry
PLSP	Partner Logistics Service Provider
RPN	Risk Priority Number
SCM	Supply Chain Management
weight per HUF pw	weight per Handling Unit Fill per week

Table of Contents

1 Introduction

Companies have to work cost-efficiently. Therefore, through addressing inefficiencies cost saving potentials can be highlighted. With new approaches, such as cooperations with other companies, these potentials can be implemented.
This master thesis deals with synergies across companies through cooperation in the Supply Chain Management (SCM) between non- competitors by using an actual project as example. In the first part of this chapter a short overview of the rationale behind this project is given. It is followed by a brief description of *Magna Powertrain* (*MPT*), as they are the main driver of this project. Further, the motivation of *MPT* and the author for this master thesis is explained. Finally, in the last part of this chapter the research questions are presented.

1.1 General

Lots of goods to receive and distribute require a high effort and costs have always to be kept in mind. Therefore, efficient planning of the transports ensures cost-efficient working. Aiming at a high utilization of the trucks helps avoiding redundant truck runs and consequently in reducing costs and saving money. In the case of *MPT* the transport division is responsible for the in- and outbound flows of the parts and products.
New approaches such as transportation cooperations with other companies are an innovative way to contribute in reducing costs. Further, the utilization of the trucks will be increased and due to less trucks on the roads CO_2 can be saved.
MPT as an automotive supplier implemented this idea and has established a transportation cooperation with a *partner from the fashion industry* (*PFI*) in order to reduce costs and save money. A longtime logistics partner of the *PFI* acts as the Logistics Service Provider (LSP) which delivers the goods. Experience for further and bigger cooperations can be built up with this first project.
On the one hand the master thesis deals with the *MPT/PFI* project as interviews with involved people are conducted and processes are analyzed, on the other hand similar examples of other cooperations are investigated and learnings for *MPT* are seeked.

1.2 Magna and Magna Powertrain

Magna has been founded in 1957 by the Austrian Frank Stronach as *Multimatic*. In 1969 the company merges with the Canadian *Magna Electronics* and was renamed *Magna International* in 1973. In the 80s *Magna* exceeded one billion dollars in sales. In the following decade a plant in Mexico was opened and several European automotive system suppliers were acquired. Sales went up to nine billion dollars.
Since 2000 several plants worldwide have been opened. Today, as Figure 1 shows, *Magna* is located in a total of 29 countries in North America, South America, Asia and Europe with 136.150 employees [MII16(a)]; [MII16(c)].

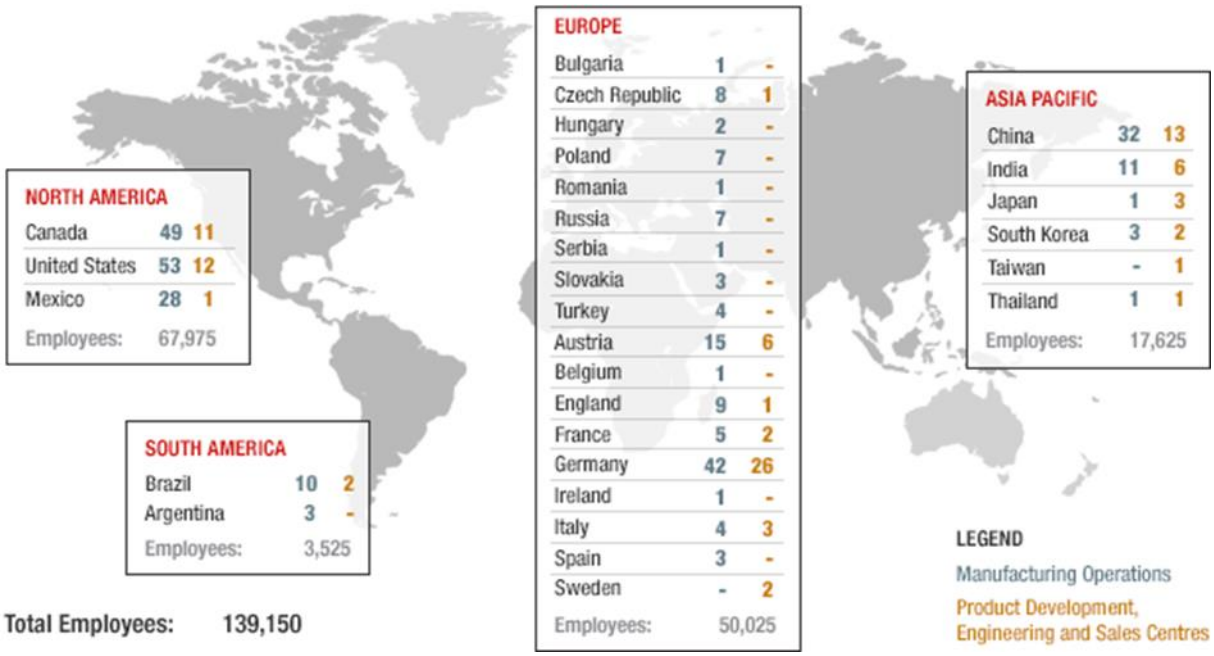

Figure 1 *Magna* worldwide profile as of fourth quarter 2015

In 2005 *Magna Powertrain* was formed out of *Magna Drivetrain* and *Tesma International*. It has been supplying the global automotive industry with knowledge, experience and excellence in designing, developing, testing and manufacturing of single parts or complete powertrains. Amongst the company's biggest customers are car producers such as *Toyota, VW, General Motors or BMW* [MII16(b)].

1.3 Motivation of Magna Powertrain

As every other cost driven company *Magna* tries to reduce costs. With an innovative approach *MPT* wants to increase the utilization of trucks. A transport cooperation with a company outside of *Magna's* sector of industry can help to reach this goal. The basic idea is to use the empty space on the cargo area of a truck and transport goods from another company.
Another factor is environmental protection. If there is a higher utilization and at some point less trucks on the road CO2 emissions can be reduced.
Storage space and costs can be saved as well. The shipment from the supplier is split up for two deliveries and transported in two smaller runs. Therefore the required storage area is smaller.

1.4 Motivation of the Author

The area of SCM is indispensable for every big company. Goods need to be delivered to the right places on the right time. As is often the case there is still room for improvements. The author's interest in this big topic and *Magna Powertrain's* interest in wanting to upgrade their already well-functioning supply chain network and their innovative ideas complement each other. This resulted in a coop-

eration for this master thesis where a cooperation between non- competing companies is investigated. It is also a great opportunity to gain first experiences in this area while working on a recent topic.

1.5 Research Questions

This master thesis investigates criteria for synergy profiles and potentials or failure causes while realizing synergies. In order to achieve these goals the following three research questions have to be answered:

- Is the launch and maintenance of cooperations facilitated if they are established between non-competing partners compared to cooperations between competing companies?
- Which criteria have to be met by the partner in order to ensure a successful cooperation?
- Which potential problems and difficulties concerning the entire transportation process can be detected?

2 Problem Analysis

This chapter gives in the first part an overview of terms and basic wording so the reader gets a better understanding of the topic and the related theory. The second part shows the challenge of efficient road freight transportation in the EU and in Austria and helps the reader to get an insight into the problem. The third part defines the problem of efficient road freight transportation and why it is necessary and important to reduce empty runs at *MPT*. Finally, in the last part of this chapter the objectives of this master thesis are presented.

2.1 Definition of Terms

The following section will be dedicated to providing definitions which will give further insight into the rationale behind choosing the present master's thesis' title "Synergies across Companies in the Supply Chain Management through Cooperation between Non- Competitors – Using the Example of the Transport Division of Magna Powertrain". Key words such as "synergies" or "Supply Chain Management" will briefly be described and explained. A more detailed description of the topics and the theory behind is given in chapter 2.2.

Synergies

The term synergy can be described as the cooperation of two or more parties in order to support and benefit from each other. The advantages of such partnerships are usually anticipated. Apart from those intended main effects, useful side effects can occur and proof as beneficial for both partners [ANS88]; [AS66]; [PUR89].

Across Companies

Due to already made experiences from *Magna* it was chosen to investigate in cooperations across companies and not in internal ones. Another *Magna Powertrain* sister-company or *Powertrain* site would be too similar in terms of flexibility, schedules or production and challenges they have to face.

Supply Chain Management

Supply Chain Management is a management approach which involves every flow of materials, parts or products of the value chain from the producer to the customer. One goal of its objectives is to optimize the usage of resources. [SKS00]

Cooperations between Non – Competitors

The scope of this master thesis was limited to cooperations between non – competitors as it was assumed that they are easier to form and maintain. In such a case various complications can be avoided and trust is simpler to obtain.

2.2 Definitions and Important Wording

The meaning of different fundamental words and terms appearing in this master thesis are explained in the following section.

2.2.1 LSP and Shipper

A Logistics Service Provider (LSP) is defined by *BusinessDictionary* as follows:

"A company that provides management over the flow of goods and materials between points of origin to end-use destination. The provider will often handle shipping, inventory, warehousing, packaging and security functions for shipments" [BD16(a)].

A shipper is defined by the *BusinessDictionary* as follows:

"Consignor, exporter, or seller (who may be the same or different parties) named in the shipping documents as the party responsible for initiating a shipment, and who may also bear the freight cost" [BD16(b)].

2.2.2 Supply Chain Management

SCM is a large topic and has an influence on the whole company because it deals with the entire value chain. Therefore it involves not just one department but needs to integrate nearly all other departments as well.
A good description which shows the scope of SCM has been made by the Council of Supply Chain Management Professionals (CSCMP). It was founded in 1963 and has it's headquarter in Lombard, Illinois. This association is "dedicated to the advancement and dissemination of research and knowledge on Supply Chain Management" [CSC16(a)]. They define SCM the following way:

"Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies" [CSC16(b)].

This definition's crucial point is the mentioning of channel partners, which are essential for a functioning supply chain.

There are a lot of different definitions of SCM with varying focuses and priorities. Simchi-Levi, Kaminsky and Simchi-Levi define it as

"…a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize systemwide costs while satisfying service level requirements" [SKS00].

This definition, compared to the first one, focuses more on an efficient design, costs and decreasing waste. Consequently SCM also has to increase efficiency and cover environmental topics with reducing waste.

2.2.3 Types of Synergy Forms

Various definitions for synergy can be found in literature. Ansoff, one of the first researchers on this topic, defines synergy as a combination of existing resources and capabilities with new product-/ market areas resulting in a company overall success of the company, which is greater than the sum of the successes of the sub-areas [ANS88].
All approaches have in common that the combination of two or more elements can result in a better effect. Some authors also describe this as "2+2=5" effect [AS66]. This can be interpreted as the whole being greater than the sum of the single parts.
Synergies need to be identified and correctly assessed. Pursche identifies three kinds of synergies which are defined as follows [PUR89]:

- Economies of scale and scope

  "Economies of scale and scope are the rewards of being bigger and broader. They include savings in corporate overheads, reductions in duplicate staff, combined service departments and leveraged sales forces. Less evident synergies of this type include cross-selling of products and access to new markets." [PUR89].

  Cheaper part costs due to a higher production of the same part or the provision of identic services more often or to more customers are referred to economies of scale. The cost impact of an addition of new services or products refers to economies of scale.
- Exploitable opportunities

  "Exploitable opportunities are the benefits of being stronger and doing things more efficiently. These include market, operational and financial opportunities. Examples would be rationalizing manufacturing capacity, capturing value added from vertical integration and capitalizing on brand names" [PUR89].
- Asset restructuring

  "Asset restructuring is the maximization of the value of assets or reserves. This category includes asset redeployment (such as divestitures), the realization of hidden value (such as overfunded pension plans) and the use of alternative financing mechanisms (such as sale/leasebacks)" [PUR89].

Distinctiveness is a further category for synergies. Pursche and Paprottka basically differentiate between three different forms of synergy potentials or synergy forms and are defined as follows [PUR89]; [PAP96]:

- Universal synergies

  "The most basic category of synergies, which can be termed universal, are those that are generally available to any logical acquirer with a capable management team. Examples of universal synergies would be most economics of scale (such as leveraging the fixed costs of an MIS department), and some exploitable opportunities (such as raising prices)" [PUR89].

  Principally a universal synergy potential emerges with every cooperation. It doesn't matter if the partners are from the same branch of industry or not. Commonly this synergy form occurs in finance or human resources management and leads ideally to a reduction of the fixed costs [GRA08].
- Endemic synergies

"Endemic synergies are those available to only a few acquirers, typically those in the same industry as the seller. These would include most economies of scope (such as broadened geographic coverage), and most of the exploitable opportunities (for example, redundant sales forces in a same-industry acquisition)" [PUR89].
It is not possible to accomplish an endemic synergy potential in every cooperation. This occurs in similar or identical ranges of action such as pooling production- or distribution capacities [GRA08].

- Unique synergies

"Unique synergies are those that are distinctive to a particular buyer. These include some exploitable opportunities or asset restructurings, and are usually tied to a unique skill that the buyer has. For example, some companies are extremely good at cost reduction, while others are masters at creative financing arrangements" [PUR89].
A unique synergy potential occurs only in special cases of a cooperation such as with patents from a company [GRA08].

All of the synergy forms can be active once, e.g. for a single action or event, or permanently, e.g. for the duration of a cooperation.

2.3 Challenge of Road Freight Transportation

With the in chapter 2.2 provided definitions and wordings and the related theory a theoretical background to this master thesis is given. This part then describes the challenge of road freight transportation with the problematic of empty runs or not fully utilized road freight transports in general. Chapter 2.4 explains this challenge for *MPT* in particular to cover a practical background knowledge.

Once a product or part is finished it needs to be transported to the next production location, to a supplier or directly to a customer. It can be shipped by either trucks, planes or ships. This master thesis, however, has its focus on road transportation. Once the goods are delivered the truck often returns with no new load. An empty truck can often be linked with a lower efficiency and a loss of money as it has to be paid anyways. Therefore logistics planners aim at a high utilization.
As McKinnon states it is not always easy to clarify if a truck really runs empty. One LSP may carry just pallets for a next delivery and declares it empty, another one returns empty bins to a customer and it may be stated as loaded [MCK10(a)]. Clearer definitions of what can be classified as empty or loaded need to be created in order to receive more significant statistics.

For getting an idea of vehicle movements and a number of empty runs the next part presents road freight statistics for the European Union with distinctions to the different EU member groups. For a comparison chapter 2.3.2 presents road freight statistics for Austria.

2.3.1 Road Freight Statistics in the European Union

As it is depicted in Figure 2 about 21% of all trucks run empty in the EU according to Eurostat. Except small changes in the decimal place this number stays nearly

constant through the last years. Therefore there is a high potential for efficiency increasing measures [EUR15].

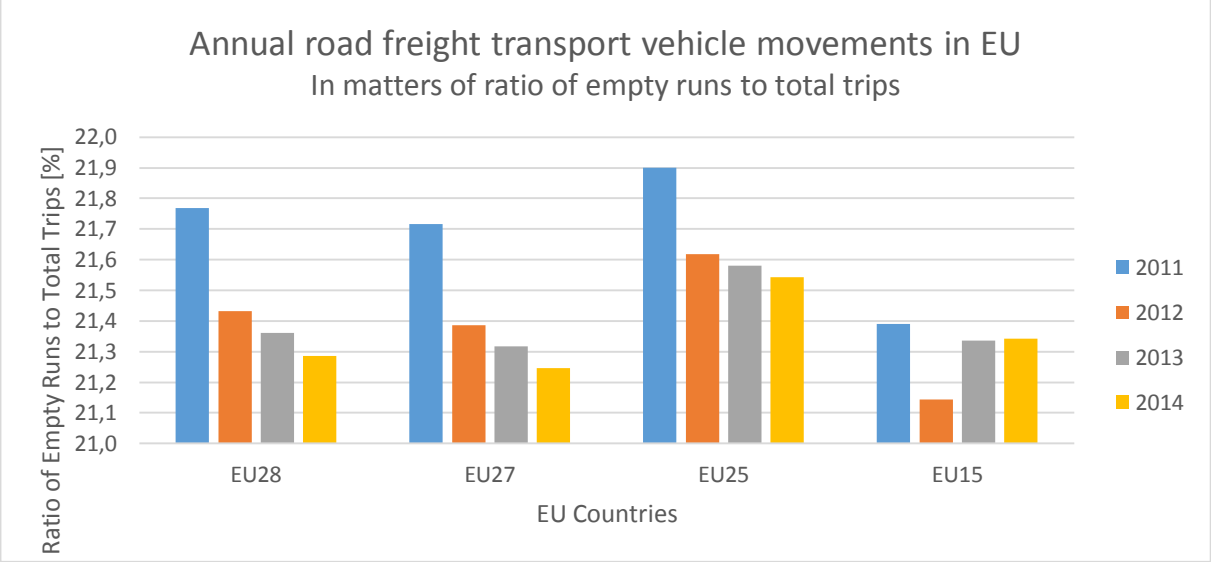

Figure 2 Annual road freight transport vehicle movements in EU – Ratio of empty runs to total runs [EUR15]

EU15 are all members of the European Union before the eastern European expansion of the EU in 2004. These are Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
The enlargement in 2004 added Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia as new members and enlarged it to the EU25.
In 2007 Bulgaria and Romania and in 2013 Croatia joined the EU which created the EU27 respectively the EU28 [EUR14].

Figure 3 shows the vehicle movements in the EU in absolute numbers. While the curves for loaded EU25, EU27 and EU 28 stay nearly constant except a small kink from 2011 to 2012, the loaded EU15 curve shows a bigger decrease from 97.000 to 89.000 million kilometers in the observed period. In contrast the curves which represent the empty runs show nearly no decrease over the time [EUR15].

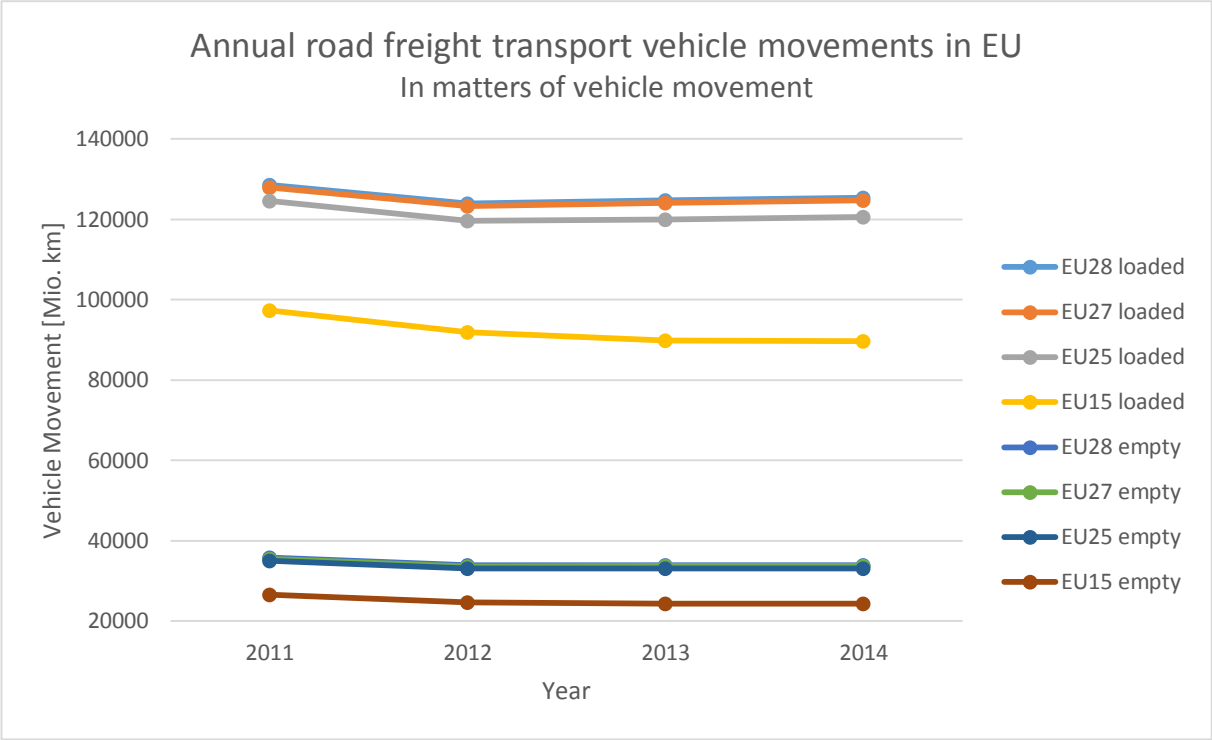

Figure 3 Annual road freight transport vehicle movements in EU – Vehicle movement [EUR15]

2.3.2 Road Freight Statistics in Austria

Figure 4 shows the statistics from loaded and empty truck runs from 2005 to 2014 in Austria. While the curve which represents the loaded truck runs decreases from 2291 to 1689 million kilometers per year except a kink in 2006 with 2451 million kilometers, the curve which represents the empty runs proceeds nearly constant. From 846 million kilometers in 2005 to 812 million kilometers in 2014, only with a peak of 941 million kilometers in 2007. Further, Figure 4 also shows a loss in efficiency as the proportion between full an empty runs between 2005 and 2014 decreases.

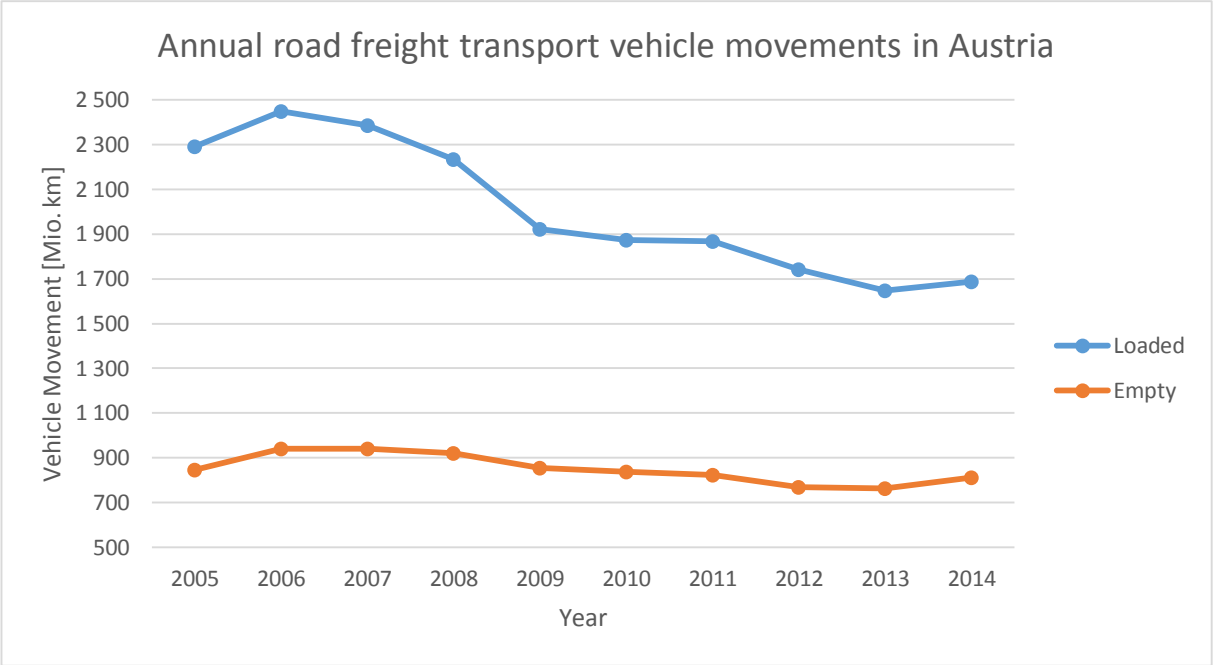

Figure 4 Annual road freight transport vehicle movements in Austria [EUR15]

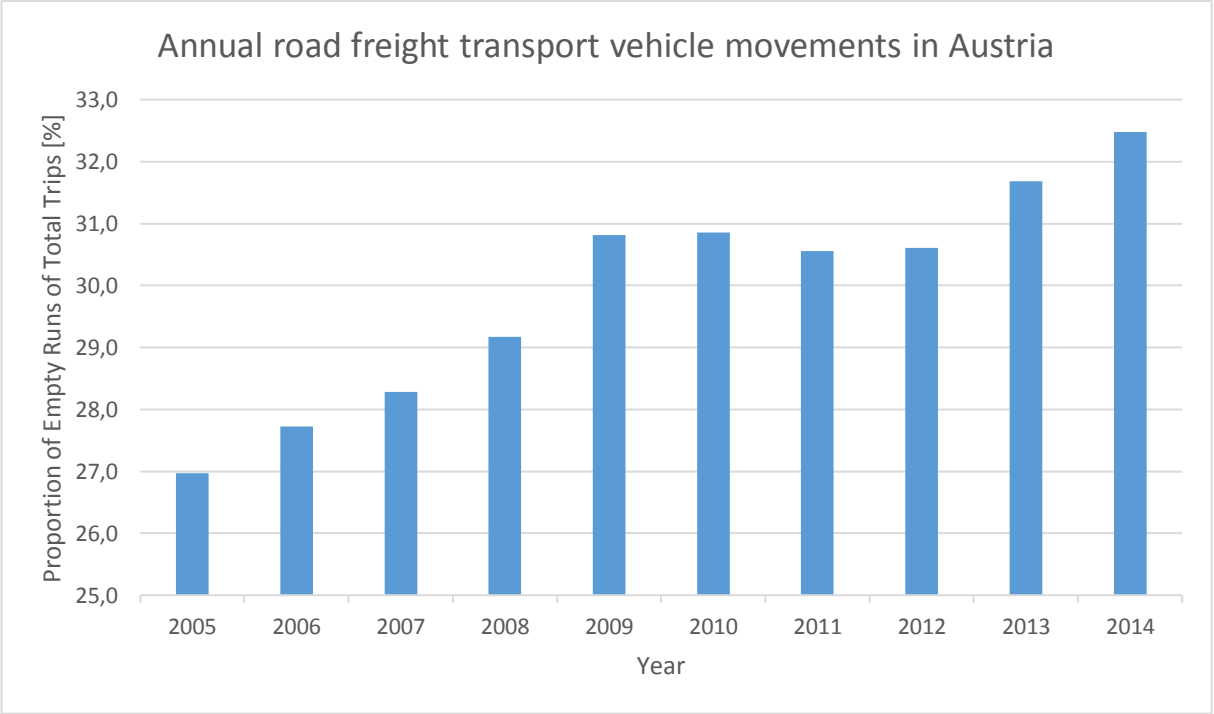

Figure 5 Annual road freight transport vehicle movements in Austria [EUR15]

This decrease of the utilization can be seen in Figure 5, as the proportion of empty runs considered in relation to the number of total runs increases from 27% to 32.5% from 2005 to 2014. This means that due to the decrease in the utilization the potential for cost saving measures increases [EUR15].
It needs to be mentioned that it is not always possible to have a degree of utilization of 100%. In some cases, certain goods require free space, there are no goods to return from the final destination of the tour or the company wants the truck to be empty when returning due to cleanliness.

Taking the described examples into account, the potential for cost savings is therefore lower. Nevertheless the low utilization is a problem in the transport departments and needs to be optimized. Improvements will not only have effects on the profit, it will also have beneficial impacts on the environment due to less CO2 emissions. There is a focus on "Green Production" in some companies which means that the products are produced environmentally friendly. Innovative approaches such as a transportation cooperation can help to fulfill such goals with low effort.

2.3.3 Further Challenges in Road Freight Transportation

Besides the problem of reaching a high utilization of trucks or saving CO2 emissions, there are further challenges in road freight transportation. The manufacturers have to deal with national and international rules, consider outsourcing of road haulage operations or coordinate the different responsible departments effectively. LSPs have to calculate driving times and distances, deal with language and cultural barriers or think about routing. A fair cost-benefit distribution is also necessary for having a successful cooperation and can raise the motivation for a committed participation of all partners [HAJ14]; [MG06].

2.4 Challenge of Efficient Road Transportation for Magna Powertrain

In chapter 2.3 the challenge of efficient road transportation in the EU and in Austria has been discussed. In this part that challenge is described for the case of *MPT*.
Magna Powertrain has suppliers all over the world. In order to ensure an on-time delivery a sophisticated Supply Chain Management, a large network of transportation service providers and therefore high expenses for the transportation of the goods are required.
MPT has a degree of weight utilization of their transports of estimated 80%. With the innovative approach of a cooperation in the transport sector with other companies *Magna* wants to increase the utilization and save money.

At the moment there is one cooperation with the *PFI* on the route between *MPT's* factory in Styria and three suppliers in Hungary, where the products are transported by the *PLSP*. The goods of the PFI are brought to its stores in Hungary and get unloaded there. As space on the cargo area of the truck gets available, goods from the suppliers of *MPT* get loaded and transported back. In that way empty runs are reduced as products are sent back.
At least two more cooperations are planned, one with the *PFI* in Slovenia and another one with an Upper Austrian company in Vorchdorf. However, there is more potential available. Theoretically a cooperation can be formed with nearly everyone but it strongly depends on the partner.
However, finding the right partners is not an easy task as several criteria have to be fulfilled, such as

- not being in competition with *MPT*

Due to company policies a non- competitive partner is preferred.
- not having a bad reputation
  If the partner has a bad reputation it can affect *MPT* badly as well.
- being flexible with the delivery of stocks
  Delivery of *Magna* requires a Just-In-Time concept. Therefore there is not much room for time delays.

If those criteria are met, negotiations about a cooperation can begin. The more partners can be found, the bigger the transportation network can get and more savings can be expected.
At the moment the savings due to the cooperation add up to 30% of the total costs. This is a high and satisfying value if the low effort is considered.

2.5 Objectives

In order to provide solutions for *MPT* for the previously discussed challenges for road freight transportation this master's thesis' scope is as follows:

- Criteria for synergy profiles
  - Literature review regarding already existing cooperations in the transport section between non-competing companies and new approaches
  - Evaluation of the current *MPT/PFI* project
- For further investigation a potential and failure analysis through investigating the process and the process steps
- As an additional result a guideline and checklist for forming successful cooperations in the future with other companies as *MPT* seeks for more partners

3 Development of Measures – Systematic Approach

For a better understanding of the differences the first part of this chapter gives a description of three different forms of cooperations. It is followed by a more detailed explanation of horizontal cooperations as the cooperation the *MPT/PFI* project is about is of a horizontal nature. Afterwards, a graphical modelling language, the Event-driven Process Chain, which is applied for depicting the process and an analysis method, the Failure Mode and Effects Analysis, are explained. The next part then introduces a new approach for transporting goods, the so-called Physical Internet. Finally, the rationale and principles underlying the interviews carried out for this study's purpose will be discussed.

3.1 Vertical, Horizontal and Lateral Cooperation

Cooperations, in any form, can have a beneficial impact on the contributing partners' success. Cruijssen, Cools and Dullaert state that a cooperation in core activities even including the exchange of customer information, is considered more desirable than a cooperation on non-core activities. The reason is the higher potential of cost savings [CCD07].
Simatupang and Sridharan identify three different structures of cooperations: vertical, horizontal and lateral [SS02]. According to their definition a cooperation is called vertical

"…when two or more organizations such as the manufacturer, the distributor, the carrier, and the retailer share their responsibilities, resources, and performance information to serve relatively similar end customers" [SS02].

For a comparison the European Commission describes vertical cooperation as follows:

"'vertical agreement' means an agreement or concerted practice entered into between two or more undertakings each of which operates, for the purposes of the agreement or the concerted practice, at a different level of the production or distribution chain, and relating to the conditions under which the parties may purchase, sell or resell certain goods or services" [EC10].

In a vertical cooperation the partners act on different stages of the supply chain but work together.

Further, Simatupang and Sridharan define a horizontal cooperation as:

"…two or more unrelated or competing organizations cooperate to share their private information or resources such as joint distribution centers" [SS02].

The European Commission defines a horizontal cooperation as follows:

"Co-operation is of a 'horizontal nature' if an agreement is entered into between actual or potential competitors" [EC11].

That means the potential competitors are not related in any case but are acting on the same stage of the supply chain and normally produce the same or similar products. In the framework of a cooperation they can share information, resources, facilities or knowledge to reduce costs or improve operations or service.

Finally, a lateral collaboration

"…aims to gain more flexibility by combining and sharing capabilities in both vertical and horizontal manners" [SS02].

The combination of a vertical and horizontal cooperation results in more effective networks in logistics. The increased flexibility and efficiency depends, of course, on the companies and their planned cooperation.

The project which is investigated by this master thesis, the cooperation between *MPT* and a *PFI*, with a *Partner Logistics Service Provider* (*PLSP*), is a horizontal cooperation. Both companies are working on the same stage of the supply chain and cooperate in the transportation sector. Therefore the next section focuses on this type of cooperation.

3.1.1 Types of Horizontal Cooperations

For protecting market positions, improving service or saving costs Logistics Service Providers (LSP) consider a horizontal cooperation an interesting approach. Therefore the development of horizontal relationships is increasing [CDF07].
There are various possibilities of how to cooperate, depending on the type of the cooperation. Four different variants of horizontal cooperation are identified by Bengtsson and Kock: competition, co-opetition, cooperation and coexistence [BK00].

- A competition can be characterized by a reaction-action pattern with a direct and simple way of interacting. Companies have the same or similar suppliers and deliver to the same or similar group of customers.
- A co-opetition has clear norms as it can have a competitive and a cooperative side.
- In a cooperation different types of bonds between the companies can arise and a frequent exchange happens. The goals are defined and commonly followed, although the companies can be competitors. As written in 3.1 a cooperation can be of vertical, horizontal or lateral nature.
- With coexistence no bonds exist and economic exchange is included and the goals of the involved companies are decided separately [BK99]; [CDF07].

A further way to classify a cooperation is the level of integration. Lambert, Emmelhainz and Gardner developed a partnership model for horizontal cooperations where they identify different degrees of integration. Figure 6 shows those different levels. They range from only little commitment in the cooperation (an arm's length cooperation) to horizontal cooperation with classification in type I, type II or type III cooperation to horizontal integration (joint venture) where the companies are merged.

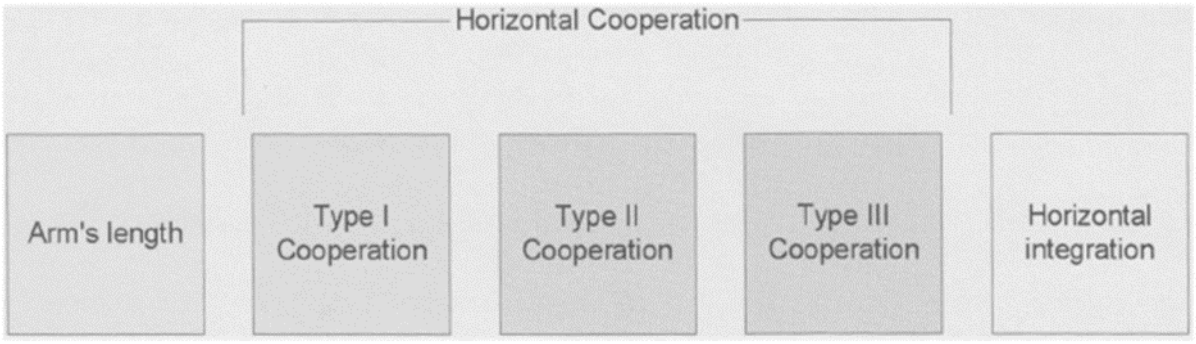

Figure 6 Levels of integration [CDF07]

Lambert, Emmelhainz and Gardner define the horizontal cooperation types as follows:

- Type I

  "The organizations involved recognize each other as partners and, on a limited basis, coordinate activities and planning. The partnership usually has a short-term focus and involves only one division or functional area within each organization" [LEG99].
- Type II

  "The organizations involved progress beyond coordination of activities to integration of activities. Although not expected to last "forever," the partnership has a long-term horizon. Multiple divisions and functions within the firm are involved in the partnership" [LEG99].
- Type III

  "The organizations share a significant level of integration. Each party views the other as an extension of their own firm. Typically no "end date" for the partnership exists" [LEG99].

An arm's length cooperation means that the cooperation exists over a long time with little interaction and the companies communicate occasionally. Therefore there is no need for a deeper commitment. An example would be if one LSP subcontracts another LSP in the case of a capacity shortage [CDF07].
Horizontal integration can be seen as the contrary level of commitment in a cooperation. Here, companies are merged together [CDF07].
Some horizontal relationships involve more commitment, trust and information sharing than others. The lower the level of integration the lower is the required commitment and trust. A type I cooperation has a low degree of integration but still requires more activities from each partner than with an arm's length cooperation. A type III has a high level of integration but there is still not everything combined with the partner.
The *MPT/PFI* project is a type I cooperation: they coordinate activities and planning (transportation), the focus is on only one division (transportation department) and it is not a long-term agreement (pilot project).

3.2 EPC – Event-driven Process Chain

For depicting processes from the *MPT/PFI* project the usage of the so called Event-driven Process Chain (EPC) was chosen as it helps imaging complex business processes. It is an intuitive and easy-to-understand graphic language. The specific

name results from the typical diagram type as the process is modelled as a "chain of events and functions" [AAL99]. It was first introduced by Keller, Nüttgens and Scheer in 1992 [AAL99].
As this master thesis is written in English this part explains the symbols, elements and the table structure of an EPC diagram for the English language use. The application of the EPC on the *MPT/PFI* project to depict three different processes can then be found in 4.5.

3.2.1 Symbols and Elements

For creating such an EPC diagram standardized symbols and elements allow to model business cases. Those can be combined with logical connectors.

3.2.1.1 Event

Events are represented as a hexagon and describe the condition the process is currently in or what is happening. They also picture the case before or afterwards of a function An EPC diagram starts and ends with an event. Examples are "arriving", "material in storage" or "order taken" [DBB(+)06].

Figure 7 EPC - Event

3.2.1.2 Function

Functions are represented as rounded rectangles and describe tasks, activities or steps which need to be taken. Examples are "load goods", "check orders" or "inform about delay" [DBB(+)06].

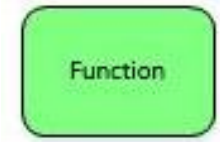

Figure 8 EPC - Function

3.2.1.3 Process Path

Process paths are represented as rectangle which lies above an event. They help to navigate in the diagram as a connection to another process. Examples are "Tour Process" or "Supplier Process" [DBB(+)06].

Figure 9 EPC - Process Path

3.2.1.4Organization Unit

Organization units are represented as ellipse with a vertical line and describe roles, persons or departments which are responsible for the function or the process. Examples are "purchasing department", "warehouse" or "truck driver" [DBB(+)06].

Figure 10 EPC - Organization Unit

3.2.1.5Information

Information is represented as a rectangle and describes information which is necessary for the input or output of a function [DBB(+)06].

Figure 11 EPC - Information

3.2.1.6Logical Connectors

Complex structures can be created with logical connectors: a function with several events or one event with multiple functions can be connected. For this purpose three different symbols can be used [DBB(+)06]:

- AND (∧) means that every way or criteria has to be fulfilled
- OR (∨) means that at least one way or criteria has to be fulfilled
- XOR means that only one way or criteria has to be fulfilled

Figure 12 Logical connectors

Figure 13 shows an example of a logical connector with three different paths. Before this exemplary joint a delay occurred. The information about the problem, which has to be forwarded by the truck driver, is needed. As there is an OR connector at least one, but also all three events can be the reason for this delay.

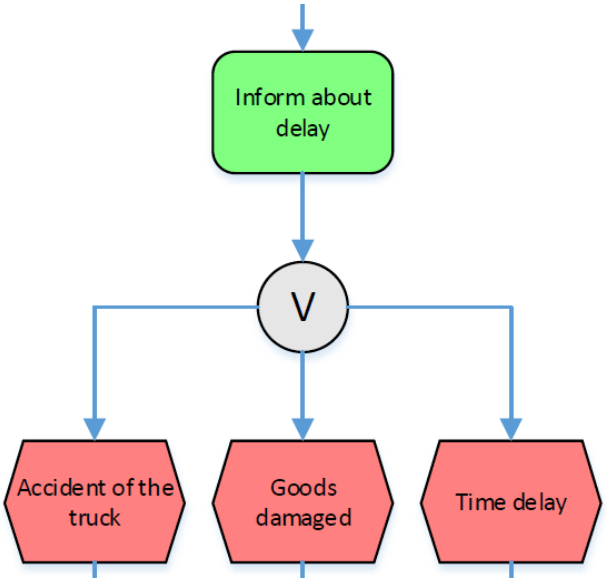

Figure 13 Example for logical connectors

3.2.2 Diagram Structure

Part 3.2.1 explained the symbols and elements of how to build up an EPC diagram. This section now shows the structure which will be used and which is proposed by the Institute of Logistics Engineering. A structure is not mandatory but gives a quicker overview and simplifies reading. Figure 14 shows the whole line of configuration. As the image may not be suitable for a good viewing it is split up in three parts in the following figures.

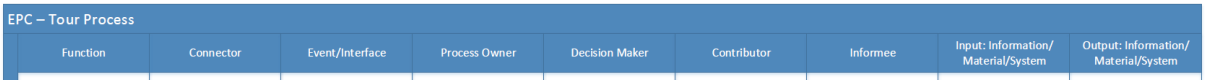

Figure 14 EPC diagram structure 1

Figure 15 shows the first three columns of the structure: function, connector and event/interface. Function elements are clustered in the first, logical connectors in the second and event symbols in the third slot.

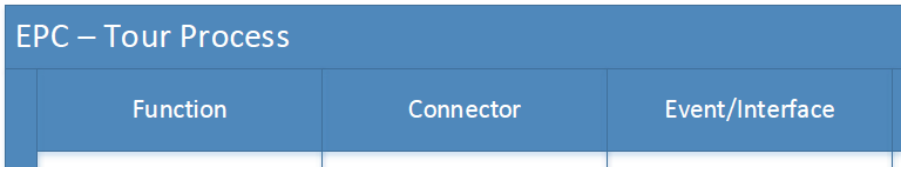

Figure 15 EPC diagram structure 2

The next three columns are illustrated by Figure 16: process owner, decision maker and contributor. Those positions are roles in the process and therefore symbols for organization units are used. The process owner is the role, person or department performing the function in the same line. The decision maker decides on important questions and is assigned to functions as well. The contributor can be seen as supporting act of the other two roles.

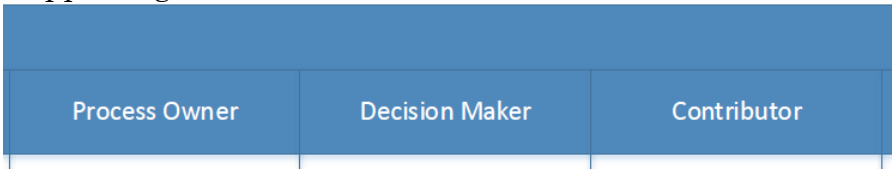

Figure 16 EPC diagram structure 3

Figure 17 then shows the third part of the EPC structure, the last three columns: informee, input: information/material/system and output: information/material/system. The informee gets noticed about the performed function. Input is the needed and output is the information given per process step.

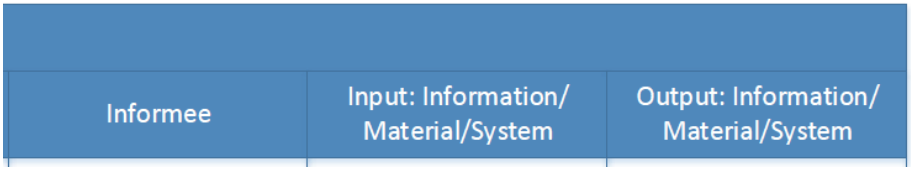

Figure 17 EPC diagram structure 4

3.3 Failure Mode and Effects Analysis

As there are humans working and processing critical steps as well, failures and mistakes can arise. The Failure Mode and Effects Analysis (FMEA) is a structured way to analyze those steps and helps to find solutions for potential problems before they even occur. For this reason this analysis method was chosen for this master thesis.
It can be distinguished between Design- or Development FMEA (DFMEA) and Process- or Production FMEA (PFMEA). The first one is used in designing or developing processes and evaluates the feasibility of a part or product. The second one considers potential weaknesses in production or operation [PBF(+)07]. For this master thesis the Process- or Production FMEA will be applied as processes will be analyzed.

3.3.1 Table Structure

The main goal of the procedure is to avoid failures and minimize risks. As many (crucial) parts, components, process steps, or (sub-) systems should get reviewed. It helps to evaluate their possible effects on the whole system in the case of failure. A standardized form with an evaluation scheme that has been defined beforehand ensures an objective rating. The layout used for this master thesis is provided from the Institute for Logistics Engineering. Figure 18 shows the whole line of configuration and also implies the procedure. As the image may not be suitable for a good viewing it is split up in two parts and can be seen in Figure 19 and Figure 20.

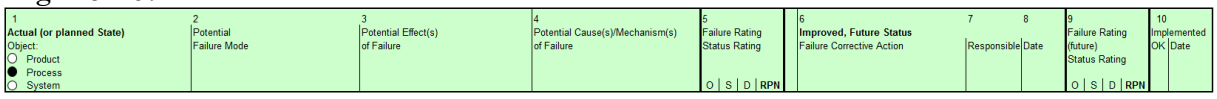

Figure 18 FMEA table structure 1

The first four columns of the structure are illustrated by Figure 19: Actual (or planned State), Potential Failure Mode, Potential Effect(s) of Failure and Potential Cause(s)/ Mechanism(s) of Failure. The objects, process steps or systems which are investigated are listed in Actual (or planned State) and the potential failure which may occur can be found in the second column. The third one lists the potential effects which may appear in the event of a failure. In Potential Cause(s)/ Mechanism(s) of Failure are the impacts specified which may have caused the issues.

1 **Actual (or planned State)** Object: ○ Product ● Process ○ System	2 Potential Failure Mode	3 Potential Effect(s) of Failure	4 Potential Cause(s)/Mechanism(s) of Failure

Figure 19 FMEA table structure 2

The columns five to ten are shown in Figure 20: Failure Rating/Status Rating Improved, Future Status, Responsible, Date, Failure Rating/ (future) Status Rating and Implemented.

5 Failure Rating Status Rating O S D **RPN**	6 **Improved, Future Status** Failure Corrective Action	7 Responsible	8 Date	9 Failure Rating (future) Status Rating O S D **RPN**	10 Implemented OK	Date

Figure 20 FMEA table structure 3

The rating of the discussed problem is done in Failure Rating/ Status Rating, according to three different factors:

- Occurrence (O): How likely it is for that failure to occur
- Severity (S): How severe the failure would be and
- Detection (D): How likely it is to detect that failure

Values are assigned to the different states of each factor: the more problems it can cause the higher the number. For example if a failure is very unlikely to appear, a 1 has to be entered into the appropriate field in the table, if the likelihood of an occurrence is very high a 9 or a 10 has to be written into the field. The same logic goes for severity and detection. Figure 21 shows that ranking.

Occurrence (O)		**Severity (S)**		**Detection (D)**	
Remote: failure is unlikely	1	None	1	High	1
Low: relatively few failures	2 - 3	Minor	2 - 3	Moderate	2 - 5
Moderate: occasional failure	4 - 6	Low	4 - 6	Low	6 - 8
High: frequent failures	7 - 8	High	7 - 8	Very remote	9
Very high: persistent failures	9 - 10	Hazardous	9 - 10	Absolute impossible	10

Figure 21 Rating of evaluation factors

Finally, all three factors are multiplied and the result is called Risk Priority Number (RPN). It is a qualitative method for the ranking. Equation 1 shows the calculation of the RPN. The lowest possible value would be 1, the highest 1000, but further limits, where a closer look at that very case would be necessary, have to be defined. Such a limit can be 125, every case with a value equal to it or higher has to be investigated.

Equation 1 Risk Priority Number

$$RPN = O \times S \times D$$

The significance of the value then is not absolute as different ways can lead to the same number. For example a RPN of 160 can be calculated with 5 x 4 x 8 or 4 x 10 x 4 (O x S x D). For this example, the difference is the possibility of a detection. While the first one has a moderate occurrence and severity but is difficult to detect, the second one would be hazardous but quite easily detectable. Therefore, the factors have to be considered as well and the final evaluation discussed by the risk evaluation team [PBF(+)07].

The sixth column then lists actions which can be made in order to avoid the failures. In the two following ones then a responsible person who watches the fulfilling of the improving actions and the date of the fulfillment are to be entered. The reevaluation of the improved parts, components, process steps, or (sub-) systems is written in column nine and the confirmation of the implementation in column ten.
The application of the FMEA on the three previously described processes will be presented in 5.2.

3.4 Physical Internet

Today most of the goods shipped worldwide are transported in standardized ISO containers. Because of their specified dimensions they can be transported easily by ship, truck or railroad. Yet they are often not fully loaded and therefore a higher utilization would increase the efficiency and sustainability.
In 2006 a new approach to face the transportation inefficiencies appeared, named Physical Internet (PI) [MON11]. This new approach can also be seen as prognosis for the future because it can revolutionize the transportation business. It is mentioned in this master thesis in order to present new ideas where *MPT* can benefit from.
Montreuil, Meller and Ballot define the PI as an

"…open global logistics system founded on physical, digital and operational interconnectivity through encapsulation, interfaces and protocols. It is a perpetually evolving system driven by technological, infrastructural and business innovation" [MMB12].

Several initiatives, research groups and companies around the world, such as CIRRELT Research Center, CICMHE, TU Graz, Boeing, Volvo, hp, are working on or supporting this project to revolutionize transportation [MON10]. The Physical Internet Initiative wants to transform "the way physical objects are moved, stored, realized, supplied and used, aiming towards greater efficiency and sustainability" [MON10]. To reach those goals it tries to adopt concepts of the Digital Internet of data transfer to the real world transportation processes. For that, the PI processes "Black-Boxes" in a shared distribution and transportation network where the goods are encapsulated in those "Black-Boxes" and only the information for identification and routing can be read out. The packet header or smart tags save this data [MON11].
The "Black-Boxes" are special designed containers, so called PI-containers, which help to fulfill the physical, digital and operational interconnectivity. As shown in Figure 22 the PI-containers have exactly defined sizes which can easily be composited and decomposed, interlocked, sealed, stored and handled.
This is a big advantage over today's 20ft or 40ft (6m or 12m) ISO containers. They are often not fully utilized due to their inflexibility in size. A lot of space remains unused if big goods with unusual measures are shipped. PI-containers can get composited differently every time, depending on the goods which need to be shipped. Their sizes range from 0.12, 0.24, 0.36, 0.48, 0.6, 1.2, 2.4, 3.6, 4.8, to 6

and 12m along the X, Y or Z axes [MON11]. This modality standardizes transportation, loading and unloading and guarantees a high flexibility to the whole logistics sector.

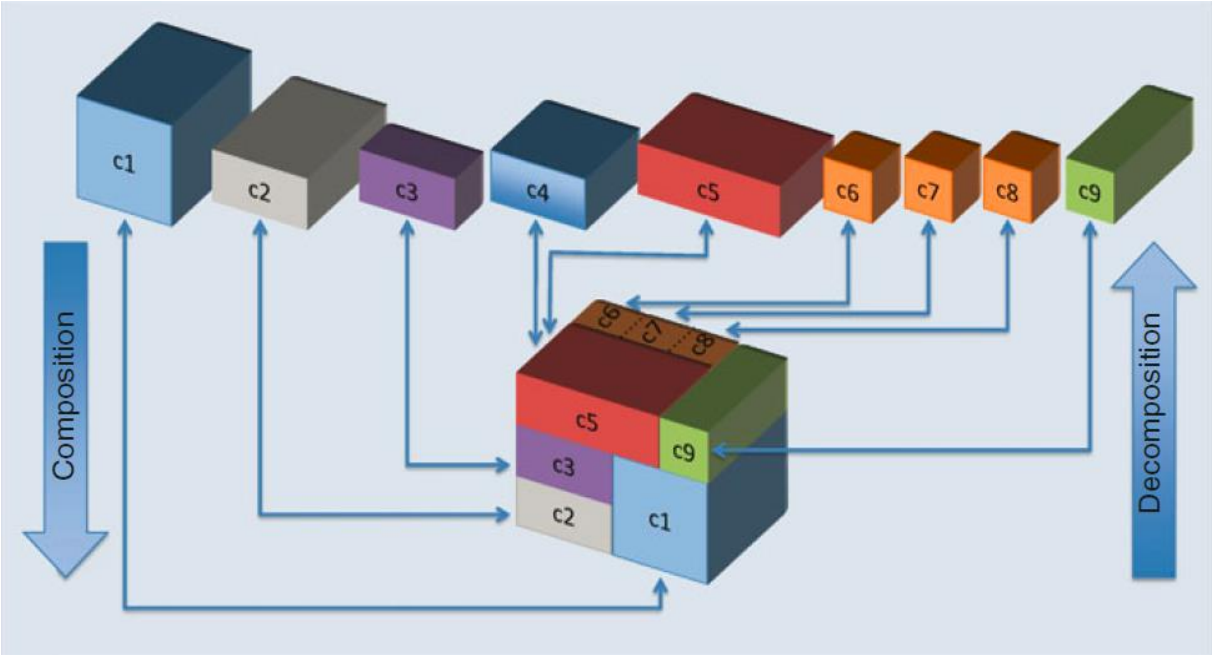

Figure 22 Illustrating the modularity of unitary and composite PI-containers [MON11]

The PI-containers are just one key element. A total of thirteen characteristics of the Physical Internet are described by Montreuil and listed hereafter [MON11]:

1. Encapsulate merchandises in world-standard smart green modular containers
2. Aiming towards universal interconnectivity
3. Evolve from material to PI-container handling and storage systems
4. Exploit smart networked containers embedding smart objects
5. Evolve from point-to-point hub-and-spoke transport to distributed multi-segment intermodal transport
6. Embrace a unified multi-tier conceptual framework
7. Activate and exploit an Open Global Supply Web
8. Design products fitting containers with minimal space waste
9. Minimize physical moves and storages by digitally transmitting knowledge and materializing objects as locally as possible
10. Deploy open performance monitoring and capability certifications
11. Prioritize webbed reliability and resilience of networks
12. Stimulate business model innovation
13. Enable open infrastructural innovation

The fifth point shows another innovation and possibility of reaching higher efficiencies through the PI. The distribution of goods would be facilitated: the PI-containers are brought to commonly used hubs, re-composited depending on the final location and are automatically sent to the right truck. This saves a lot of time and money due to faster and more accurate processing and handling, saved man-hours and round-the-clock working.

The PI also simplifies transportation cooperations because they are profitable on short ways as well. One LSP can deliver goods to the hub, they get re-composited and then another LSP carries them to the next location.

One of the first research projects in order to realize the PI is the MODULUSHCA (Modular Logistics Units in Shared Co-Modal Networks) project and was financed by the EU research program FP7 (7th Framework Programme for Research and Technological Development). MODULUSHCA was a three-year funded project, from 2012 to 2015, and focused on the area of FMCG on a European level, with North American Partners.
Objectives of this project are

- the demonstration of the vision's core components,
- a simulation-based and a field-based proof of concept should be achieved through testing key functions
- a global synchronization with projects from Canada and the USA and planning of an intercontinental market implementation [MOD15].

After the end of the FP7 research program in 2013 the next big research program, called Horizon 2020, started. The European Technology Platform ALICE (Alliance for Logistics Innovation through Collaboration in Europe) assisted and supported the European Commission with the implementation of this research program, where the PI is one of the core research topics and ensures the progress of the PI [ETP16].

The PI is a next step of how the connected modern world changes the way logistics used to be. In the future goods will use new interfaces and special protocols and can consequently be arranged automatically depending on their final location. With a higher grade of automation the whole process of sending and receiving goods gets more efficient, faster and also more reliable.
However, as it can imagined there is still a lot of research and development required to meet all these characteristics and criteria. It is not only about designing a new container, it is about designing an entirely new concept and network. Changes will affect the international air, sea and road transportation due to higher efficiency, lower emissions or new highly specialized companies entering the market. The pricing then will also have to be made differently than now as other factors play critical roles. Cheaper possibilities of sending and receiving parcels or goods does not only have effects on big companies it also has an impact on the peoples' life. More products can become affordable. Nevertheless a change of thinking in the work – world has to take place. A higher level of automation handling the goods in the companies changes also the jobs of the people. More high qualified jobs will occur and low qualified jobs probably get less. Even so it can take years, but in the end it will affect the way people live in a positive way.

3.5 Interviews

After having found fundamental background information in order to enhance the understanding of the issue of horizontal cooperations, the next step was concerned with conducting interviews with employees from all involved companies from the *MPT/PFI* project. This approach was chosen as it is an excellent and easy way

to get a feeling for the everyday business, understand the challenges at the beginning and during the operation and learn about new ideas which are not implemented yet. Also, further and deeper information regarding different topics such as transportation safety, information flow, coordination of the cooperation and the results was gathered.

Interviews can be conducted with two different research methods: qualitative and quantitative method [HOH00]. The quantitative method is structured, asks standardized questions and can be evaluated by statistical procedures. Examples are questions with two or more answer possibilities or when a decision on a frequency (rare, sometimes, often) has to be made. The qualitative method asks broad and open questions and tries to answer the "why" and "how". The most important difference between those two methods is the flexibility. In terms of the answer possibilities qualitative methods are more flexible than quantitative methods [HO00]. For this master thesis the qualitative research method for the interviews is used.

For conducting a good interview McNamara suggests the application of eight principles [MCN10]:

- Choose a setting with little distraction.
- Explain the purpose of the interview.
- Address terms of confidentiality.
- Explain the format of the interview.
- Indicate how long the interview usually takes.
- Tell them how to get in touch with you later if they want to.
- Ask them if they have any questions.
- Don't count on your memory to recall their answers.

Further, the wording of the questions is also important. It is recommended not to ask closed questions or give answer possibilities as this hinders clear answers [HOH00]. Additionally, McNamara proposes five principles for a good and clear wording [MCN10]:

- Wording should be open-ended.
- Questions should be as neutral as possible.
- Questions should be asked one at a time.
- Questions should be worded clearly.
- Be careful asking "why" questions.

In 4.3 the results of the interviews are presented and discussed. Together with the results from the literature research the answers from the interviews were used for finding criteria for a successful cooperation and also for creating the guidelines for further cooperations. The criteria are then discussed in 5.3.1 and the guideline is presented in 5.3.

4 Methodology of Procedure

In the first part of the following chapter a brief overview of the legal framework conditions is given, followed by examples of horizontal cooperations from the industry with a short discussion afterwards. The next part then will be dedicated to the interviews conducted for the purpose of this study. This will be followed by a detailed list of crucial criteria for cooperation profiles and factors that need to be taken into account prior to launching a cooperation with another company. Afterwards, the methodology of the guideline is described. This chapters' final part will focus on an illustration of the whole ordering and delivering process of the *MPT/PFI* project.

4.1.1 Legal Framework Conditions

For forming cooperations between companies legal aspects have to be considered, too. This part gives a short overview of those aspects and points out the challenges of cooperating with competitors. In this way, the reader gets an idea of the obstacles the companies of the in chapter 4.2 presented examples had to face.
The most important law concerning applies a cooperation between non- competing companies is the law on competition according to the Institute of European Law at the University of Graz and the Wirtschaftskammer Steiermark.
On the one hand there is the EU – wide law on competition which is valid in every member state and on the other hand there are national laws which are valid in the different states but are not allowed to dissent the EU law such as national laws on competition.
Basically it says that a cooperation is not allowed to influence the competition according to price, market share or the access to resources in a negative manner. Although this cooperation between *MPT* and the *PFI* is not be affecting the market but is seeking for an improvement in the transportation sector, the law on competition has to be considered if the cooperation is affecting the transportation business in any way.
Nevertheless some minor laws have to be considered such as law on driving times and idle period and the case of cabotage. The first one manages the times a truck driver is allowed to drive and make breaks. The second one deals with the originating country of transportation companies and how many tours they are allowed to perform abroad. However, those two are only important for the transport service provider.
To evaluate if a horizontal partnership acts inside the boundaries of the law several criteria have to be considered. For example it depends on the size and goals of the cooperation, the number of the involved partners and if they are competing or prohibited acts such as price fixing take place. A law expert or a lawyer should check it case-by-case.

4.2 Examples for Horizontal Cooperations

Beside the cooperation between *MPT* and the *PFI* numerous other examples for partnerships between companies can be found.
Table 1 gives an overview and a summary of cooperations between non-competitors or competitors, which can be compared according to different categories. The

first column lists the companies involved, the type of competition and the synergy type are stated in the next two. The columns four, five and six then answer the questions why the cooperations were started, where the focus was put and which results were accomplished. The table finishes with a description where the cooperations took place and the literature sources.
Examples which will be described more detailed are highlighted in green. The rationale behind picking them was on the one hand the significance and relevance for this master thesis and on the other hand the quality of the available information. Those examples were conducted within an EU project, called CO^3, which explains the availability of deeper information. The examples of "*Baxter, Colruyt, Eternit and Ontex*" and "*Nestlé and PepsiCo*" were realized and described with case studies, the third one, "*Spar Retail Belgium*", was a project which was conducted outside of the case studies.

Table 1 Overview of examples

Involved Companies	Competition	Synergy Type	Reason for Cooperation	Focus on	Results	Area	Sources
Baxter, Colruyt, Eternit, Ontex Consulter: TRI-VIZOR LSP: Corneel Geerts Transport, Transfennica	Non-Competing	Endemic	Improve transportation route from Belgium to Northwest of Spain	Road-short sea-road transportation route	•More than 60 FTL successfully synchronized and shipped back and forth •Overall potential collaboration savings of more than 3% •CO_2 reduction of more than 30%	Belgium, Spain	[CAB(+)14] [JVV13]
Colgate-Palmolive, Johnson&Johnson LSP: Coop	Competing	Universal	•Improve warehousing and distribution operations •Sustainability to all involved actors	Global Data Synchronization (GDS)	•46.724km, 19.754l diesel saved, 53t CO_2 not released •Savings between 10 and 30% of transport costs/year to each destination •Full synchronization reordering process	Italy	[TCH11] [VB10]
Danone Dairy, Carrefour	Non-Competing	Universal	Leverage supply-driven shopper insights based on near real-time (daily) data of inventory and transaction at store level	Data gathering and analyzing	•On-shelf availability improvement to 98% •Business growth for Danone of 2.5% •Category growth for Carrefour of 1.2%	France	[TCH11]
Kellogg's, Kimberly-Clark LSP: LPR	Non-Competing	Endemic	•Shared warehousing for consolidating vehicles into outbound delivery •Flexible use of yard space to facilitate a pallet processing depot on site •Operations for sites sharing	Transportation cooperation	•Reduction of empty running by 434.000km/year •Saving the equivalent of 113.000l fuel and 380.000kg CO_2 •Several operations for sites sharing	Europe	[MCK10(b)] [SB10]
Mars Netherlands, Heinz LSP: Kuehne Nagel, Nabuurs	Non-Competing	Endemic	Improved reliability of truck turn times lead to less trucks in transport network and improved productivity at DCs	•FMCG networks •Truck turn times	•Implemented the Green order sustainable logistics initiative	The Netherlands	[TCH11] [PVA13]
Mars Petcare France, United Biscuits, Saupiquet, Wrigley Consulter: ArgusI, IPS Europe, GOLS LSP: Norbert Dentressangle	Non-Competing	Endemic	Create logistic flow with FTL	Shared warehouse	Savings: •Wrigley:-29.1% •Mars: -31.0% •Saupiquet: -32.2% •UB: -32.4%	France	[CAB(+)14] [GJC12]
Nestlé, PepsiCo Consulter: BABM, TRI-VIZOR LSP: STEF	Competing	Endemic	•Same DC as basis •Upgrade logistics flow to FTL	Improve LTL to FTL	•Cost savings of 10–15%	Belgium, Luxembourg	[CAB(+)14]
Network of 20 different suppliers in Northern Sweden	Either	Universal	•Increase frequency of distribution •Increase truck utilization	Co-Distribution		Sweden	[HS04]
Spar Retail Belgium Consulter: TRI-VIZOR, GS1/ECR Belgilux	Non-Competing	Universal	Share suppliers' transportation capacities in retail network to reduce empty runs	Improve retail distribution network	No numbers available, but important learnings: •Communication is crucial •Every necessary department should be involved •A neutral trustee should be engaged •LSPs should be seen as equivalent partners •Success should be celebrated	Belgium, Luxembourg, the Netherlands	[VB14]
United Biscuits, Nestlé	Competing	Endemic	Transportation cooperation	Reduce empty runs	•Transport savings of 280.000 vehicle-km/year	United Kingdom	[TCH11] [MCK12] [MCK10(b)]
Zoetwaren Distributie Nederland (ZDN)	Competing	Endemic	Increase efficiency of delivery processes	Cut transportation costs	•Cut transportation costs •Increased customer service •Reduction of unloading and handling costs •Customers got access to a broader product assortment	The Netherlands	[CDF07]

As seen in the literature research and as it is presented in Table 1 it can be stated that the competition status is not a reason for declining a partnership. The required time period from the first contact to the start of the first transport may take longer due to widespread negotiations but it is possible as the success shows. However, trust between the partners is crucial in order to overcome doubts.
Further, the evaluation of the synergy type is based on the theory in part 2.2.3. As those cooperations are not about patents unique synergies do not appear. They are either universal or endemic though almost every cooperation is the first one. Seven out of eleven are then endemic as they bundle distribution synergies.
Also, almost every quoted example started with the main goal of cost savings or an increase of the efficiency. Only two had an analysis of different data as their aim. However, costs are the driving factor for most companies.
Remarkable is that side-synergies appear with nearly every cooperation. Besides main-synergies such as cost reduction or raised efficiency also savings of diesel or carbon emission and an increase of the service level could have been achieved. It shows that there can exist several undetected potential.

The chapter continues with the description of the CO^3 EU project, where the focus lay on freight transportation. In the framework of the project four case studies with pre-defined borders were conducted. Those four cases are described briefly. As they were vital for answering the research questions, two of them are explained in further detail. The third example of a successful cooperation, which is mentioned in this chapter and described, then deals with an approach of managing the suppliers' transportations in a retail network in a more efficient way.

4.2.1 CO^3 – Collaboration Concepts for Co – Modality

In November 2008 a European Research Group connected to European Supply Chains and also co-financed by the European Commission announced that it is necessary to increase the utilization of freight transport systems in Europe. Low efficiency and lack of sufficient scale were identified as key factors for preventing a quicker development of answers of the transportation problems' urgent questions. Out of this considerations the CO^3 project was born.
The project's mission was to encourage European companies to form horizontal cooperations and realize a structural breakthrough in European logistics 'competitiveness and sustainability. The focus was put on horizontal collaboration and scenarios for projects and test cases were created. The CO^3 consortium set up test projects and supported companies who wanted to transport their goods more efficient and in an environmentally friendlier way [CO314(a)]. In a nutshell the project's objectives were

- creating a legal framework and remove managerial barriers for horizontal cooperations,
- planning, starting and coordinating several test cases
- supporting all the involved parties with workshops or seminars [CO314(b)].

For the purpose of those horizontal cooperation projects often a neutral partner was required in order to maximize the gains and managing and ensuring a trustful and fair working environment. In the CO^3 cases such a partner was called a network orchestrator or "trustee". A trustee helps with sharing confidential data,

when partners work in the same markets or in synchronizing daily operations [CO314(b)].
Four different projects with varying levels of complexity were introduced during the CO^3 project's lifetime [CO314(c)]. Those projects were then described within case studies and made publicly accessible. In order to provide a better overview of the scope of all case studies they will be described shortly afterwards. The second and the fourth case study are then explained in a more detailed way as they are vital for answering the research questions.
Further, a good insight into the challenges of forming cooperations with other companies and into learnings the companies made could be obtained out of those case studies. As it can be seen in chapter 5 this insights were then also used for synergy profiles, the guideline and for the practical application.
On 31st August 2014 the CO^3 project has been successfully completed and the results are now openly accessible on the homepage [CO314(c)].

For a better understanding the term shipper is explained here briefly: a shipper is the party which is responsible for the transportation of parts, products or goods from one place to another.

4.2.1.1Case Study 1
The first case study was a road transportation cooperation between two or more shippers. The capacity utilization should be increased and the number of trucks on the road decreased. Further, the costs for logistics, the service level and the sustainability for the involved companies should be improved.

4.2.1.2Case Study 2
The second case study was as a multimodal transportation cooperation between two or more shippers, meaning to bring together volume which is large enough to form a sea- or railway transportation corridor between two regions in Europe. It should demonstrate the potential of freight flow bundling.

4.2.1.3Case Study 3
The third case study was a retail distribution cooperation with two or more shippers. It deals with a horizontal cooperation in the area of daily distribution of fast moving consumer goods (FMCG) and shows the potential for vehicle fill rate increase and carbon footprint reduction.

4.2.1.4Case Study 4
The last case study is more complex compared to the others because it covers a horizontal cooperation for warehousing, value added logistics and international distribution for several shippers which are active in the same sector. The challenge is to bring together all important actors of the supply chain, form synergies and test if it creates any additional synergies.

For this master thesis two of those case studies have been taken into account and studied more thoroughly, the second and the fourth one. They are the most relevant in terms of similarity to the *MPT/PFI* project, are well described and provide more information compared to the others.

4.2.2 Case Study 2 – Baxter, Colruyt, Eternit and Ontex

In this case study, which deals with the formation and management of a sea- and railway transportation corridor between Belgium and the northwest of Spain, four shippers, two LSPs and one neutral trustee take part.
The participating shippers in the project are [CAB(+)14]:

- *Baxter*, which is a globally acting healthcare company and has intercompany flow of goods between Belgium and Spain,
- *Colruyt*, a retailer located in Belgium, imports wines and other beverages from Spain back to Belgium,
- *Eternit*, which is also a Belgium company but manufactures and exports construction and building materials from Belgium to Spain
- *Ontex*, a company which handles FMCG, produces hygienic disposals and has intercompany flows of their goods between Belgium and Spain as well.

Due to the geographic proximity of the companies to each other and their similar transportation flows it was possible to form a "closed loop shipping corridor" [CAB(+)14]. Analogically to the *MPT/PFI* project, all of those listed shippers are transporting their goods on similar routes (between Belgium and the northwest of Spain) which simplifies it to form a transportation cooperation and bundle the transportation flows. The companies are also non-competitors which avoids some obstacles in the beginning.
Two different companies take part as LSPs [CAB(+)14]:

- *Corneel Geerts Transport (GGT)* is a family-owned LSP from Belgium and is specialized in long distance transport on the road and provides intermodal transportation services as well
- *Transfennica* is a sea-shipping provider focused on short sea routes, based in the Netherlands providing integrated transportation solutions.

The neutral trustee is *TRI-VIZOR*, which is a spin-off company of the University of Antwerp and is also located in Belgium. They acted as project manager, brought the interested companies together, started the test case and concluded it in May 2013. For setting everything up the standard methodology of the CO^3 consortium, a three-phased approach, was applied [JVV13]:

- Phase 1 – Identification: suitable companies and transportation flows need to be selected
- Phase 2 – Preparation: a cooperation concept and the calculation of the business case has to be prepared
- Phase 3 – Implementation: operational and management processes need to be implemented

Further, *TRI-VIZOR*, which had also to consider the project's goals of decreasing the carbon emissions and increasing sustainability, decided to use short-sea

routes as much as possible and pushed full truck loads (FTL) in the whole process [JVV13].
The whole case study took place between January and April 2013. More than 60 FTL were successfully synchronized and shipped between the northwest of Spain and Belgium [JVV13].
The outcome were important learnings and conclusions for the companies about cost, reduction of carbon emission, legal aspects and better service. Further, a significant reduction of 32% of carbon emission compared to the status before the cooperation was achieved. A potential of savings of more than three percent has been calculated before the project started. Though, due to two unexpected problems a slight cost increase of three percent occurred: an unexpected drop in the volumes just before the start of the project and the suboptimal distances between the drop and pick-up locations in Spain which caused empty runs. During the evaluation meeting the partners came to the conclusion that more loads or extra shippers and fewer empty runs would have led to actual cost savings [JVV13].
This case study shows some important lessons for the *MPT/PFI* project and learnings for further cooperations [JVV13]:

- Preparing and setting up such a collaboration can be quite long and should not be underestimated. In this very case it required more than one year between the first steps and the first shipment.
- The more partners take part in such a cooperation, the more complex and complicated is it to realize and maintain it.
- A "critical mass" with a sufficient transport volume should be reached to work cost-efficiently.
- There should be a plan for last minute changes of the volumes or delivery date [JVV13].
- The higher the level of uncertainty is, the more difficult it is to bring other shippers to participate in the project.

4.2.3 Case Study 4 – Nestlé and PepsiCo

The fourth case study of the CO^3 project deals with creating and managing a horizontal cooperation in retail distribution in the area of fresh and chilled temperatures (2 – 4°C) between two shippers, one LSP and two neutral trustees.
The two shippers which are acting in the field of FMCG are [JLV(+)14]:

- *Nestlé*, which is a leading company in nutrition, health and wellness, has a portfolio with lots of different food brands and is present in 197 countries. In retail *Nestlé* is active with more than 40 brands in Belgium
- *PepsiCo*, one of the leading beverages and food companies in the world, being active in more than 200 countries. In 2012 in Belgium *PepsiCo* was the fastest growing FMCG company.

The two shippers are normally competing but are working together in this transportation partnership. The processes of warehousing, co-packing and outbound distribution of the products is bundled in the case study's framework. Compared to the case studies presented in 4.2.2, different challenges such as anti-trust laws, organizing FTL, reducing carbon emission and the transportation and handling of cooled products need to be faced.

As common LSP a European wide acting company named *STEF*, which is specialized in temperature controlled logistics, has been selected by *Nestlé* and *PepsiCo*. They are present with 223 sites in nine different European countries. *STEF* also manages all logistical processes and is therefore fully responsible for managing the administrative and financial flows [JLV(+)14].
Normally, producers of FMCG perform transports to their main customers, which are mostly retail distribution centers, with Less than full Truck Loads (LTL). This is mostly because of the short expiration date and a small share of many FMCG companies' product portfolio. The challenge for achieving cost savings, improving service and reducing CO_2 emissions is to rearrange and synchronize the loads and deliveries in a better way in order to get FTL [CO314(d)].
Two organizations acted as orchestrators or neutral trustees in this case [JLV(+)14]:

- *Belgilux Association of Branded products Manufacturers (BABM)* is representing FMCG branded products in Belgium and Luxembourg and supports its members with networking, information and stakeholder contacts
- *TRI-VIZOR* applied the three-phased approach for setting everything up (as described in 4.2.2)

The start for this case study in 2010 was marked by *BABM* members identifying the need for increased cooperation in the fresh and chilled distribution. As a supporting and neutral partner *TRI-VIZOR* was hired. An important part of *TRI-VIZOR's* tasks was to ensure the neutrality and anti-trust compliance of the horizontal cooperation. Due to the competing market position of *Nestlé* and *PepsiCo*, it was not possible to share crucial details such as delivery information or cost calculations amongst both shippers. Therefore, information such as this had to be exchanged with *BABM* as legal and *TRI-VIZOR* as logistic trustee. *Nestlé's* and *PepsiCo's* legal departments and an external lawyer controlled the data exchange to avoid any misuse [CO314(d)].
Cost savings and CO2 reduction were the main driving factors. 10 – 15% of cost savings were realized in the first audit. As key success factor or key learnings some points are mentioned here [CAB(+)14]:

- The project needs to be managed reliable and neutral due to the competing character of the partners. The trustees can fulfill this role perfectly and are responsible for a trustful environment.
- The ideas have to be communicated well to the management and people involved to create a trustful and open atmosphere towards the concept of a horizontal cooperation.

In order to generate more synergies and to use the potential such a horizontal cooperation in retail in FMCG has, the project can be expanded from the very partnership to an open access cluster. In this cluster interested shippers can join and bring in their transports as well [JLV(+)14].
MPT can also find interesting learnings for future cooperations especially if a cooperation with a competing company is considered:

- An external legal expert besides a neutral partner helps to avoid troubles with anti-trust agreements.

- It is difficult to have a high level of data security if there are just two partners: to get the partner's transportation volumes or costs, the own numbers can be subtracted from the total value.

4.2.4 Spar Retail Network

This example was also conducted within the scope of the CO^3 EU – project and deals with the creation and management of a horizontal cooperation in the logistics sector and synergy possibilities in *Spar's* supply network in Belgium.
Spar Retail Belgium, which is part of Belgium's largest retailer, the *Colruyt Group*, is responsible for 249 stores. All of them are supplied from the central distribution center of *Spar* which causes consequently a lot of inbound and outbound traffic in this area. Hence a lot of room for improvement is given [VB14].
The project was conducted by the Belgium and Luxembourg company *GS1/ECR* in cooperation with *TRI-VIZOR*. The latter one was again engaged as project manager and neutral trustee and used the CO^3 methodology (see 4.2.2) to bring this project to success [VB14].
GS1 Belgium & Luxembourg is part of the worldwide acting neutral non-profit organization *GS1 Group*. They are active in more than 100 countries, develop standards for identifying, capturing and exchanging industrial data and have a focus on value chain cooperation. *GS1 Belgilux* merged with *ECR Belgilux* in 2007. *ECR (Efficient Consumer Response)* is a neutral cooperation platform for suppliers and retailers [VB14].
As there is just a small number of universal retail distribution centers in central Belgium there is a big potential of cooperations between different companies in logistics. However, those potentials need to be identified in the first place. In the inbound supply network innovative approaches were applied by *Spar* to improve the processes.
Therefore, the project aims at reducing empty running of trucks by sharing transports through crosscompany cooperations. The total performance of the network can be improved in three ways [VB14]:

- Efficiency: by lowering transportation costs per drop or per pallet and reducing inventories
- Effectiveness: by increasing the service level, the frequency of deliveries or improving the management of the supplies
- Sustainability: by reducing CO_2 emissions and increasing the utilization of the trucks

Interesting for *MPT* can be the fact that *Spar* tries to optimize logistics in a distribution center as *MPT* is sharing one with several other companies as well close to Graz. Therefore potential for synergies is given. However, a detailed evaluation would be necessary before any cooperation can be formed.
The success of this horizontal cooperation project was measured through Key Performance Indicators [VB14]:

- Utilization of trucks (volume and weight)
- Less driven and less empty kilometers in the network
- Less receptions at the gate of the warehouse of *Spar* and therefore lower labor costs

- Lower inventory levels due to higher rotation of the inventory
- Increased service level because of smaller drops and faster deliveries
- Less traffic has an positive impact to the society

Numbers for a quantitative measurement of the success are not provided in the report but it is stated in the report that *Spar* is very satisfied with the project's outcome and got useful learning out of it [VB14]. These learnings can be used for a better and more efficient cooperation management of *MPT* as well:

- Communication is the key to a successful partnership and concerns should be taken seriously
- Every necessary department such as purchasing, sales, legal or transport should be involved
- A neutral trustee for the overall project management and local persons for the companies should be engaged and trusted
- LSPs should be seen as equivalent partners and accordingly respected
- Success should be celebrated in order to build a good and strong cooperation culture. Nevertheless, failures should also be communicated honestly.

4.2.5 Summary of the Presented Case Studies

The three presented examples from the CO^3 project show the challenges of different scenarios for cooperations: between non-competitors, between competitors and the improvement of a supply network. For further cooperations several important lessons and can be drawn. One of the most important learning is to engage a neutral trustee as he can ensure a successful cooperation with a neutral management.
A more detailed summary, also referring to one of the research questions from 1.5, will be made in 5.1.

4.3 Interviews

In chapter 3.5 the reasons why the interviews were conducted are described. Here the procedure of the questioning is explained and the results are presented.
From *MPT* three employees and one manager, from the *PFI* one manager and from the *PLSP* one manager and one employee took part in this interview. The interviews were held time-wise to each other and every person got the same questions. Therefore a comparison and evaluation of the answers was possible.
As there were six interviews with thirteen questions each not every answer will be listed up here, instead the responses are summarized per question and listed up below. This list will then be followed by a discussion. The answers of those interviews together with results from the literature research, are used for developing criteria for further cooperations and provide a structure for the Event-driven Process Chain (EPC) in chapter 4.5. Further, the answers provide an input for a Failure Mode and Effects Analysis (FMEA) in chapter 5.2 and act as help for the guideline.

1. General information about the cooperation

Negotiations and discussions about forming a transportation cooperation between *Magna Powertrain* and the *PFI* and the *PLSP* as Logistics Service Provider started in mid-2014. In mid-2015 the *PLSP* made their first tour for this partnership on a route from a distribution center in Werndorf, which is nearby Graz, to Hungary and back. The *PFI* delivers fashion articles on a fixed route to their stores in Hungary and *MPT* has three suppliers which are located closely to this route. Due to this geographic proximity a transportation cooperation was obvious. Nevertheless the packages from the suppliers have to meet the truck weight limits of nine tons, otherwise they cannot be transported.
Before the cooperation started, the products from the three Hungarian *MPT* suppliers were collected once per week by an LSP which drove exclusively for MPT, now they get collected twice a week due to two weekly tours performed for the *PFI*. The challenge was to change the routine of the deliveries from the suppliers in order to pick them up twice a week instead of once. This resulted in smaller batches and accordingly less required storage area for *MPT*. Although the transporters are with 80 to 90% not fully utilized.
MPT aims at reaching savings of 40% compared to the pre-cooperation numbers. The costs for a single transport, performed only for *MPT* would be 100%. Through the partnership a cheaper price can be achieved and those savings could therefore be feasible. Currently *MPT* is saving more money than the *PFI* or the *PLSP* due to their higher expenditures or required detours, but are still not at the claimed value. In the future there should be a fair gain distribution between the three partners which would also increase the satisfaction for everyone.
A productive cooperation can only be guaranteed provided the structures and routes of the transports remain steady and fixed. Daily or very rapid changes would result in a total breakdown or an increase of complexity and complication of the entire process. Other factors that need to be considered are mutual respect and trust between all parties engaged.

2. Structures and sequences in in- and outbound logistics
    - Information about the Cargocenter Graz in Werndorf
    - Who organizes the logistics, deliveries and storage?
    - Who purchases the transportation services?

MPT's and the *PFI's* logistics are processed via different distribution centers (DC). *Temmel Logistik Center* (*TLC*) operates DCs in Ilz and Lannach, which are close to *Magna* sites. They are exclusively responsible for *MPT* and manage the inbound logistics. The majority of the goods, about 85%, are handled at the DC in Ilz, the minority of about 15% are sent directly to the DC in Lannach.
At the Cargo Center Graz (CCG) in Werndorf, which is close to Graz, the logistics of the *PFI* are processed. There the distribution center is responsible for Central and Eastern Europe which is one out of three DCs of the *PFI*, next to one in Germany and in Switzerland. At the CCG the goods for Slovenia, Hungary and Austria are distributed. The logistics itself are operated, coordinated and planned by the *PFI*, the Logistics Service Provider *JCL* is responsible for all operative activities such as distributing and storing, but only at the CCG. The goods get loaded on the trucks by *JCL*, the *PLSP* picks them up and performs the deliveries.

In case any new routes or tours are required, they get written-out and several offers are seeked. The best offer then receives the order. If the order concerns only a single run, there are special platforms where offers can be advertised. The tour plans itself are designed by the *PFI*.

3. Motivation to form this cooperation
   - Is it similar to *MPT's* reason: reduce empty runs and reduce consequently the costs? Or is a higher utilization of the trucks the driving factor (with volume and/or weight)?
   - What is the actual number of empty runs (absolute number or percentage)?

The main reason of starting such a cooperation is, of course, to cut costs. In the best case all three partners can profit from it: *MPT* and the *PFI* get cheaper transports due to the savings and the *PLSP* can earn more money although they have a higher effort due to loading and accounting.
Further, the partnership helps to decrease empty runs, which range from about 10 to 20% at the moment, and consequently increase the utilization of the trucks. As a result the CO_2 emissions would be lowered as well, which is also a defined point in the *Magna* Agenda (how can CO_2 be saved and production be environmentally friendlier).
Another advantages of such cooperations is the fact that it helps to save storage space at *MPT* as there are two smaller deliveries instead of one bigger, fixed tours simplify planning and it is an innovative approach which shows that the department can work creatively and find out-of-the-box solutions.
Successful cooperations can form the basis for further mutual projects as well.

4. For which transportation runs are certain cooperations relevant?
   - Is the cooperation only with regular or also with non- regular transportation routes?
   - Which potential challenges does a cooperation with more transports pose?

The cooperation only comprises regular and weekly standard transports which are not one-way tours. Currently the cooperation with the *PFI* performs on the route Austria – Hungary and back. However, there are negotiations with other companies for cooperations in the area of Upper Austria or Slovenia.
There are several challenges which need to be considered before launching further transportation cooperations such as the branch of industry the partner is operating in (retail, furniture, fashion…), cleanness, weight and volume of the goods or the legally allowed drive times. The tour plan should also fit with the location of the other companies to avoid detours and therefore higher costs. Further, it also depends on the flexibility of the reception of the deliveries as *MPT* has a tight schedule and the *PFI* can receive the goods at some time at night. If the tour plan requires adaptions, *MPT* has to be informed about two to three weeks in advance due to their tight production plan.
After a certain time, which is about half a year or a full year, the cooperation will get evaluated and the partners reflect on factors they consider as good and what needs to be improved.

5. Routes and deliveries
   - Which routes are part of the cooperation?
   - Where is still potential for further cooperations – also with other companies?
   - Are cooperations on any other routes planned – what are influencing factors?

Cooperations are only cost-effective on longer ways. Time is very crucial on short tracks and therefore an extra drive would not be profitable. Currently the cooperation with the *PFI* and the *PLSP* is performing on the route Austria – Hungary and back.
Basically a partnership is possible in every country, but it strongly depends on the partner. A flow of commodities has to be given, possible delivery times have to be checked, the location should be close to the route to avoid long detours and the other company has to be interested in and committed to the cooperation. Also, the potential of a cooperation is higher the longer the distances and the heavier the goods are.
There are more partnerships on other routes planned or at least considered. Potential for further cooperations in the form of smaller suppliers can be found in Hungary. Another tour which is performed for the *PFI* in Slovenia shows also potential with a supplier for *MPT*.

6. Interest in further cooperations
   - Should there be further cooperations with *MPT*, maybe internal?
   - Shoulder there be further cooperations with different companies? What does it depend on?

Similarities in production, time schedules, delivery and flexibility would create difficulties for cooperating with another *Magna* sister-company. Due to this reasons the coordination, organization and set up would be too challenging and the required effort would be too high.
A cooperation with another company is mostly a matter of resources because it also needs a certain amount of time (lead times) to combine transports. Further, it depends on the tour plans, other companies' interest and commitment in the partnership and transportation flows. It can also be stated that opposites are easier to work with and contrast can complement each other: flexible/inflexible, inbound-/outbound logistics, Just In Time (JIT)/not Just In Time.

7. Safety
   - Order tracking: Do orders get tracked or monitored?
   - How are the transports insured?

Transports do not get tracked in real time. At the moment it works manually with paper proofs as the drive- and idle time gets recorded. There would be the possibility of live-tracking via GPS since it sends a signal every 30 seconds. With the by the *PLSP* used program FLEETBOARD the data can be used to check tour information such as exact location, velocities, braking, idle-, rest-, drive times, mileage or messages to the driver. Order tracking is therefore possible, but the

necessity is not given. In the transportation management system of the *PLSP* data could be entered manually to connect information about the loading with the truck. Until now it was not necessary because the tours were exclusively operated for the *PFI* and therefore it was always the same load. Today there is no proper IT system existing to connect this data automatically. Managing it online would be a next step as it improves the current procedure. Supplier management works via SAP, the tour information can be processed out of delivery data and start-/end times.
If there occur any problems during a tour such as a technical issues a quick notice has to be sent and the LSP has to forward it. A time buffer for the tours is planned anyways to secure smaller issues. As long as this works no monitoring is needed. If there are bigger delays or a special JIT delivery, a more detailed tracing can be necessary. Coordination is held with part disposal, storage and production staff if delayed goods can cause any troubles. In order to overcome delivery delays a safety stock, which has to be as big as it would take the quickest transport to *MPT*, has to exist. At the supplier's site a safety stock of at least three days has to be available.
Insurances are concluded between the *PLSP* and the company and not between *MPT* and the *PFI*, but an insurance for the goods and the truck is concluded anyways. In case of acts of nature the LSP cannot be made responsible though if there are shipping damages the LSP is liable. Therefore the *PLSP* is self-insured and any transported goods are also insured throughout Europe. The loading of the goods is conducted by the supplier, the LSP is then responsible for the safety of the loading. Contracts, including a non-disclosure agreement, are made accordingly to *MPT* policies with the LSP, but there are no extra contracts with the *PFI*. Here just the planning and the operative processes are coordinated. Accounting is made then with the *PLSP*.

8. Problems and difficulties in the beginning and now
    - Which initial difficulties needed to be overcome?
    - Where is potential for improvement?
    - What could be better? Are there any new ideas or approaches?

At the beginning of the cooperation several obstacles had to be overcome. Some of the initial difficulties were

- convincing every involved person or department of changes or a new approach. In a supply chain many parties are involved such as the LSP, the *PFI*, *MPT* or part disposal. Planned changes have to be communicated in a proper way and advantages for every area need to be highlighted to the right persons.
- the first get-to-know and the understanding of how the partner works as it is very important.
- establishing a learning curve: before the start a certain amount of time is required to guarantee a smooth operation. Good planning is necessary to avoid risks and foresee problems.
- the coordination of picking-up the goods, calculating the delivery times, punctuality and predefinition of the times of the tours.

- the correct implementation of the tour plan from the *PFI* at *MPT*. Misunderstandings occurred about the constellation of the tour. The *PLSP* and the *PFI* already worked together well, *MPT* had to adapt the tour plans. Now a fixed pick-up frequency of the goods is established.

Further, logical issues appeared due to legal holidays and at the end of the year:

- At the end of 2015 in calendar weeks 53/1 a logical error came up as the tours used to differ in even and uneven week numbers and two uneven weeks were following. It had a big impact on *MPT* due to their strict and inflexible time schedule.
- Also, legal holidays caused major problems in the delivery rhythm. The stores of the *PFI* are closed on these days and therefore there are no tours, but *MPT* has standard shift operation. In order to address this issue, *MPT* and the *PFI* agreed on giving each other notice two or three weeks prior to any tour cancellations due to legal holidays. Changes are communicated via e-mail and have to be sent in time to avoid troubles.
- Waiting times when arriving at the DC before being able to deliver the goods are tolerable now.

As it can be imagined the whole cooperation is not working perfectly yet and there is still potential for improvement. It may lay in

- more frequent and better communication
- coordination or regular meetings every two weeks to tackle and solve problems together and communicate changes quicker and more efficient.
- evidences (documents, stamps, signatures) of MPT. At the moment there are several different documents which have to signed and filled out. Less paper work would lead to higher efficiency.
- pick-up equipment of the goods in order to avoid possible damages
- gathering the returned goods digitally because currently it is made via phone
- a project-chart of the transports when picking-up and delivering
- the design of the tour plans with sender and receiver
- a better gain distribution. Currently it is a win-win situation for *MPT* and the *PFI* but the *PLSP* does not have high earnings. An improved distribution might increase the motivation and satisfaction.

Additionally, the following two statements have to be considered as well.

- Problems such as traffic obstructions or other time delays get reported immediately. At the moment the tour is well optimized and there is hardly any potential for improvement on the tour itself.
- Cooperations work on an operative basis except quick changes need to be made. In that case problems at *MPT* can occur and the production flow could be disturbed. Then the need for a single transport can arise.

Finally, new ideas which may develop new tours or increase the efficiency are

- the creation of tour segments because there is free space again from the first stop on
- using shorter ways such as internal traffic of *MPT* in the area of Graz

- splitting-up transports: divide deliveries to several trucks → preliminary storage is minimized and the timing of storage space gets optimized
- forming further cooperations in Austria
- creating hubs near shopping malls as there is a high logistics traffic

9. Coordination of the cooperation
   - How and where is this cooperation coordinated?

MPT, the *PFI* and the *PLSP* coordinate their own responsibilities by themselves. Though the *PLSP* has to be in contact with everyone (*MPT*, *PFI*, suppliers, stores) and seek all information which makes the LSP a very important player.
MPT follows the tour plans which are designed by the *PFI* as they have the tour structure. Those plans are released once a week. Important for the *PFI* is, that the goods are delivered every second day to the stores, independent of the week day. Legal holidays and seasonal postponement have to be considered as well as they have impact on *MPT*.

10. Information- and data exchange
    - How does the exchange of the data and information work (e-mail, mutual platform…)?
    - What kind of information is exchanged?
    - Are there common data standards?

Communication and data exchange mostly works via phone and e-mail as everything should exist in a written form in case any issues occur. Lists are created and edited with *Microsoft Excel*. The program is also used as common standard for all suppliers. The supplier receives such a file, edits and forwards it to the LSP and part disposal. This file contains information about the goods such as dimensions, weight and amount, sender or receiver. An electronic data exchange platform would be an idea for improvement.
At the end of the year an overview and a summary is created.

11. Criteria for cooperations
    - What does the partner company's profile have to look like?
    - With which company can be cooperated? With which companies cannot be cooperated?
    - What requirements and criteria does the own company need to fulfill?

The partner has to bring in sincerity, transparency and trust, interest in the cooperation, a tight structure, a high planning security and transport stability as variations should be prevented. Company policy has to be taken into account as well: difficult or discredited partners should be avoided. There would probably also be no approval if the other company is a competitor.
Basically a cooperation can be made with everyone originating from the furniture-, pharmacy-, retail-, fashion or automotive industry, but it has to fulfill the company guidelines. The partner should also get insight into the production processes in order to understand the other company better and get a feeling e.g. for possible

delivery urgencies. An important question is where the truck is emptied on the tour in order to avoid long detours which would result in empty mileage.
Opposed transportation flows can simplify the tours. It can be feasible with identical flows as well, but it would complicate it. Contrary partners can be simpler to work with as contrasts can complement each other: flexible/inflexible, inbound-/outbound logistics, JIT/not JIT.
Proper transportation equipment has to be used as cleanness requirements has to be fulfilled such as being oil- and dust-free, not greasy or smelly and no construction material should have been in the truck before. Further, weight and volume regulations have to be considered in planning and not everything may be able to be transported at once. Also rear-loading of the trucks should be possible. In the current ones a standardized construction is included where clothes-rails can be mounted and goods can be stored underneath. Bigger sized packages can be secured via belts and straps.
The own company has to clarify which requirements have to be considered such as inflexibility with deliveries (JIT) or stackability of heavy or lighter goods. Basically the demand on the own company is similar to the partners'.

12. Transportation requirements
    - What are the requirements on the transport?
    - What can and what cannot be transported?
    - What are the limitations to the own and to the other goods?

Top priority for transportation are weight limits and net load. Further, a tarpaulin body should not be an issue as long as there are no holes in it because humidity and rust are problematic. However, *MPT* packages are designed to avoid such troubles. Therefore, requirements concerning the partner's transports are higher than *MPT's* e.g. about 60% of the *PFI's* goods are hanging ware.
Some specific parts cannot be piled or nothing else is allowed to be put on top of it. Oils or powders which may flow out should also not be in the same truck or stored separately.
Goods of the partner (*PFI*) are light but need a lot of space. *MPT's* products are the opposite – heavy but do not need much space. Gears and gear wheels are stored in boxes as the clothes must not get dirty. The transportation flow has to be ensured.
Resources and capacities are easier to schedule when the tours are planned and fixed.

13. Results so far
    - Can you evaluate the cooperation so far? Are you satisfied with the results and the operational process so far?
    - How can the success of the cooperation be measured?

The overall rating of the cooperation is very positive. On an operative basis the cooperation worked out well although constant monitoring is necessary and if problems occur, proper measures have to be taken.
MPT measures the success in numbers (costs) with a comparison of before and after values and in the satisfaction of the employees. Currently the savings add up to approximately 30%. Although the cooperation means a higher coordination

and organizational effort than just engaging a LSP, potential is seen in this form of a partnership.
The *PLSP* is also very satisfied as the sales increased, although the price range is tightly measured. Here, success is measured in numbers as well as in customer satisfaction. The LSP reaches a 95% success rate with tour drive times and a flexibility of short changes is given as well.
Currently the majority of savings is on the side of *MPT*. The *PFI* is not aiming at great savings as for them every saved Euro is an improvement. This is no issue since the tour has to be made anyways and it does not matter if something else is transported at the same time. However, gains should be distributed more regularly in the future. The goal of *MPT* are savings of up to 40%. In the best case every partner can profit from this cooperation. This can also be an incentive for the LSP in the form of an extra plus as they have the highest efforts (accounting, responsibility). The shipper just passes the primary costs. Positive side effects such as CO_2 savings and improvements in audits are not yet included but too have a beneficial impact.
The cooperations also serves as generation for new customers for the *PLSP*: it is a possibility to work for corporations which would have never been customers – they started with a fashion company and now they also operate tours for the automotive industry. When performing successfully a kind of a "snowball-effect" appears. It is also easier if the LSP is smaller, with the *PLSP* exists a large foundation of trust.

4.3.1 Discussion of the Conducted Interviews

The main motivation for the formation of the cooperation was to reduce costs. Through the transportation partnership empty runs have been reduced and the utilization of the trucks has been increased. Besides that, savings in carbon emissions have been realized as well. *MPT* nearly reached their goal and saved about 30% of their costs, the *PFI* and the *PLSP* are also satisfied with the outcome so far. Still, a better and fairer gain distribution should be introduced, as the majority of savings is on the side of *Magna*. A distribution model where the gains are split up depending on the effort made, might be a solution.
A fixed tour plan and structure was already available through the *PFI* and the *PLSP* as this partnership existed before. Although it took about one year from starting the negotiations between the three partners to the first run. If a cooperation between partners who did not have any or only very little contact beforehand should be established, probably more ramp-up time should be scheduled. Further, the choice of the partner needs to be considered well. Trust is one of the most important criteria for maintaining a successful cooperation.
The current partnership can be seen as success and the effort was manageable. Having a bigger cooperation with more partners also leads to more potential for higher cost and CO_2 savings and more opportunities of new routes. On the downside being engaged with further partners results in investing more work for the coordination and the daily business.
For the future, a common communication platform and an updated data exchange standard would simplify the coordination.

4.4 Criteria for a Cooperation

Before starting a cooperation with another department or company numerous criteria should be considered. For that, input and suggestions have been found in specific literature and from project reports of other cooperations (see chapter 4.2). Further, the conducted interviews with employees of the involved companies lead to great insights and deep knowledge. Those perceptions will be presented here. Firstly, the outcome of the literature research is discussed followed by the results of the interviews. At the end of this section a summary can be found.

4.4.1 Criteria from the Literature Research

Different authors have already been engaged with transportation cooperations and conducted interviews with companies or performed research projects. In their published papers and articles various criteria, recommendations, facilitators or characteristics can be found. Those findings and also problems which may occur in a partnership are listed up in this part.

Lambert, Emmelhainz and Gardner [LEG99] developed a model for a partnering process and found four primary facilitators which can be expected in every partnership [LEG99]:

- Compatibility between companies
- Similar philosophies and techniques of the managements
- Mutuality and
- Symmetry

Further, five extra facilitators which can strengthen the cooperation are described [LEG99]:

- Exclusivity
- Shared competitors
- Geographical proximity
- Experience of cooperations and
- Shared customers

The four primary facilitators are similar to each other as they are non-tangible characteristics. It is very important to have a mutual basis for working together and it simplifies negotiations. The extra facilitators are then more measurable characteristics. Common competitors and end users may be addressed quite easily and the advantage of geographical proximity can be considered when choosing a partner. Further, experience in partnerships can be beneficial as well.

La Londe and Cooper [LC89] conducted a survey which was sponsored by "The Council of Logistics Management" about shipper-third party partnerships. Gibson, Rutner, and Keller [GRK02] summarize this survey and describe "five major relationship building facilitators" [GRK02] in their paper [GRK02]:

- Determination of an effective partnership
- Design of a non-zero sum solution
- Arrangement of a technology interface
- Global capabilities have to be owned and

- Share of gains and burdens

Those five steps can be seen as rough framework for starting a cooperation. In the beginning the conditions have to be negotiated and defined and the outline has to be developed for an economic solution. Further, a technology interface is required to communicate and exchange information and data. For acting regionally or globally, appropriate capabilities should be possessed. The fifth recommendation is to share the gains throughout the partners, but the burdens as well. This will maintain a fair and respected partnership. They also complement the criteria found by Lambert, Emmelhainz and Gardner very well as their findings point out intercompany and interpersonal criteria.
Another outcome of the research paper of Lambert, Emmelhainz and Gardner is a table about how to prevent failures in a partnership [LEG99]. Their described model can also address failures which may occur in a cooperation. Table 2 shows the findings discussed above. The first column is divided into two different categories: the first one lists possible failures due to perceptions which do not match, the second one lists possible failures due to inferior execution. The second column then gives a prevention or a solution. Drivers are the important factors necessary for a successful cooperation.
It can be seen that detailed negotiations and preparations are necessary to avoid wrong expectations beforehand and a competent management is crucial to prevent issues during operation. Further, lots of problems may not occur if all goals, changes, gains, challenges or burdens are communicated clearly. Trust is something which has to be built up and well maintained to avoid other troubles.

Table 2 How the model addresses causes of failure [LEG99]

Failure due to mismatched perceptions	**Model prevention/solution**
Unrealistic expectations	Calibrated during discussion of the drivers.
Corporate culture differences	Resolved during discussion of facilitators or taken as an indication that a partnership is not warranted.
Lack of mutual benefits/unprofitability for either party	Review of drivers indicates either that each side has a benefit or that no partnership should be implemented.
Lack of shared/clear goals	Goals need not be the same, but each partner must have specific goals, and the goals must not be incompatible. The discussion of mutuality as a facilitator ensures that each party understands and accepts the other's goals.
Deliberate attempts to sabotage	Likely become noticeable in discussion of both the drivers and facilitators.
Lack of top management support	Becomes evident during discussion of facilitators.
Imbalance in power	Discussion of facilitators indicates whether imbalance is severe enough to result in partnership failure.
Failure due to poor execution	**Model prevention/solution**
Concern over loss of direct control/uncertainties about service levels	Establishing joint operating controls and rich communication as part of components establishes well-understood service levels.
Unfairness in cost and pricing	Unlikely if the facilitator of mutuality and the component of trust and commitment are adequately addressed.
Poor up-front planning	All aspects of the partnership are specifically addressed prior to implementation.
Lack of trust	Explicit discussion and agreement in establishing components.
Overpromising and underdelivering	Calibration of drivers and agreement on components.
Lack of strategic direction	Explicit consideration of the contract scope along with determination of the level of partnering ensures strategic direction.
Poor communication	A separate and specific component; partners establish and regularly review joint communication channels.
Failure to respond to changes in corporate strategy/market conditions	Model works as a tool for analyzing on-going relationships and provides a mechanism for deciding that a partnership is no longer appropriate.

Verstrepen, Cools, Cruijssen and Dullaert conducted a survey with managers of different LSPs in 2004 in Belgium and the Netherlands on "internal and external drivers for horizontal cooperation" [VCC(+)06]. A total of 347 companies replied

and out of those responses a comparison was created. Table 3 shows external motives for horizontal cooperation, internal motives for a horizontal partnership can be seen in Table 4.

Table 3 External motives for horizontal cooperation [VCC(+)06]

External motive	Example
Customers	- Reduced customer loyalty - More doubtful debtors - Large fluctuations in demand - Demand for higher and constant service levels - Need for specialized LSPs - Outsourcing of non-core activities by shippers - Postponement - Mass customization - Regulation on working hours of truck drivers - Flexible capacity - Narrower pickup and delivery time windows imposed by shippers - One stop shopping (full service)
Economic environment	- Increasing petrol prices - Stricter safety regulations - Open borders - Increased uncertainty due to shorter planning, purchasing and production cycles
Industry	- Alliances and mergers between existing competitors (market concentration) - New competition through diversification - Price erosion - Investment in GPS/GPRS - Investment in tracking and tracing systems - Investment in RFID - Larger geographical market

Changes through customers, in the economic environment or in the industry are addressed as external challenges by the in the survey asked managers [VCC(+)06]. A horizontal cooperation can offer a solution due to combined resources and synergies which arise. Internal motives can urge a company to enter a cooperation as well. Such a step often means that a weakness should be reinforced or access to more resources should be gained. The main motivation is to save costs or increase efficiency. Verstrepen, Cools, Cruijssen and Dullaert identify five internal motives: better utilization of existing infrastructure and assets, increasing capacity, extending geographical coverage, improving service and diversification [VCC(+)06].

Table 4 Internal motives for horizontal cooperation [VCC(+)06]

Internal motive	Rationale
Better utilization of existing infrastructure and assets	- Better use of existing infrastructure and assets - Better use of present expertise - Reconsidering internal processes - New technologies (RFID, track and trace) - Make number of vehicles and FTEs more flexible in order to better cope with operational or demand fluctuations (peak loads)
Increasing capacity	- Increased scale of operations at clients (e.g. multimodal transportation) - Raise the scale of operations to benefit from greater complementarity and synergy - Need for a quick expansion to benefit from first mover advantage and gain a competitive edge
Extending geographical coverage	- Service new countries or regions - Overcome problems related to foreign investment, language or trade barriers, e.g. By partnering with a local LSP in China to comply with locals legislation
Improving service	- Following trends in Supply Chain Management - Implementing new technologies and computer systems
Diversification	- Spreading logistics activities over a larger number of product/market combinations to become less dependent on business cycles

Although those are the views of managers from LSPs and motives which can lead to cooperations, it can be interpreted as criteria as well. A stable and trustful partnership, planning certainty, better cost profiles or access to new markets can be crucial factors for companies and should be fulfilled.

Zineldin and Bredenlöw state in their paper that trust and commitment are the simplest ways to maintain a non-zero sum cooperation as it avoids the necessity of pre-defining every potential outcome or detail [ZB03]. Further, they list up additional criteria defined by Zineldin [ZIN98]:

- Individual willingness, motivation, and strategic fit
- Interdependence
- Cultural fit
- Organizational arrangements and institutionalization
- Integration and integrity

Those are intercompany and interpersonal criteria and highlight the importance of a good and trustful basis for a cooperation. Communication should also happen on the same level.
Of course, not every cooperation is meant to be successful and can fail. Zineldin and Bredenlöw also list problems which may occur in a cooperation [ZB03]. Those

"risks and problems facing strategic alliances" were originally identified by Elmuti and Kathawala [EK01]:

- Clash of cultures and "incompatible personal chemistry"
- Lack of trust, clear goals and objectives and coordination between the managing teams
- Differences in operating procedures and attitudes among partners
- Relational and performance risk
- Strategic alliances might create a future local or even global competitor
- Other problems in strategic alliances

Yet Elmuti and Kathawala detect crucial factors for a successful partnership [EK01]:

- Senior management commitment
- Similarity of management philosophies
- Effective and strong management team
- Frequent performance feedback
- Clearly defined, shared goals and objectives
- Thorough planning
- Clearly understood roles
- International vision
- Partner selection
- Communication between partners: maintaining relationships

In both cases the high significance of clear communication and coordination and good management is pointed out. If goals and objectives are not well communicated, trust from the management is missing and the chemistry between people is bad then the cooperation is probably doomed to fail.

Another survey with the focus on horizontal cooperation in supply chain was conducted in 2011 by McKinley Muir. The target group consists of manufacturers, retailers, LSPs, freight forwarders and carriers and other business types [MUI11]. One part of this survey was about barriers which are preventing companies to invest money or time into a cooperation. The answers are grouped and listed below [MUI11]:

- Difficulty starting trusting relationships or finding appropriate partners
    - Fear of information disclosure
    - Lack of clarity over who is in charge
    - Unsure who needs take precedence
    - 3rd-party model is not flexible enough
    - Pricing problems when one party leaves
    - Lack of an exit strategy
- Lack of support from top management, 3PLs or carriers
    - Lack of widespread acceptance of the idea
    - Lack of internal knowledge
    - Lack of IT infrastructure and/or support
- No regulatory or legal framework/contract templates
    - Lack of gain-sharing models
    - Unsure who would act as principal client

To overcome those doubts, the fears stated by the respondents of the survey have to be faced. A trustful partnership, a clear regulatory framework and clear roles in the cooperation and support from the right departments and the management are therefore crucial points.

Cruijssen, Cools and Dullaert state in their paper that LSPs are in general aware of the big potential of horizontal cooperations and believe in their chances as it can improve the service level and increase profitability. For that conclusion they conducted a survey in Flanders in 2004 and got replies from 162 LSPs [CCD07]. With the help of other literature they proposed different statements which were verified through the answers. The propositions are summarized and listed below [CCD07]:

- Horizontal cooperation increases the company's productivity for core activities (e.g. decrease in empty hauling), reduces the costs of non-core activities (e.g. safety training) and purchasing costs (e.g. vehicles) and helps to protect the market share
- Horizontal cooperation enables individual LSPs to tender with large shippers on larger contracts
- LSPs can specialize while at the same time broadening their services
- LSPs can offer better quality of service at lower costs (e.g. in terms of speed, frequency of deliveries, geographical coverage, reliability of delivery times)
- It is hard to find commensurable LSPs with whom it is possible to cooperate for (non-)core activities and a reliable party that can coordinate the cooperation in such a way that all participants are satisfied
- When an LSP cooperates with commensurable companies, it becomes harder to distinguish itself
- It is hard for the partners to determine the benefits or operational savings due to horizontal cooperation beforehand
- Partners find it hard to ensure a fair allocation of the shared workload in advance
- A fair allocation of benefits to all the partners is essential for a successful cooperation
- Over time smaller companies in the partnership may lose clients or get pushed out of the market completely
- Cooperation is greatly hampered by the required indispensable ICT investments
- When benefits cannot be shared in a perceived fair way, the larger players will always benefit most

Remarkable is that a horizontal cooperation would affect a LSP in many ways, from economic to operational to social perspectives. When cooperating those propositions have to be considered as well as they are not only suitable for cooperations between LSPs.

In 4.2.4 the *Spar* case study was described and the learnings and outcome listed up. Here, in this part, requirements for compatibility in transport and transport

equipment is summarized. Those aspects are criteria which also have to be considered [VB14]:

- Truck types: city vans, trailers, double deck trailers, taut liners, boxes, side or rear loading
- temperature regime: ambient, chilled, frozen
- Max. weight and volume of the products
- Pallet sizes and packaging/returns management
- Availability of a tail lift
- Pallet strength and stackability
- Vehicle cleanliness
- Food safety regulations (e.g. HACCP)
- Licenses and insurances
- Necessary documents (e.g. POD, temp. tales)
- Security
- Procedures in case of transport damage
- Transport booking and invoicing

These aspects are important criteria for the trucks and have to be considered in a transportation point of view.

4.4.2 Criteria from the Interviews

Out of the six interviews presented in 4.3 the author got various insights into the cooperation, the transportation process, the handling of it and the daily business. Therefore, a lot of requirements gained from experience was gathered. Out of this pool of information the criteria was extracted and grouped in similar topics. The outcome is listed below:

- Truck demands
  - Parts for *MPT* and fashion products from the *PFI* are transported in the same truck. Therefore no residues of oil or dust and no smell is allowed on the cargo area and purity requirements exist.
  - Further, the performance of special-transports or loading of construction material in the same truck is prohibited.
  - The transportation equipment has to fit the requirements: rear-loading of the truck should be possible, clothes-rails are necessary for the hanging ware of the *PFI* and packages need to be secured via belts and straps.
- Weight and volume requirements
  - The weight and volume limits have to be considered during the tour planning as not everything may be possible to be transported at once.
  - The goods should be able to get stacked.
- Location
  - Geographic proximity to the route of the branch offices or sites of the cooperation partner should be given. It results in shorter ways, avoids detours and therefore time, costs and emission can be saved.
- Delivery structure
  - An opposed transportation flow of the partners' transports may be preferred as a round trip is easier to realize.

  - Special time tables of *MPT* need to be considered. JIT delivery is required which limits the flexibility. Partners with a more flexible time schedule may simplify planning.
  - Delivery conditions from the partner such as a demand on every second day also have to be considered in planning.
- Scheduling
  - When having variances or time delays the companies need to be informed as soon as possible that appropriate reactions can be ensured in time.
  - Changes in the transportation schedule due to legal holiday and seasonal delays have to be communicated in time.
- Social aspects
  - Interest in cooperation from both partners has to exist. They also have to bring in honesty, transparency and trust.
  - A tight structure and high planning security which results in stability of transports, meaning avoiding of big variations, is also crucial.
  - Follow company policies: the management might probably not grant an approval for a cooperation with a partner with bad reputation or with a direct competitor.
  - The partner should get insight into the production sequences to understand the importance and urgencies for just-in-time (JIT) delivery.
- The bigger the distances and the amount which needs to be transported, the higher is the cost saving potential

4.4.3 Summary of the Criteria

Remarkable is that the answers from the interviews complement the findings and criteria from the literature very well as varying responses would have been possible. The accordance also implies the reliability of the found and used criteria. The summarized criteria can be found in 5.3.1 which will also represent the set of criteria. The set of criteria is also part of the guideline as it provides a basis for forming further successful cooperations. In the following part 4.5 the methodology of the guideline is described.

4.5 Guideline for Finding Partners for a Successful Cooperation

The guideline follows the in 4.2.2 described standardized methodology with three steps of the CO^3 consortium. This part briefly describes the adapted approach of the already mentioned methodology. The complete guideline itself can be found in 5.3, also including the set of criteria, which is separately presented in 5.3.1.

Identification

The first step is to identify potential partners for a cooperation in a practical way. One way can be to use a telephone book and call every listed company and ask if they are interested in a partnership. As this would be too costly and inconvenient, a more efficient approach is therefore needed. First of all a number of potential

companies has to be found such as a Top List of a specific branch of industry and. Afterwards, the companies on this list have to be sorted out according to predefined criteria and then the firms have to be contacted. In the first contact crucial information should be provided, such as the idea of what it is about, what the next steps would be or the framework of a cooperation.

Preparation
The next step then is to prepare the cooperation. It can be assumed that there are already companies which showed interest and that they have received all information needed for the first steps. Now, a more detailed evaluation of the partner is possible. Details such as flexibility, potential of cost savings, planning certainty or even protection of the environment can be discussed now. Further, the flow of goods, designated routes or the clarification of the roles can be negotiated at this point. Those information is, most of the time, not available on the companies' homepages and therefore has to be inquired.
After that, a more detailed evaluation can be conducted and a choice for one or more companies as partner(s) for a cooperation has to be made.

Operation
The third and last step is the operation. Now, all essential details should be clarified and the routes fixed. No crucial changes should be necessary anymore, at most just some small adaptions.
It should be noted that from the first contact to the first start on a common route several months up to some years can pass. The time span depends on factors such as interest and trust, reply times, number of details which need to be clarified, size of cooperation or volume of the flow of goods. Also, companies can back out in the last moments before the first launch of a truck.

4.6 Depiction of the Processes of the MPT/PFI project

For this master thesis three different processes of the *MPT/PFI* project were investigated and are imaged and discussed in this section, followed by a short summary. It should help the reader in understanding the processes and getting a quick overview. The symbols and elements and the structure of an EPC diagram are described in 3.2.

- The Tour Process, including ordering and loading of the goods, transporting them to the stores of the *PFI*, continuing to the *MPT* supplier and driving back.
- The Supplier Process, including arriving at the supplier, unloading and loading of the goods and driving on to the next one.
- The Delay Process which shows possibilities of what can happen if a problem occurs.

Further, the depicted processes serves a basis for the application of the FMEA in chapter 5.2.

4.6.1 Tour Process

Figure 23 shows the depicted Tour Process and the beginning with a delivery order. The first step then is to issue a new order which is decided by the purchasing manager from the purchasing department. The *PFI* gets informed. Information from the storage about the stock is used and information about the required goods is needed. After ordering and preparing the goods they get loaded. Afterwards, the trip to the first location starts. The truck driver owns this process step as he is responsible for it. The *PLSP* is the informed party because they are the LSP. The needed information is the destination and the given one is the expected arrival time. Next, the truck driver arrives at the store of the *PFI*. There the goods get unloaded by the logistics of the store. The *PLSP* and the store are then informed about this step. As there is now a free spot on the truck and the tour plan is accordingly the transporter continues to the first *MPT* supplier. Now the element "process path" appears and refers to another process. Imaging the Supplier Process as a whole in the Tour Process would be not suitable and make everything confusing. Therefore an extra process is created and explained in the next part. If the Supplier Process is passed through once the path continues the Tour Process and a query (any suppliers left) is made. The logical connector then splits the path: if there is a supplier left on the tour the Supplier Process has to be repeated, otherwise the full truck can continue returning to Ilz. The path then continues with a query of a delay. The logical XOR connector then splits the path up again: If there is a delay the Delay Process has to be considered, otherwise the truck can continue. After the arrival in Ilz the goods get unloaded by the logistics of *MPT*, the warehouse acts as contributor and *MPT* and the *PLSP* get informed about the goods and the trip

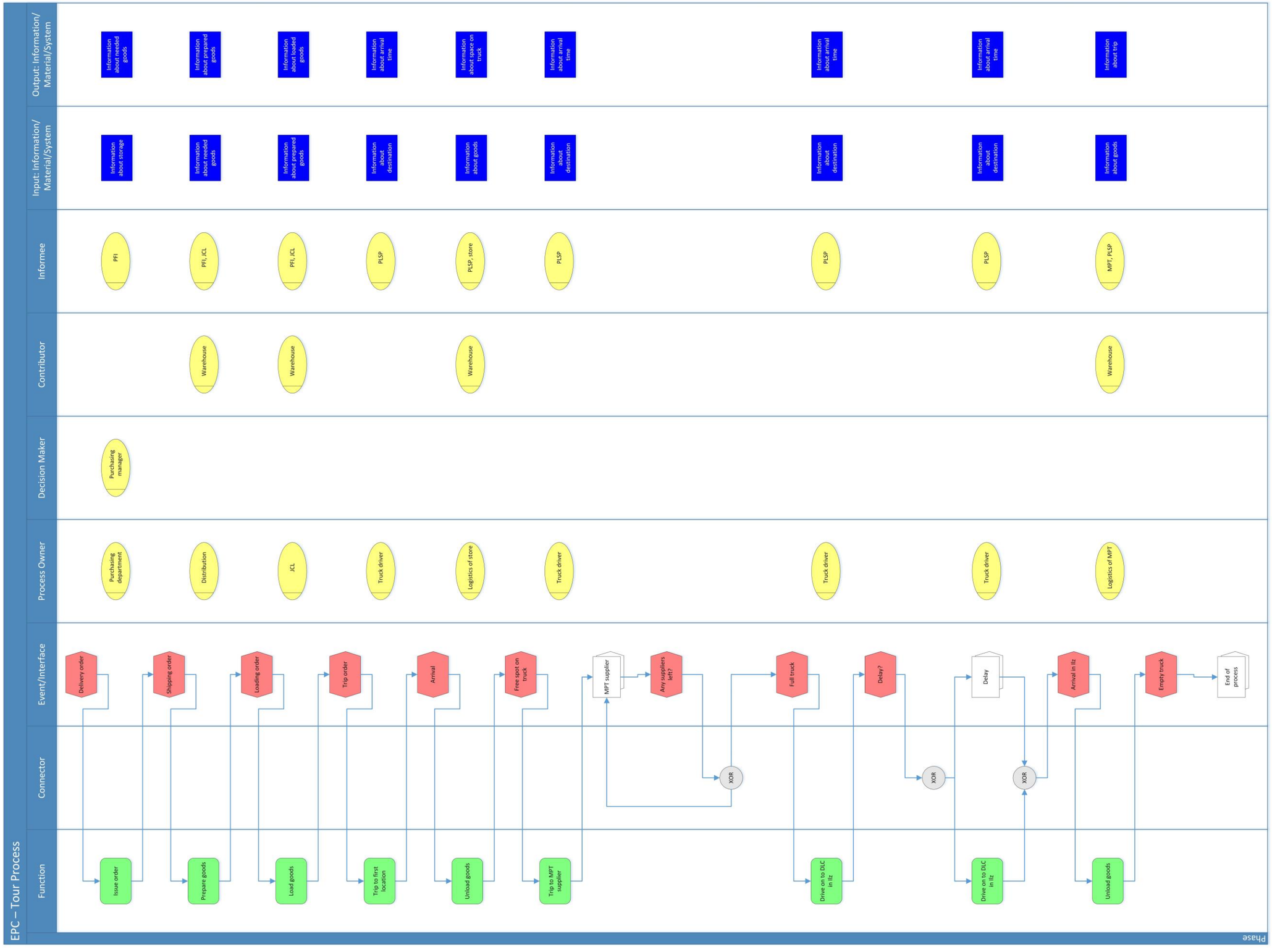

Figure 23 Tour process

4.6.2 Supplier Process

The Supplier Process is illustrated in Figure 24. It begins with arriving at the first *MPT* supplier. Due to the fact that the truck has an empty spot on the cargo area goods can be loaded. This is performed by the logistics of the supplier. The contributor is the warehouse and the *PLSP* and the supplier act as informees. Having finished this procedure the truck driver can carry on to the next store where the goods get unloaded. Afterwards, the journey continues to the next supplier. The process closes with another process path and refers back to the Tour Process. There an important element, a logical XOR connector, follows. If every supplier and store have been visited, the truck can continue the journey as planned, otherwise the Supplier Process has to be repeated.

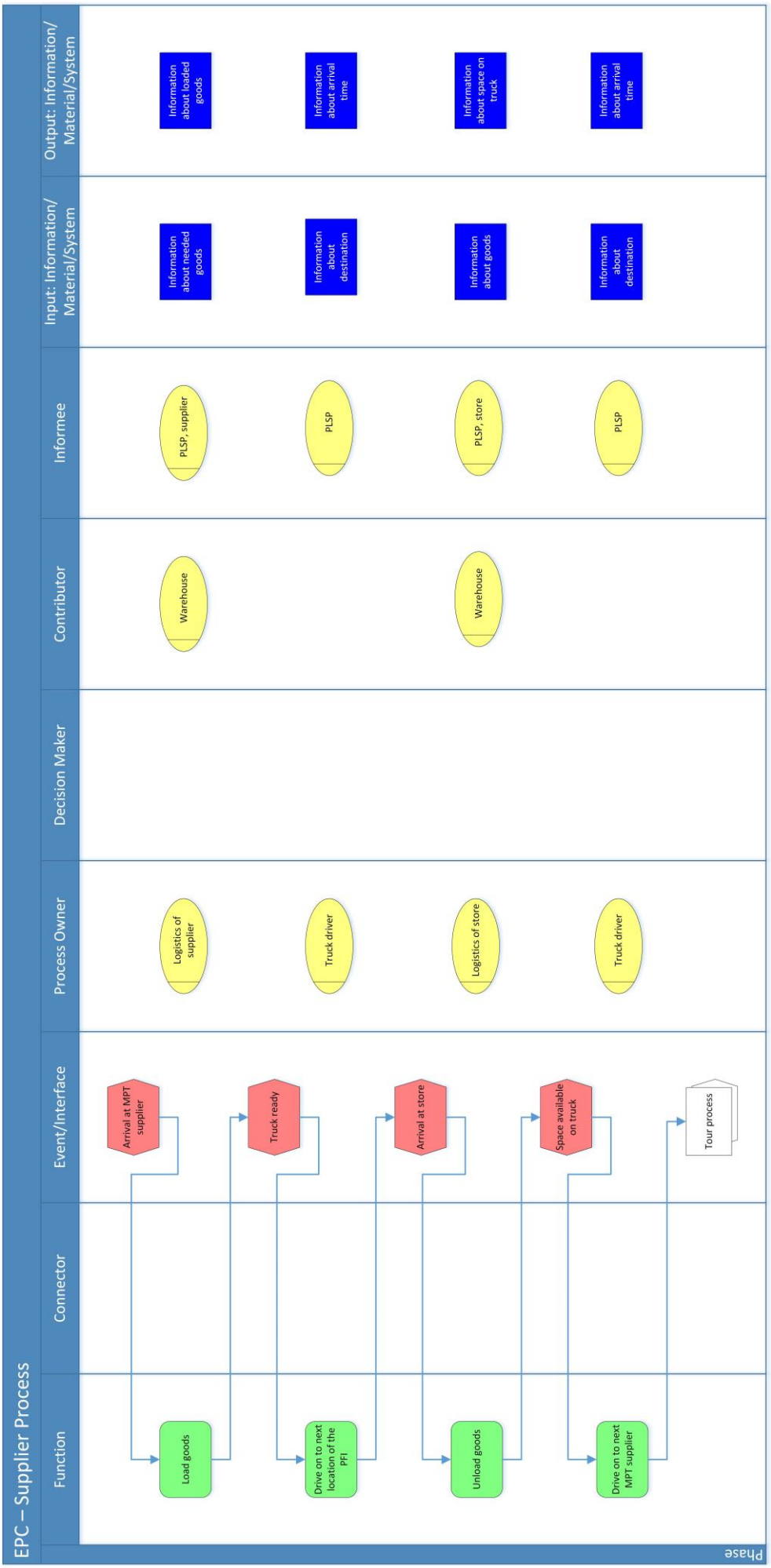

Figure 24 Supplier process

4.6.3 Delay Process

The Delay Process can be seen in Figure 25. It starts with a query if a delay occurred. Stating no the path continues and the truck can go on to Ilz, otherwise the cause has to be communicated. A logical OR connector divides the process into three lines with three different possibilities:

- Accident of the truck
- Goods got damaged
- Time delay due to other reasons

Depending on the reason for the delay a proper reaction follows. Another truck is sent to pick up the goods if an accident happened, a new order is placed if the goods are damaged or the warehouse gets informed about the time delay. When everything is corrected the truck can continue the tour and drive back to the DC in Ilz.

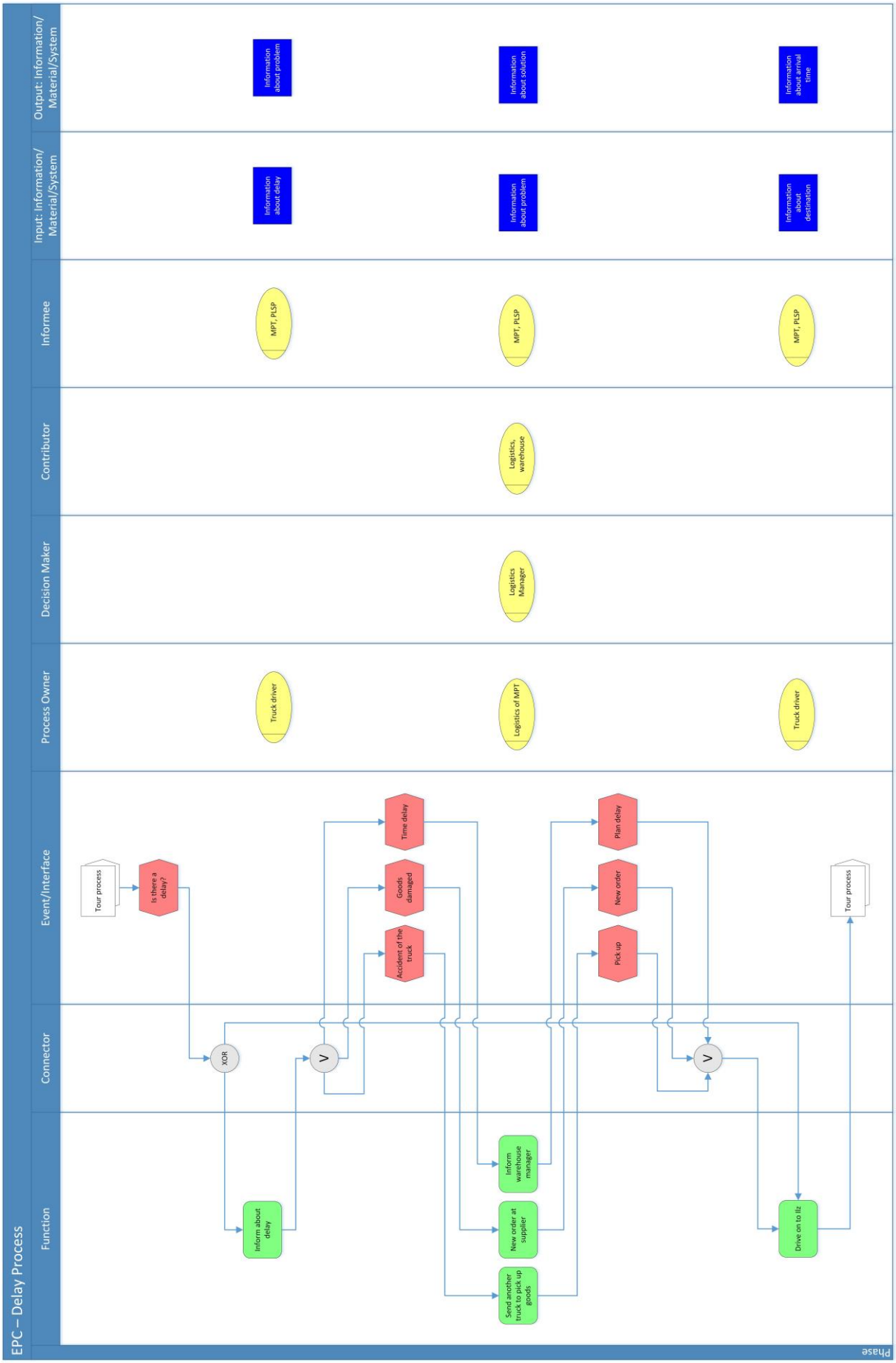

Figure 25 Delay process

4.6.4 Summary of the Depicted Processes

As seen in the depicted processes the EPC is a simple way to visualize complex business processes for a better understanding. It can take some time to figure who is exactly in charge for what but in the end an adequate overview is the outcome. The depicted processes can now be used as a basis for an additional analyses. For this master thesis a FMEA is used to analyze the processes deeper, point out potential failure causes and find solutions to those problems.
In chapter 5.2 the FMEA analysis will be conducted and discussed.

5 Evaluation of Procedure

This chapter takes a closer look at the results of the previous parts. The first section reviews the examples for horizontal cooperations which are discussed previously. Afterwards, the application of the FMEA is explained where critical steps of the processes modeled in 4.5 are further analyzed. Further, the guideline for finding partners for a successful cooperation is presented, including the set of criteria. The final part of this chapter then shows an application of this master thesis and answers the question of how suitable companies can be detected in real life.

5.1 Examples for Horizontal Cooperations – Case Studies

After reviewing the examples from real case studies from the industry in 4.2, a conclusion can be drawn. It also refers to the first research question "Is the launch and maintenance of cooperations facilitated if they are established between non-competing partners?" from chapter 1.5.
It can be concluded that compared to cooperations between competing companies a cooperation between non-competing ones seem to be more fruitful as it avoids initial difficulties and therefore makes it easier to start and maintain such a partnership. Obstacles, which can be avoided, can be strict and long negotiations about contracts and non-disclosure agreements and time spent for building up a learning curve or adjusting the coordination. Also, the boundaries and a clear definition of what is in the scope of the cooperation have to be accurately negotiated and the contracts need to be agreed on by every party. However, such negotiations are shorter and less complicated between non-competitors. For a successful cooperation trust has to be build up and the expected advantages should be highlighted for every partner.
Furthermore, between competitors more legal aspects need to be considered compared to non-competitive partnerships although every cooperation has to be checked separately and anti-trust regulations always have to be taken into account. Yet checking such a case of a cooperation in a competitive environment where a cooperation can influence the market in a bad manner can require much more effort and the commitment of external attorneys or law experts. Other contracts such as a non-disclosure agreement or regulations on coordination or gain distribution are also recommended but it can be shorter and easier to draft if it is made between non-competitors.
In many cases a lot of potential for transportation cooperations is already existing but not visible for everyone and therefore needs to be identified. For this task, the identification of hidden possibilities for a partnership, an external company can be engaged. They can help with identifying the potentials, arranging the cooperation, working on the operative tasks and can also fulfill the role as neutral trustee. In this case the neutral trustee also guarantees a fair gain distribution between the partners and mediates in case of issues.
Through a good promotion of the partnership and their success other companies or LSPs can be brought to the cooperation and a bigger network can be created.

5.2 Application of the Failure Mode and Effects Analysis

Failures and mistakes which can be made during the realization of synergies or cooperations have already been discussed in the previous chapter. In this part actual obstacles, which may occur during transportation of the goods are analyzed. In 4.5 three modeled processes are presented: the Tour Process, the Supplier Process and the Delay Process. Crucial steps of those in described processes are taken into account and further investigated with a FMEA. The following tables, Table 5 and Table 6 show the results.

Table 5 FMEA 1

MAGNA POWERTRAIN

Failure Mode and Effects Analysis - FMEA — Test - Object: — Date:

Master Thesis - Process Analysis — Comment: — Responsible:

1 **Actual (or planned State)** Object: ○ Product ● Process ○ System	2 Potential Failure Mode	3 Potential Effect(s) of Failure	4 Potential Cause(s)/Mechanism(s) of Failure	5 Failure Rating Status Rating O	S	D	RPN	6 **Improved, Future Status** Failure Corrective Action	7 Responsible	8 Date	9 Failure Rating (future) Status Rating O	S	D	RPN	10 Implemented OK	Date
1 Manual loading of the truck	• Goods fall down or turn over or get damaged whilst unloading	• Goods and/or already loaded goods get damaged	• Poorly trained personnel	3	5	2	**30**	• Training of personnel									
		• Extra costs	• Time stress, tight scheduling					• Improved time management									
		• Delivery delay	• Poor precaution whilst loading					• More careful handling of the goods									
2 Manual unloading of the truck	• Goods fall down or turn over or get damaged whilst unloading	• Production constraints	• Poorly trained personnel	3	5	2	**30**	• Training of personnel									
		• Goods and/or already loaded goods	• Time stress, tight scheduling					• Improved time management									
		• Extra costs	• Poor precaution whilst unloading					• More careful handling of the goods									
3 Information from truck driver	• Time delays caused by acts of	• Delayed arrival/delivery	• Traffic jam	5	5	2	**50**	• Automatic update when having a longer standstill									
		• Production constraints	• Tempest					• Precast information form									
		• Extra costs	• Strikes					• Standardized information form or process									
4 Communication via e-mail and telephone	• Wrong orders	• Reorders, changes	• Confusion caused by too many e-mails	3	5	4	**60**	• Electronic data exchange platform									
		• Loss of time	• Overlook of changes					• Communicate only necessary information									
		• Production constraints	• Too many e-mails per discussion														
	• Loss of information	• Cancellation, changes, reorders	• Overlook of changes	3	4	3	**36**	• Electronic data exchange platform									
		• Overlook of important information	• Confusion caused by too many e-mails					• Mutual chat program									
		• Time loss due to seek of information	• No live-communication between several people via e-mail					• Communicate only necessary information									
	• Failure due to technical issues	• Communication outage	• Insufficient maintenance	2	6	2	**24**	• Online data storage									
		• Loss of data	• Operating error					• Improved maintenance									
		• Cancellation of order	• Outdated equipment					• Modern equipment									

Table 6 FMEA 2

MAGNA POWERTRAIN

Failure Mode and Effects Analysis - FMEA
Master Thesis - Process Analysis

Test - Object:
Comment:

Date:
Responsible:

1 **Actual (or planned State)** Object: ○ Product ● Process ○ System	2 Potential Failure Mode	3 Potential Effect(s) of Failure	4 Potential Cause(s)/Mechanism(s) of Failure	5 Failure Rating Status Rating O	S	D	RPN	6 **Improved, Future Status** Failure Corrective Action	7 Responsible	8 Date	9 Failure Rating (future) Status Rating O	S	D	RPN	10 Implemented OK	Date
5 Delivery process of LSP	• Goods get lost whilst loading/unloading/transfering	• New order	• Insufficient labeling of goods	2	5	5	**50**	• Emphasize importance of self-control of cargo								
		• Extra costs	• Time stress, tight scheduling					• Improved time management								
		• Internal extra effort, tracing of the goods						• Standardized labeling, highlight important information								
6 Monthly inspection of the vehicle by the truck driver	• Truck outage due to technical issues	• Production outage	• Insufficient maintenance	2	7	1	**14**	• Technical check-up before start								
		• Extra costs	• Material fatigue													
		• Transfer goods to other truck	• Careless handling of truck													
		• Delayed delivery														
		• Special transport														
7 Self-control of the loading through truck driver	• Poor cargo safety	• Goods get damaged	• Goods poorly secured	4	8	2	**64**	• Training of personnel								
		• Only partial delivery	• Unsuitable cargo area/containers					• Emphasize importance of self-control of cargo								
		• Re-disposition necessary	• Failure of transportation securing					• Improved cargo and securing equipment								
		• Production outage														
	• Delivery of wrong goods	• Special transport necessary	• Poor labeling of goods or containers	2	8	8	**128**	• Clear design of order picking- and providing zone								
		• Search for correct goods	• Wrong documents					• Inspection before loading								
		• Urgent delivery necessary	• IT input error					• Incentives for order picking personnel								
		• Production outage	• Carelessness whilst order picking and providing goods at the ramp					• Standardized forms								
		• Re-disposition necessary	• Time stress					• Order input with IT support								
		• Return wrong goods														

The first two potential failure cases are directly linked to the loading processes: the manual loading and unloading of the truck. The problems which may arise here, are a damage of the goods and what may be caused. As the RPN is quite low, no further actions need to be taken here.
The third failure case is the information flow from the truck driver in the event of a time delay caused by acts of nature: delivery or arrival may be delayed and therefore production constraints and extra costs can occur. A solution can be an automatic update if the truck has a longer standstill. The RPN is here also quite low, therefore no further actions are necessary.
The fourth investigated failure case is linked to communication. Wrong orders, loss of information or failures due to technical issues may arise when communicating via e-mail or telephone. Wrong orders would be the most critical issue here, as reorders, time loss and production constraints may be potential consequences.
Failure case number five is the delivery process of the LSP. Goods may get lost if they are often reloaded. A better labeling of the goods and a better time management may be an improvement.
The sixth failure case investigates the monthly inspection of the vehicle by the truck driver, as technical issues may occur at any time. A technical check-up before starting, where crucial elements get checked can avoid break-downs.
The seventh and last investigated failure case handles the self-control of the loading through the truck driver. Poor cargo safety or the delivery of the wrong goods can be avoided if the driver would check the cargo area before starting.

The case of delivering wrong goods has the highest RPN of all seven cases with a value of 128: a special transport with an urgent delivery and a re-disposition may be necessary. Further, it may cause a production outage if the safety stock is not big enough and consequently costs a lot of money. Those issues can be avoided with a clear design of the order picking- and providing zone, an inspection before loading, incentives for the order picking personnel in order to encourage a controlled and concentrated work or standardized forms to fill out.

5.2.1 Summary of the FMEA Analysis

To sum up, it can be said that the processes are well organized and executed as the risk priority numbers show low values. However, the cooperation is only formed between two companies and performed on one fixed tour. There are also not that many possibilities where failures can appear. It would look totally differently if there would be more partners on longer and more routes with more reload actions.

5.3 Guideline for Finding Partners for a Successful Cooperation

The in chapter 4.5 mentioned guideline with the three step methodology is presented in this section. The set of criteria can be used in the second step, called preparation. As the criteria are an essential part of this master thesis it is presented separately in 5.3.1.

The guideline can be seen as a basis for identifying partners for future cooperations. *MPT* can use it as a checklist in order to get an overview of the steps in the process of finding new partners.

Identification

Inbound and outbound transportation flows from *MPT*, current LSPs and potential cooperation partners have to be identified in order to get an overview and point out potentials. Further, data about their transportation flows have to be collected and analyzed. Potential partner companies and the flows can be classified and categorized with criteria defined beforehand. The most suitable companies can be selected. This described process results in a pool of preselected options and candidates.

- Review inbound and outbound transportation flows from and to *MPT*
    - The time period should be long enough to avoid large variations and explain single peaks.
- Evaluate and sort those findings according to pre-defined criteria such as:
    - Route (single trip, roundtrip)
    - Frequency of deliveries (number of deliveries per day, week or month)
    - Product type
    - FTL, LTL
    - Transportation volume (amount of delivered goods)
    - Weight of delivered goods
    - Region
    - Possibility of changes
    - How are the goods transported? (truck, train)

Those information is available through MPT, the LSP or the supplier. Further the making of a map of the transportation flows for easily recognizing regions with the highest traffic is recommended. Those areas should be the main focus for seeking cooperation partners. It allows a categorization into regions.

- Evaluate and review LSPs responsible for those routes according to predefined criteria such as:
    - Who are the actual LSPs? (name and location)
    - Do they have sub-partners?
    - Who is actually performing the transports?
    - Are they reliable?
    - Contact information

Those information is available through *MPT*, the LSP or the supplier. It helps to get a quick overview of the involved service provider. The following criteria then is probably not as easy to get as the ones before as they require more insights but can simplify an evaluation:

- What trucks and transportation equipment do they own?
- Legal conditions (Is the partner allowed to cooperate with *MPT*?)
- Do they want to be engaged in a transportation cooperation?
- Do they have the resources for that?

Changing a LSP is not an impediment for forming a cooperation, although it can be seen as risk and administrative extra effort:

- Potential cooperation partners then should be placed close to the *MPT's* suppliers or the routes. Evaluation and selection can be conducted according to further criteria such as:
    - Geographic proximity to *MPT's* suppliers or the routes
    - What do they produce? Is this compatible with *MPT's* products?
    - What is the size of the company? An own transportation/logistics department or an extra transportation manager would simplify the implementation and management of a cooperation.
    - Are there any cultural barriers which may impede the operations?

Those information is provided on the company's homepage or on other webpages. With this data then a basic profile can be created quickly and a first evaluation is possible. However, those are only the fundamental criteria for pre-selecting potential partners.

An important factor is that the more data available the more difficult it gets to analyze it manually. At some point this can result in a "Big Data" problem and the right approaches to solve them have to be chosen. For that issue several programs help analyzing the data:

- ELG-Web
  The company Giventis uses ELG-Web, which is an "industrial scale network analysis and optimization software, to identify, filter out and further examine potential bundles, co-loading routes, FTL roundtrips, etc. based on automated freight flow data analysis" [BV13].

- ARCView
  TRI-VIZOR uses Geographical Information System called ARCView. It helps "to visualize individual transport networks and validate collaborative opportunities across different tradelanes or networks. This visualization is useful to single out network nodes or tradelanes that are missing or obsolete in the provided dataset, and facilitates the discussion with collaboration stakeholders in the relevant companies" [BV13]. Figure 26 shows an example image of this program.

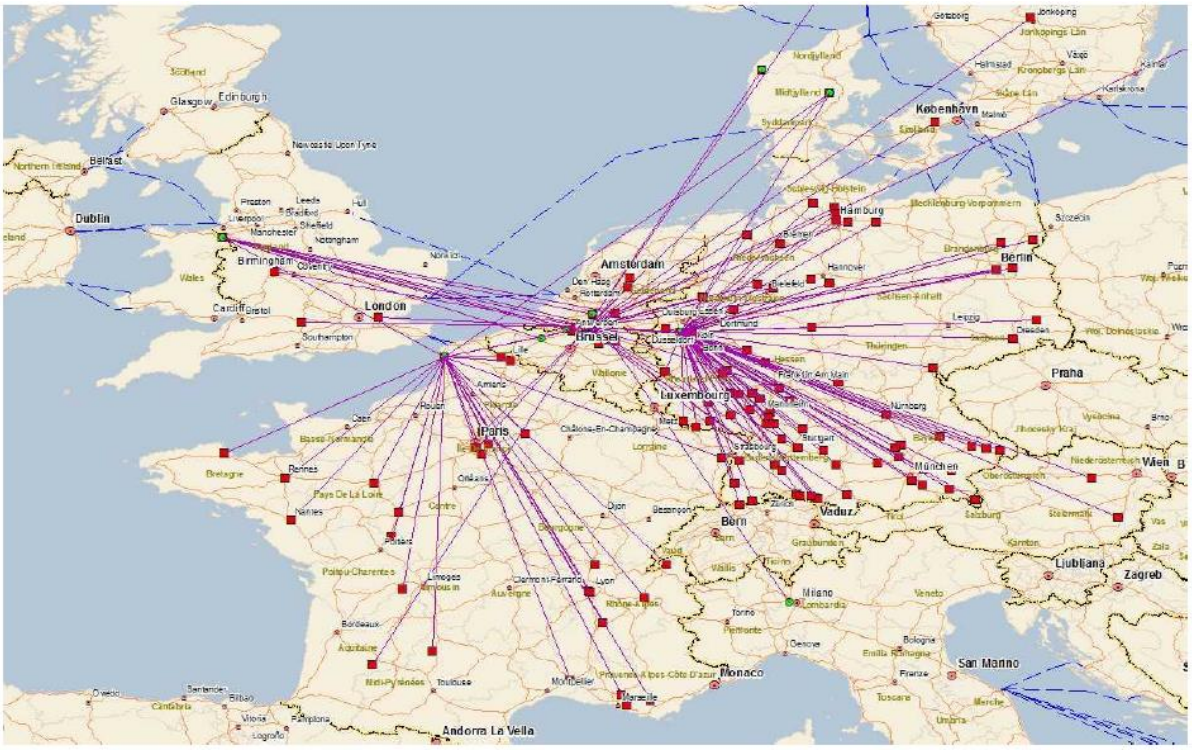

Figure 26 Mapping and visualization of European supply networks (TRI-VIZOR/ArcGIS) [BV13]

- Flowmatcher
  TRI-VIZOR developed and also uses a Visual-Basic application called Flowmatcher. "The visual aspect makes it easier for a human analyst to detect and evaluate collaboration opportunities, and to discuss these opportunities in real-time in a meeting or workshop with the candidate collaborating parties" [BV13]. An example image of this program can be seen in Figure 27.

Figure 27 Mapping and visualization of a retail distribution network [BV13]

Preparation
In this step the list of potential partners is already narrowed. Now they have to be contacted and informed about the concept of a transportation cooperation and the ideas behind. Advantages such as cost savings, reduction of carbon emissions or an increase of efficiency, gain sharing concepts, roles in the cooperation or the expected effort have to be highlighted and described. An easy access for other companies to take part in the partnership, facilitates the whole process of forming a cooperation. The more effort required the bigger are the doubts and fears. Examples which underpin those benefits are the current successful cooperation between *MPT* and the *PFI*, where also exact numbers are available and the ones from the literature.
A possibility to inform interested partners is to arrange an information event where the outline of the project is presented, former said advantages are highlighted again and questions can be answered.
After addressing all those matters a more specific planning can start. A framework of the cooperation can be set up and conditions negotiated. Further, a more detailed profile of the partners can be created. In this step the set of criteria which is presented in 5.3.1 can be used.

Operation
Operational means are not covered here as it is not included in the scope of the master thesis. This part, of course, depends strongly on preparation, trust and communication.

5.3.1 Criteria for a Successful Cooperation – Set of Criteria

The found criteria from the interviews and the literature are presented in 4.4. Here, in this part, those criteria are summarized to the set of criteria. This also refers to the second and third research question "Which criteria have to be met by the partner in order to ensure a successful cooperation?" and "Which potential problems and difficulties concerning the entire transportation process can be detected?" from chapter 1.5. The set of criteria is also part of the guideline and can be used in the second step, called preparation.

The author divided the found criteria into groups to get a better overview and a quicker insight. Five categories are defined to group them:

- What are the requirements for the own company?
- What are the needs of the partner(s)?
- What is necessary for the organizational process?
- What is necessary from a social perspective?
- Which failures have to be avoided in order to ensure a successful cooperation?

What are the requirements for the own company?

- Truck, general transportation and/or delivery requirements on the own products (storage, cleanliness…)
- Flexibility (JIT…)
- Information flow

- Support from management

What are the needs of the partner(s)?
- Insight in production process
- Flexibility (JIT…)
- Information flow
- Clarification of roles
- Improvement of services

What is necessary for the organizational process?
- Shared goals and objectives, defined roles
- Reliable transportation flow
- Geographic proximity: proximity of the partner and supplier to the route, where does the truck get empty?
- Flexibility in transportation and delivery
- Delivery conditions
- Contracts, NDA
- Experience from cooperations before
- Arrangement of a technology interface (communication, tracing, accounting…)

What is necessary from a social perspective?
- Trust, honesty, transparency, integrity, mutuality
- Company policies
- Individual willingness, acceptance of ideas and commitment of the involved people and departments
- Similar philosophies and techniques of the managements
- Share of gains and burdens
- Frequent performance feedback

Which failures have to be avoided in order to ensure a successful cooperation?
- Clash of (corporate) cultures and "incompatible personal chemistry"
- Lack of trust, clear goals, objectives and coordination
- Differences in attitudes and operating procedures
- No support from top management
- Unsatisfying gain sharing models
- Lack of contracts/framework
- Communication issues, unrealistic expectations

Before starting a cooperation it is recommended to fulfill or at least consider the in this part listed criteria. Yet the listed criteria is not a guarantee for a successful cooperation. Fulfilling all of the recommended aspects can be useless if a responsible person votes against a cooperation. It means that there are still factors which cannot be excluded.

5.4 Practical Application

This chapter presents two practical applications. The scope of the first practical application comprises the detection of potential future cooperation partners. In

the beginning a list with possible partner companies is created. Those companies are then evaluated on the basis of criteria which were discussed with the supervisor from *MPT* to narrow the listing down to ten remaining ones. Finally, contact information from those Top 10 companies are looked up for a first informal contact. If the other company shows interest, more information can be shared and a deeper evaluation of the potential partner according to the set of criteria can be performed.
The second practical application refers to the in- and outbound flows of the goods from *MPT*. A table with all relevant information about the suppliers or goods is used as starting point. Then the statistics are assessed in order to get an overview of the flows from the countries where the suppliers are from. It points out that the highest goods traffic is with German companies. Therefore, a closer look is taken on this country with the numbers being assigned to the federal states. The Top 10 companies found in the first evaluation in are then analyzed again to find their subsidiaries in the German states.

5.4.1 Finding Potential Partners – A Top 10 List

After a short discussion with the supervisor of *MPT*, it was agreed to use a list of the top 100 companies of Styria for the evaluation [TOS16]. The list rates the 100 biggest companies of Styria according to their sales. Further, information about the location of the company's headquarters, number of employees and branch of industry is provided. The author then added sub-categories such as sub-branch of industry, products, locations, area of operations and a link to the homepage. On the basis of this list the companies got classified again, from three to zero. Three means the potential partner is very suitable, a zero means the other company would not be suitable for a cooperation. For example a mineral oil distributor is a zero, as those goods cannot be transported together with the products of *MPT* or a supplier of *MPT*. The table with the companies rated with two and three can be seen in the appendix in 8.2.

Companies with a rating of two or three are evaluated again, now in a more detailed way. The rating scheme is now 9 – 6 – 3 – 0, where a nine means the highest and a zero the lowest accordance. The seven new criteria are:

- Area of operation / geographic conformity
    - Where does the other company operate?

  An area of operation in North America, Europe and Asia would be the best, followed by an area of operation only in Europe and only in Asia and an area of operation in none of the areas above with the worst rating. This is a knockout criterion which means a zero would preclude this company.
- Flexibility
    - How flexible is the other company?

  As *MPT* is not that flexible in terms of delivery, production and time schedule, a more flexible partner would be beneficial. A high flexibility would be best, a low one worst.
- Planning certainty
    - How well is the routing plannable? Does the partner's routes change frequently?

  A high planning certainty would be best, a low one worst.

- Heavy cargo / volume cargo
    - Which products do get manufactured by the partner? Which kind of goods will get transported?

  Volume cargo would be best, followed by heavy and volume cargo and just heavy cargo. Mineral oil or bulk cargo would be worst. This one is a knock-out criterion as well, which means a zero would preclude this company.
- Idea of environmental protection
    - Is the company engaged in environmental protection?

  A high idea of environmental protection with lots of actions would be best, none would be worst.
- Existing cooperations / willingness to cooperate
    - Are there any cooperations this company is already engaged in? Is the other company interested in cooperations?

  A high willingness would be best, none would be worst.
- Cost saving potentials
    - How much money can be saved when cooperating with this company?

  A high cost saving potential would be best, none would be worst.

Information such as area of operation, heavy cargo or volume cargo and idea of environmental protection is quite easy to gather as it is available on the homepage of the potential partner most of the time. The other information can be clarified with one-to-one conversations.
After the second evaluation the best ten companies are summarized and listed in a new table. There, contact details such as e-mail addresses, phone numbers or addresses are added. Table 7 shows a list of the Top 10 companies from this evaluation with the final rating.

Company Name	Total
ams AG	**51**
Leder & Schuh Gruppe	**48**
Charles Vögele (Austria) GmbH	**48**
Andritz AG	**45**
LEGERO Schuhfabrik Gesellschaft m.b.H.	**45**
XAL Holding GmbH	**45**
AT&S Austria Technologie & Systemtechnik AG	**42**
AHT Cooling Systems GmbH	**42**
Stölzle-Oberglas GmbH (Stölzle Glasgruppe)	**42**
Wollsdorf Holding Schmidt GmbH	**42**

Table 7 Top 10 companies

5.4.2 Analysis of the In- and Outbound Flows of Goods

Information about the flow of goods to and from *MPT* have been provided to the author for this analysis. In this table details to all in- and outbound flows are included, such as article/ product information, supplier information, transportation details and quantity and frequency of the goods and transports. Data about the weekly shipped weight is also included. The weight is defined as "weight per Handling Unit Fill (HUF) per week (pw)", which means it is the weight of the volume handled per week.

For getting another table where the total weight per HUF pw per country can easily be compared to the other countries, only information of the suppliers' origin countries and the weight they are handling is extracted of the first table.
Also, an extra column with the percentage of each entry is added to get a quick overview of the parts. Most suppliers are from Germany with a percentage of nearly 30%, followed by Spain and Austria with about 15%.
For a more detailed analysis, the numbers of Germany and Austria are then split up to the single zip codes of where the suppliers are from. Most of *MPT's* suppliers in Austria are from Styria with a percentage of almost 70%.

Apart from that, it is even more interesting to take a look at potential partner's countries of origin. A new route can be created if the potential Austrian partner has a subsidiary close to the origin of the supplier. The longer the tour and the more goods have to be transported (higher utilization), the higher is the cost saving potential. The best case would be if more suppliers are located in the same city or region as there would be big potential for cost savings.

Germany has been chosen as an example as about 30% of *MPT's* suppliers are from this country. The zip code of the supply firm is assigned to the specific federal state, visualized in a map with circles and can be seen in Figure 28. One circle represents one German federal state. The bigger the circle, the higher the weight per HUF pw in this region.

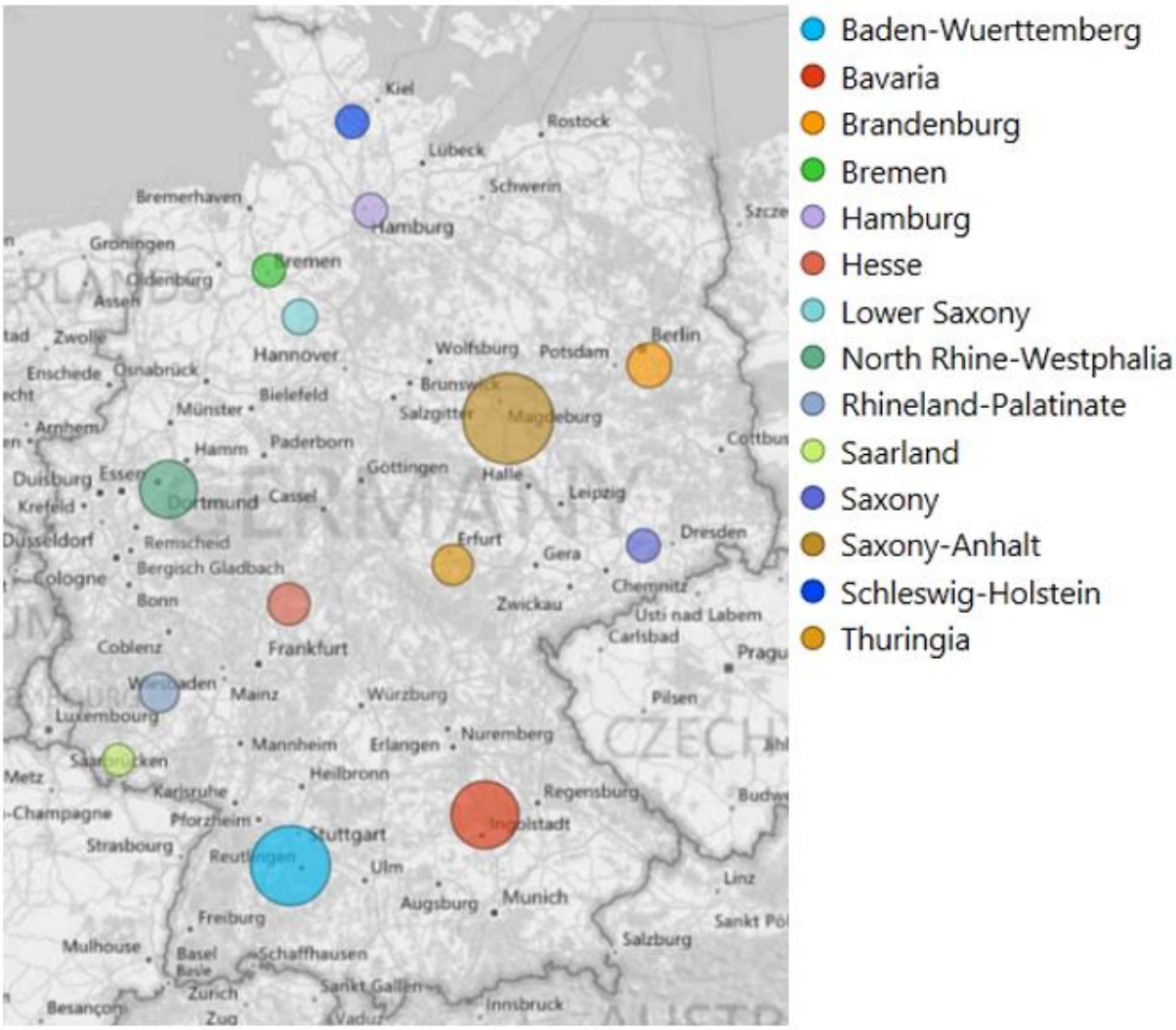

Figure 28 Weight per HUF pw per region in Germany

It can be assumed that the transportation flows are not bundled yet. Consequently, the biggest potential is in federal states with big circles. The first step can be to combine this flows. It is also possible for transports from the northern part of Germany to pick up goods from the middle or southern part.
Although the interpretation and set up of new cooperations is not included in the scope of this master thesis.

As combination of the first analysis, described in 5.4.1, and the second analysis, described in 5.4.2, the subsidiaries of the Top 10 companies have been listed in a new table with address, federal state and contact details. The key parts of this result can be seen in Table 8.

Table 8 Top 10 with locations in Germany

Company name	Comments	Federal state
ams AG		Baden-Wuerttemberg
Leder & Schuh Gruppe		Hesse
Charles Vögele (Austria) GmbH	Charles Vögele Deutschland GmbH	Baden-Wuerttemberg
Andritz AG	21 sites 4 different business branches	Baden-Wuerttemberg
		Bavaria
		North Rhine-Westphalia
		Saxony
LEGERO Schuhfabrik Gesellschaft m.b.H.	No production sites in Germany 5 specialist retailers	Lower Saxony
		Schleswig-Holstein
		Bavaria
		Baden-Wuerttemberg
		North Rhine-Westphalia
XAL Holding GmbH	XAL GmbH Headquarters Germany	Bavaria
	8 further offices	Bavaria
		North Rhine-Westphalia
		Hamburg
		Hesse
		Baden-Wuerttemberg
		Berlin
	4 retailers	Baden-Wuerttemberg
		Saxony
		Schleswig-Holstein
		Saarland
AT&S Austria Technologie & Systemtechnik AG	Sales office No production sites in Germany	North Rhine-Westphalia
AHT Cooling Systems GmbH	Selling agency	Bavaria
	Selling agency	Rhineland-Palatinate
Stölzle-Oberglas GmbH (Stölzle Glasgruppe)	No production sites in Germany but Stölzle Glasgruppe is part of the CAG-Holding	
Wollsdorf Holding Schmidt GmbH	No production sites and no sales offices in Germany	

5.4.3 Conclusion of the Practical Applications

The approach for finding new partners which is discussed in 5.4.1 is just one idea how to handle this issue. Not all of the evaluation criteria used in this case are best for the first evaluation round as important information, which would be required in some of the categories, are not available on the companies' homepages. Therefore more evaluation rounds could be conducted. A discussion about different evaluation criteria, which are more relevant for *MPT*, can be useful to get a more significant and sophisticated result of the first evaluation. Although some of those criteria can be used in a second evaluation round when the first contact

has already been made. The author proposes the following changes of the evaluation scheme:

1. Evaluation of the companies according to area of operations and type of goods
2. First contact with the partner(s)
3. Second evaluation according to willingness to cooperate, flexibility and planning certainty.
4. The idea of environmental protection may be not that crucial for a successful cooperation.

A new evaluation scheme for creating a list of potential partners is also proposed by the author. With the used 9 – 6 – 3 – 0 scheme big jumps of the total number occur if one criterion is rated differently. This can change the whole list. A 5 – 4 – 3 – 2 – 1 scheme can be better as the gaps are not too big.

6 Conclusion and Outlook

This master thesis describes the issues and complexity of how difficult it is to form a cooperation with another company. A lot of different factors have to be considered and various opinions have to be taken into account. As the answers from the interviews in chapter 4.3 show, several obstacles had to be overcome. However, the master thesis provides one method, the guideline with the set of criteria, which can facilitate the first steps in forming a new cooperation.

The master thesis shows the high potential of activities to increase the truck utilization or to save costs in the area of road freight transportation. As companies tend to save money new ideas and new approaches such as transportation cooperations with other companies can help to reduce costs.
Further, the importance of convincing all involved persons and departments (in the own and partner company) before trying to implement something new is shown. This issue can be tackled with providing information and highlighting all the benefits.
The results from literature and the interviews show that it takes time for a good cooperation to obtain the expected and wanted results. The required time period from the first contact to the start of the first transport can take up to two or three years.
Although, the core of a successful cooperation is good and clear communication as potential problems can be tackled quite well if everything is well communicated.
In addition to the previous points also negative aspects have to be considered. A lack of shared goals and unrealistic expectations has to be avoided as this can lower both parties' motivation to cooperate. Also, the differences in corporate culture are a factor which should not be underestimated. A motivational factor would be the gain sharing. If one company does not get not paid equally compared to the others, a loss in commitment can be a consequence.
It is no surprise that the criteria taken from literature are similar to the ones from the interviews as both sources use the knowledge of skilled and experienced employees.
Another possibility of recognizing potential problems beforehand is the analysis of the planned processes. The master thesis describes two different methods, the Event-driven Process Chain (EPC) and the Failure Mode and Effects Analysis (FMEA). The first one depicts the processes and unclear or problematic process paths can easily be detected. The latter one uses fixed table structure where potential failure cases can be entered and analyzed, but improvements have to be filled out as well.
MPT can use the results of this master thesis as basis for the search for potential partners for future cooperations. The theory provides a proper background and the guideline can be used as a checklist in order to get an overview of the steps in the process of finding new partners. As every application of the guideline will improve the steps and the criteria, it can be seen as first version.

Future research may focus on the case of a network of more partners or on a partnership between competing companies as it is described in a case study in 4.2.

There, different approaches and different forms of communication would be necessary. Also, the development of a digital form of a partner finding tool can facilitate the whole process.

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7.2 List of Figures

7.3 List of Tables

7.4 List of Equations

8 Appendix

In the first part of the appendix the short texts of this master thesis are presented in English and German. The second part presents a table with the most important information of the companies rated with 2 and 3 from the practical application in 5.4.

8.1 Abstract and Kurzfassung

This part contains the master's thesis' published short text from TUG – online. The Abstract is written in English, while Kurzfassung is written in German.

8.1.1 Abstract

This master thesis deals with synergies through cooperations between non- competing companies in the Supply Chain Management. Numerous of companies have to work cost- efficiently and therefore expenditures have to be reduced. As transport divisions contribute a substantial part to the company's expenses, there is a high potential for savings. Those goals can be achieved with the help of cooperations with other companies.

The first chapter of this master thesis briefly introduces Magna Powertrain, as this company is the initiator of this master thesis. It describes the motivation of Magna Powertrain and the author to investigate this topic together. In the last part the research questions are presented.

The second chapter starts with an explanation of this master thesis' title in order to give further insight into the rationale behind choosing this title. Afterwards, elucidations to the crucial theory are given in order to provide background knowledge to the topic. Following, statistics concerning the road transportation of goods in the European Union and in Austria are shown and the problem of efficient road transport of Magna Powertrain is discussed. Finally, in the last part the objectives of this master thesis are presented.

The following third chapter describes different forms of cooperations and explains horizontal cooperations more detailed. Afterwards, the Event-driven Process Chain (EPC) and the Failure Mode and Effects Analysis (FMEA) are explained. The next part then introduces a new approach which can revolutionize the world-wide flow of goods, the so called Physical Internet. Finally, the rationale behind the conducted interviews is described.

The fourth chapter begins with a presentation and a short discussion of examples of horizontal cooperations from the industry. The next part then will be dedicated to the interviews conducted for the purpose of this study. Afterwards, a detailed list of crucial criteria for cooperation profiles and factors that need to be taken

into account prior to launching a cooperation follows. In the next part the guideline is described. Finally, the depiction of three processes of the MPT/PFI project with the EPC is explained.

In the fifth chapter of this master thesis the examples for horizontal cooperations are reviewed. Afterwards, the FMEA is applied on the previously discussed process models. Further, the criteria for a successful criteria are summarized in the set of criteria. The final part of this chapter then shows an application of this master's thesis' findings and answers the question of how potential partner companies for future cooperations can be detected in real life.

The sixth and last chapter closes this master thesis with a conclusion and an outlook for potential future research.

8.1.2 Kurzfassung

Diese Masterarbeit beschäftigt sich mit Synergien durch Kooperationen zwischen nicht konkurrierenden Unternehmen im Supply Chain Management. Da viele Unternehmen kosteneffizient arbeiten müssen, wird versucht, in allen Bereichen die Aufwendungen zu verringern. Da das Transportwesen einen bedeutenden Teil zu den Ausgaben beiträgt, gibt es hier großes Potential für Einsparungen. Durch Kooperationen mit anderen Unternehmen besteht die Möglichkeit diese Ziele zu erreichen.

Das erste Kapitel dieser MA stellt Magna Powertrain kurz vor, da diese Firma der Initiator hinter dieser Masterarbeit ist. Im Anschluss wird die Motivation von Magna Powertrain und des Autors erklärt, dieses Thema gemeinsam zu untersuchen. Zum Schluss werden die Forschungsfragen vorgestellt.

Das zweite Kapitel beginnt mit einer Erklärung des Titels der Ma, um dem Leser ein besseres Verständnis geben zu können. Danach werden Erläuterungen zur relevanten Theorie gegeben um ein gutes Hintergrundwissen zur Verfügung zu stellen und mögliche Fragen im Vorfeld zu klären. Anschließend werden Statistiken zum Gütertransport auf Straßen in der Europäischen Union und in Österreich gezeigt und die Problematik von effizienten Straßentransporten von Magna Powertrain diskutiert. Schließlich wird am Ende auf die Aufgabenstellung genauer eingegangen.

Das folgende dritte Kapitel behandelt verschiedene Formen von Kooperationen und beschreibt dann horizontale Kooperationen detaillierter. Anschließend werden die erweiterte Ereignisgesteuerte Prozesskette (eEPK) und die Fehlermöglichkeits- und Einflussanalyse erklärt (FMEA). Im letzte Teil werden die Hintergründe für die Auswahl der Interviews erklärt.

Das vierte Kapitel beginnt mit einer Auflistung und einer kurzen Diskussion von Beispielen über horizontale Kooperationen aus der Industrie. Der folgende Teil befasst sich genauer mit den Interviews, die im Rahmen dieser Masterabeit durchgeführt wurden. Anschließend werden Kriterien, die beim Start einer Kooperation wesentlich sind, detailliert aufgelistet. Des weiteren wird die

Guideline beschrieben. Der letzte Teil behandelt die Darstellung dreier Prozesse des MPT/PFI Projekts mittels eEPK.

Im fünften Kapitel dieser MA werden zu Beginn die Beispiele für horizontale Kooperationen noch einmal betrachtet. Anschließend wird die FMEA auf die im vorherigen Kapitel erstellten Prozessmodelle angewandt. Des weiteren werden die Kriterien für eine erfolgreiche Kooperation im Kriterienkatalog zusammengefassst. Der letzte Abschnitt beschreibt eine Anwendung der Erkenntnisse dieser Masterarbeit und beantwortet die Frage, wie passende Unternehmen für zukünftige Kooperationen gefunden werden können.

Das sechste Kapitel schließt die Ma mit einer Schlussfolgerung und einem Ausblick auf mögliche weitere Forschung zu diesem Thema.

8.2 Table of Companies Rated with 2 and 3

Table 9 shows the companies which have been rated with 2 or 3. Note that not every category is listed here due to the size of the original table. The table is held in German as it was created for *MPT*.

Table 9 Companies rated with 2 and 3

Unternehmen	Umsatz	Mitarbeiter	Unterbranche	Standorte
Andritz AG	5.859.269.000	24.853	Anlagenbau	weltweit
Siemens AG Österreich (Gruppe)	760.000.000	2.380	Elektrifizierung Automatisierung Digitalisierung	Österreich
AT&S Austria Technologie & Systemtechnik AG	667.010.000	7.630	Elektronik	Leoben, Fehring, Ansan, Nanjangud, Shanghai, Chongqing
Sappi Austria Produktions-GmbH & Co KG	630.526.000	1.270	Papier	Gratkorn
Leder & Schuh Gruppe	521.000.000	3.609	Schuhe	Österreich, Bulgarien, Deutschland, Kroatien, Polen, Rumänien, Slowakei, Slowenien,

				Tschechien, Ungarn
ams AG	464.000.000	1.636	Elektronik	weltweit
AHT Cooling Systems GmbH	387.096.000	1.277	Kühlsysteme	Rottenmann, Changshu, Navegantes, Traunstein
Fresenius Kabi Austria GmbH	339.058.156	1.095	Pharma	Graz, Linz
Stölzle-Oberglas GmbH (Stölzle Glasgruppe)	296.000.000	2.100	Glasbearbeitung	weltweit
GAW Group Pildner-Steinburg Holding GmbH	269.000.000	1.800	Anlagenbau	weltweit
Kastner & Öhler Warenhaus AG	253.000.000	1.256	Mode	Österreich, Slowenien
Anton Paar GmbH	228.000.000	2.031	Messsysteme	weltweit
Zellstoff Pöls AG	200.301.944	407	Papier	Pöls
Pankl Racing Systems AG	165.027.000	1.238	Racing Aerospace High Performance	Österreich, Deutschland, UK, USA, Slowakei, Japan
Wollsdorf Holding Schmidt GmbH	156.000.000	900	Leder	weltweit
ADA Möbelwerke Holding AG	151.957.826	2.458	Möbel	Österreich, Ungarn, Rumänien
LEGERO Schuhfabrik Gesellschaft m.b.H.	144.130.825	794	Schuhe	Europa
Georg Fischer GmbH & Co KG	135.883.131	519	Gießerei	weltweit
Charles Vögele (Austria) GmbH	123.615.590	1.001	Mode	Österreich

Odörfer Haustechnik GmbH	122.103.259	401	Großhandel	Graz, Brunn am Gebirge, Leoben, Klagenfurt, Linz
Röhren- und Pumpenwerk Bauer GmbH	111.389.230	467	Landwirtschaft	weltweit
Maschinenfabrik Liezen und Gießerei Ges.m.b.H.	105.558.687	771	Maschinenbau Anlagenbau	Tochter- und Schwesterunternehmen in Österreich, Deutschland, Italien, Schweiz, Bolivien, Südafrika, China
Sattler AG	105.104.489	673	Textil	Österreich, Deutschland, Italien, Frankreich, Rumänien, USA, Schweiz
Boehlerit GmbH & Co KG	100.000.000	770	Hartmetallschneidstoffe	Österreich, Deutschland, Spanien, Türkei
XAL Holding GmbH	87.280.000	919	Beleuchtung	weltweit
IBS Austria GmbH	85.000.000	568	Papier	weltweit
A&R Carton Graz GmbH	75.000.000	400	Verpackung	weltweit
Remus & Sebring Holding AG	72.000.000	620	Fahrzeugzulieferer	Bärnbach
Secop Austria GmbH	70.000.000	415	Kompressortechnik	Fürstenfeld,

				Deutschland, China, Slowakei
Roto Frank Austria GmbH	62.987.513	394	Fenster- und Türtechnologie	weltweit
ATB Spielberg GmbH	60.915.503	474	elektrische Antriebssysteme	Spielberg Deutschland, GB, Polen, Serbien, China
Gaulhofer Industrie-Holding GmbH	56.500.000	450	Fenster und Türen	Österreich, Deutschland, Schweiz
Zultner Gruppe	56.096.000	163	Vertrieb von Metallwaren	Graz, Klagenfurt, Wels, Wien
Ventrex Automotive GmbH	54.605.431	135	Fahrzeugzulieferer	Graz
SAKO-STAHL Handels-, Schneide-, Biege- und Verlege-GmbH	52.009.543	78	Baugewerbe	Ratschendorf, Tribuswinkel
Teubl Handelsgesellschaft mbH	51.000.000	231	Großhandel	Steiermark, Burgenland