Autonomous Driving in the Logistics Industry

A multi-perspective view on self-driving trucks, changes in competitive advantages and their implications.
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________________________________________

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Abstract

Background: Nowadays, logistics service providers face several challenges which create an urge to rethink their strategy to improve their position within the market, decrease their costs and their environmental impact. At the same time the introduction of autonomous driving potentially has an impact on logistics. Self-driving trucks can help logistics companies to tackle these challenges. However, the implementation of this technology could fundamentally alter the competitive landscape. Hence, certain competitive advantages currently held by logistics firms might lose their relevance in the future and need to be adapted to maintain a strong market position.

Purpose: The purpose of this study is to explore the perception of self-driving trucks within logistics and the impact on competitive advantages of logistics service providers. Thereby, this thesis will look at experts from Germany and Sweden and their opinion on future implications of self-driving trucks.

Method: An inductive research approach is used to explore the topic. A multi-method research strategy is applied to gather data through qualitative semi-structured interviews with 17 participants. These were divided into five different case groups. To interpret the data a thematic analysis approach was chosen.

Conclusion: The main contribution is a model representing the impact of autonomous driving on competitive advantages and the implications for the logistics industry. Findings are based on the perception of experts about autonomous driving, current resources and capabilities.
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Abbreviations

EU European Union
LSP Logistics Service Provider
OEM Original Equipment Manufacturer
RBV Resource-based view
SAE SAE International (global association of more than 128,000 engineers and related technical experts in the aerospace, automotive and commercial-vehicle industries)
TPL Third Party Logistics

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1. Introduction

The following chapter provides a brief overview of current development of self-driving vehicles, acceptance of this new technology in the market and the potential impact on logistics. It starts with background information about autonomous driving, identifies problems with this upcoming development and shows the importance of this thesis. Furthermore, research questions are identified and limitations of the study are discussed.

1.1. Background

‘Man minus the Machine is a slave; Man plus the Machine is a free man.’

(Henry Ford, Source: Wik, 1973)

As major turning point in history, the Industrial Revolution changed the way manufacturing processes and logistical flows are being handled. Automation and machines substituted hand-production processes and transportation. Since the 18th century innovation and disruptive technologies have transformed the global economy towards an automation of information, logistics and production. Nowadays, digitisation, electrified cars, connectivity and self-driving vehicles are game-changing innovations, which will impact the way current business models and logistical flows are being handled (DHL, 2016; McKinsey&Company, 2016a).

While years ago, self-driving vehicles sounded like a scenario out of a futuristic movie, it might soon be reality on our roads. Self-driving vehicles will not only reshape the world of the automotive industry but also influence the way logistics processes around the world are handled. Nonetheless, the idea is not a new one. In 1478, Leonardo Da Vinci had already sketched plans for a driverless vehicle, consisting of a self-propelled wagon (Hooper, 2004). However, first experiments with remote controlled cars, known as the ‘phantom auto’, only took place centuries later - in the 1920 (Lafrance, 2016). In the 1930s, General Motors predicted automatic cars by 1960 (Bartz, 2009). A few years later, Bel Geddes argued in the book, Magic Motorways, that humans should be removed from the driving process (Bel Geddes, 1949). In the 1950s, General Motors pushed the development of automated highway technology by using in the street embedded wires (Bart, 2009). Their engineers successfully demonstrated this system in the late 1950s and 1960s (Bart, 2009). However, costs were too high to enhance this technology (Bart, 2009). In Europe, the EUREKA Prometheus project, which aimed to develop self-driving cars, was launched in the 1980s (Payre, Cestac & Delhome, 2014). Since then, prototypes of autonomous vehicles were built but have never been commercialised (Payre et al., 2014). However, interest in autonomous driving remained.
With the development of technology and computer intelligence we have reached an era in which the machine could fully replace the human driver in the near future.

The following thesis focuses on the development of autonomous driving, i.e. a fully automated driving system, in which the vehicle performs all dynamic driving tasks. However, it should be noted that there are five different levels of driving automation, ranging from driver assistance to full automation, with decreasing levels of human intervention (SAE International, 2014). While Advanced Driver Assistance Systems (ADAS), like adaptive cruise control, adaptive light control or GPS navigation are already implemented and accepted by most consumers, more sophisticated systems such as automatic parking, blind spot detection or autonomous driving are still facing consumer scepticism (Quain, 2016; Cox Automotive, 2016). A study conducted by Nielsen showed, that although the future generation (aged 8-18) were informed about this recent development of self-driving cars, 60% of the respondents preferred to drive themselves (Nielsen, 2016). Regardless of this existing scepticism towards autonomous driving the topic remains highly discussed in the media.

Multinational automobile manufacturers like Mercedes, Tesla and Volvo see great potential in this future development and are in the testing phase of self-driving vehicles. Beyond that, non-automotive companies such as Google, Uber and Apple show high interest in this field (DHL, 2016; Kollewe, 2017; McKinsey&Company, 2016a). Consequently, new tech entrants entering the market will influence the competitive landscape of the automotive industry. In 2016, DHL, a multinational logistics company, published a trend report about upcoming changes in logistics. They outline the adoption of self-driving vehicles in controlled environments such as warehouses over the last decades. DHL expects a high impact on all sectors investigated in their report, i.e. Automotive, Engineering & Manufacturing, Technology, Energy, Life Sciences & Healthcare as well as the Retail & Consumer sector (DHL, 2016).

Autonomous driving will have a positive influence on the cost breakdown of logistics companies, in form of lower stress levels of truck drivers, as well as helping to overcome the struggle with long distances and innovate the way products are transported across the globe. Current forecasts expect that by 2020-2025 autonomous driving enters the market; experts predict that by 2035, 75% of cars will be autonomous (McKinsey&Company, 2016a; BI Intelligence, 2016; DHL, 2016; Stoll, 2016).

It is apparent that the upcoming trend of self-driving vehicles and especially self-driving trucks will not only have an impact on employment, lead times and reliability, but also on the
way the supply chain and its actors are interrelated. However, there are many obstacles to implementing this new technology; Aside of the high research and development costs, ethical issues, legal regulations and road standards, consumer adaptation needs to be overcome. Furthermore, companies and actors must assess how this will affect their current role in the supply chain and how they can adapt to stay competitive. Finally, the supply chains themselves should be reconsidered, to create a business strategy that involves a transport mode with a decreasing human factor dependency.

1.2. Problem

The global economy faces several key challenges: increasing internationalisation, growing importance of sustainability, growing population, ageing society and technological innovations. These emerging trends could influence the existing structures of the logistics industry and have an impact on how current businesses operate.

With the growing significance of globalisation, transportation solutions become increasingly important. Globalisation not only increases the transfer of products, but also facilitates the division of labour and enables the development of new technologies (OECD, 2010). However, internationalisation of markets and mobility also increase the impact on the environment. Rising quantities of freight and road transportation have a negative impact on CO₂ emission levels (Van Veen Groot & Nijkamp, 1999). Thus, there is a rising demand for finding transportation solutions, which are reliable, efficient and provide low CO₂ emissions levels.

The logistics industry is a highly competitive and fast-paced field. Creating solutions to tackle the challenges mentioned above lead to high research and development costs for companies. Hence, in order to limit these costs, collaborations and partnerships between different actors within the market play an important role. The logistics environment is becoming more and more technology-driven and companies need to adapt quickly to upcoming trends and innovations in order to differentiate themselves from competitors (Garner, 2017). Automation and especially autonomous driving represents one of many technological advancements for the industry, which logisticians need to consider.

Competition within logistics is known to be fierce (Garner, 2016). Thus, logistics companies need to assess their internal capabilities and capacities to meet customers’ strategic needs (Garner, 2016). At the same time, supply chains try to cut costs as much as possible (Garner, 2017). Although technological advancements such as increased automation help to differentiate from competitors, they could lead to even lower price demands by customers
Technological advancements could increase “standardisation” and further fuel the “pressure of commoditisation” within the market (Garner, 2017).

Many logistics companies face the challenge that transportation costs are a main component of their overall costs. These costs are determined by the respective mode of transportation. Land logistics, i.e. rail and road transportation, link almost all logistics activities because even air and maritime transportation require some form of land transportation to reach the destination (Rushton, Croucher, & Baker, 2014). Although road transportation is not as cost effective as some of the other modes, there are few supply chains which do not rely on it. (Tseng, Yue & Taylor, 2005; Clarke, 2014). Furthermore, road freight transportation offers the opportunity of being easily accessible due to a well-developed road infrastructure in comparison to rail networks (Rushton, Croucher, & Baker, 2014).

Moreover, pipelines account for 5% of inland freight movements, inland waterways account for 6%, rail transportation accounts for 16%, whereas road transportation accounts for 73% of all inland freight movements within the European Union (EU, 2011). The described prevalence of road transportation means that many businesses are dependent on road transportation and hence, are heavily affected by its costs. The high utilization of road transportation leads to constant traffic congestions, which lowers the efficiency and increases the overall costs. Current development does not indicate any improvements on this situation (Clarke, 2014). Thus, solutions are needed to tackle the issue of road congestions within the European Union, especially in relation to the growing population.

Regarding environmental issues and costs, fuel consumption represents a prevailing concern for logistics companies. Fuel represents the largest factor of a transport firm’s expenditure (Rushton, Croucher & Baker, 2014). It not only adds to the variable costs of a company, but also increases energy costs and taxation expenditure. Fuel consumption is determined by driving habits, route planning, technological advancements and fluctuating energy prices. Minimising fuel consumption will not only save costs but will also lower the environmental impacts of road transportation companies.

Another challenge for road transportation is the lack of qualified drivers, which correlates with the phenomena of an aging population and driver shortage (Roland Berger, 2016). Transportation companies face various issues in this regard. Laws and regulations limit truck drivers’ working hours and require them to take breaks on a regular basis (Maurer, Winner, Lenz & Gerdes, 2016). Moreover, being a truck driver has significant health risks. A representative survey with truck drivers from the US showed a significant correlation between
their profession and risk factors such as, hypertension, obesity, smoking, high cholesterol, no physical activity, six or fewer hours of sleep (Sieber, Robinson, Birdsey, Chen, Hitchcock, Lincoln, & Sweeney, 2014). There is also an increased risk of being involved in an accident. This is an alarming factor, since in 2009, 34,500 people died in road accidents within the EU (Clarke, 2014). Most incidents are caused by human error, while driver fatigue was one of the reasons pointed out in the EU study (Clarke, 2014). Thus, managing factors such as driver wellness, driver retention, driver distraction and tackling driver shortage are existing concerns of logistics service providers. They need to balance efficiency of their operations with health and safety considerations.

New ideas are constantly being introduced into the market. To differentiate themselves from other competitors, companies try to innovate and develop products and invest into disruptive technologies. In a Harvard Business Review the innovation dilemma was divided into disruptive and sustaining technologies (Bower & Christensen, 1995). While sustaining innovations are developed from existing and established technologies, disruptive innovations are characterised by a technology that significantly alters the business methods (Bower & Christensen, 1995). The challenge remains to identify which technology companies should invest in, how consumers will adapt to it and how to overcome existing barriers such as legal regulations. Automation within road transportation is a trend which has grown over the last years (O’Byrne, 2017). Companies need to evaluate whether this technology could disrupt the market and alter their own business methods.

As the world is becoming increasingly complex and international, customers now demand next day delivery. The internet has given room to many ground-breaking companies like Amazon and eBay to enable platforms, where the customer can easily purchase products with a simple click from home. However, customers still demand a timely and fast delivery, ideally on the same day. Thus, the market for parcel delivery is a growing one in times of e-commerce. In order to facilitate transportation and customer expectations, there is a rising demand for an automation of transportation modes, to make it more reliable, faster and to overcome the challenges e-commerce puts on companies (McKinsey&Company, 2016). Thus, companies are confronted by high pressure for short lead times, efficiency and high quality at low costs.

To conclude, the presented threats and opportunities that logistics companies are currently facing, push the process of finding suitable solutions and technological development forward.
Companies need to develop their competitive advantages and address issues such as driver shortage, road safety, fuel costs and service performance to maintain a good market position.

1.3. Purpose

To tackle the problems logistics companies are currently facing, logistics providers need to rethink their strategy to improve their position within the market, decrease their costs and their environmental impact. There is ample support for the claim that innovation is an important criterion for successful economic performance (Romero & Martinez-Roman, 2012; Kangasharju & Pekkala, 2002). Introducing self-driving trucks in logistics could help logistics companies to overcome future challenges.

Autonomous vehicles have been used for internal logistics operations since the early 1960s, however, transferring this technology to road transportation and reaching a point where transportation can be executed without human intervention leads to substantial cost savings, tackles the lack of qualified drivers, reduces road congestion, increases safety on the road and decreases the environmental impact (Maurer, Gerdes, Lenz & Winner, 2016). Nonetheless, the question of competitiveness between logistics service providers remains. Therefore, the following purpose can be derived for our thesis:

The purpose of this study is to explore the perception of self-driving trucks within logistics and the impact on competitive advantages of logistics service providers.

It is important to examine the relationship between self-driving trucks and competitive advantages because the logistics industry is diverse, fast-changing and exposed to a very competitive environment (Klaus, 2011). Thus, logistics service providers need to adapt quickly to changes in the industry in order to compete. Researchers have already identified that self-driving trucks will impact the market and existing business models (Angerer, 2016; Van Melder & De Boeck, 2016). The question, however, of how these trucks will impact the logistics market has been neglected. Therefore, by exploring the impact on competitive advantages this thesis will help logistics managers to identify possible threats to their unique selling points and develop their business accordingly. Furthermore, it will help customers to adapt their processes to possible changes, such as the absence of drivers for document management, loading and unloading tasks. Lastly, it will help achieving a common understanding from a societal and legislative point of view towards possible future scenarios within the logistics market.
The thesis will look at the perception of logistics experts towards the upcoming trend of self-driving trucks. Based on this, implications and possible future scenarios can be derived. Perception is being defined as a way of interpreting the given context based on experiences, intuitive recognition and logical understanding (Merriam-Webster, 2017). It is based on sensory impressions from the past to explain present experiences and make decisions based on these perceptions (Judd, 1909). Since autonomous driving trucks are not available yet, no studies can be conducted on the actual application. However, we do believe that the perception and opinion of logistics experts show a high relevance for research, since they can determine how such technologies are being adopted in future.

The introduction of this technology could alter established patterns within logistics. Hence, companies need to rethink their role within the supply chain. Especially small to medium-sized firms will face the burden of having high investment into research and development. New tech entrants are interested in entering the market and could change the competitive landscape of predominant manufacturers (OEMs). New services or roles could arise from the disruptive nature of this technology. Consequently, self-driving trucks could have an impact on current unique selling points of companies, such as qualified and well-trained drivers or flexibility and short lead times. There are no studies available on how the introduction of self-driving vehicles impact road logistics and what logistics service provider need to change in order to stay competitive in a new environment with autonomous driving trucks as status quo. The following thesis aims to close this gap in research by examining possible future scenarios.

1.4. Research Questions

Based on our purpose the following research questions arise, which we aim to answer within the scope of our thesis:

I. What is the perception of self-driving trucks within logistics?
   a) How is innovation viewed within logistics in general?
   b) What are the main barriers for the introduction of self-driving trucks?
   c) What advantages and opportunities are expected when using self-driving trucks?

II. How do logistics experts view current resources and capabilities of logistics service providers with regard to the introduction of self-driving trucks?

III. How can logistics service providers build competitive advantages once self-driving trucks enter the market and what potential new players will enter the logistics industry?
The presented research questions assume that (i) autonomous driving for trucks will enter the market in near future as predicted by several trend reports, (ii) logistics service providers will be influenced by the trend in some way and (iii) there will be an impact on the factor of the human driver. While the first research question looks at the current situations within logistics, the other two research questions examine future scenarios and expert opinions on the trend development. Hence, assumptions of the feasibility of self-driving trucks are established. Research questions II and III anticipate that (iv) necessary technological requirements for the implementation are given; (v) legal prerequisites are in place to allow self-driving trucks on the streets and (vi) the infrastructure is compatible for self-driving trucks, i.e. highways, main roads and city traffic.

1.5. Delimitations

Autonomous driving represents an extensive research field due to its complexity, novelty and implications for transportation. However, based on the identified gap in literature this thesis will be thematically limited to self-driving trucks within the logistics industry (Rosenzweig & Bartl, 2015). Thus, it will not look at other autonomous driving vehicles such as trains, drones, inner-operational transport vehicles or passenger cars. We believe that most research papers already focus on passenger cars, furthermore, within logistics trucks with a focus on external transport activities are of higher interest for an academic investigation. Although trains and drones represent another appealing research topic for logistics providers, the study will be limited to road transportation as it represents one of the most widely used modes of transportation (EU, 2011).

The thesis is conducted within the area of business administration with a focus on international supply chain management and logistics. Thus, this study will look at logistics, implying that we will not focus on any detailed technological aspects of autonomous driving, legal issues, marketing-, human resources- or psychological aspects of this innovation. Although these might be mentioned as influencing factors, they will not represent the focal point of this thesis. We will solely try to examine the impact on market players within logistics and the implied impact on logistics service providers based on insights and opinions we gathered from logistics experts.

Since the implementation of autonomous driving will look different in different geographical areas due to legislative standards, infrastructure, resources and requirements, we will limit this study to standards set by the European Union. Furthermore, due to the assumption that autonomous driving requires a certain level of road infrastructure (i.e. road
quality, driving lanes, etc.), investment and a compatible business structure we will solely focus on highly developed countries within Europe. We believe that self-driving trucks will first be adapted in industrialised and highly developed countries, since they already have the necessary requirements in place for the implementation of the technology.

Our research is limited to a qualitative study to uncover trends in opinions of logistics experts. Thus, we will not examine the topic of autonomous driving from a quantitative perspective to measure views of these experts (Easterby-Smith, Thrope & Jackson, 2015). We have chosen to interview different experts, who operate in Swedish and German markets to represent highly developed countries within the European Union. This is explained by the time and scope constraint of our thesis. On basis of our findings we solely aim to develop an initial understanding to provide a solid foundation for further decision-making.


2. Frame of References

The following section consists of the topics autonomous driving, RBV on supply chains and road transportation. In this chapter, they are being introduced and explained to provide an overview and create a conceptual framework for our analysis. The established research questions will later be examined and addressed based on the introduced concept of this chapter.

2.1. Autonomous Driving

2.1.1. Definition

To select, review and identify missing gaps in the available literature, the terminology of autonomous driving needs to be defined. Currently, there is no common definition of the term “autonomous driving”. The words “automated driving, autonomous driving, self-driving and cooperative driving” are being broadly used with overlapping characteristics (SMART, 2010).

Automated driving and cooperative driving focuses on driver support systems and vehicle-to-vehicle (V2V) or vehicle-to-road-infrastructure (V2I) communication, while autonomous driving represents the full automation of vehicles without a need of human intervention or monitoring, i.e. full self-driving capability (SMART, 2010; Aramrattana, Larsson, Jansson & Englund, 2015; SAE International, 2014; Daimler, 2017; Maurer, 2016). The Society of Automotive Engineers (SAE, 2014) and the German Federal Highway Research Institute (BASt, 2012) divided the term autonomous driving into five different levels of automation, with level 5 being the stage of full automation, where the vehicle’s
decision-making and action is based on algorithms. Figure 1 illustrates the 5 levels according to their automation level.

VDA (German Association of the Automotive Industry) and German OEMs clustered autonomous driving in a similar way, however, focussing on three simple levels of partially automated vehicles (i.e. driver assistance systems), highly automated and fully automated vehicles (Daimler, 2017). While research conducted in the field of driver assistance system is numerous, research on autonomous driving itself is still very limited. In the following, we will focus on research done on the topics of highly automated and fully automated vehicles (level 3 to level 5 in Figure 1).

2.1.2. Barriers and Opportunities: Self-driving trucks

Research on autonomous driving within logistics is very limited, only few published articles discuss barriers and opportunities of autonomous trucks. Nonetheless, there is rapidly growing interest in this topic. Especially, consultancies and large multinational companies published trend reports and consultancy reports on the topic of autonomous driving. By sighting several different reports regarding the topic of autonomous driving, we identified that there is a consensus view on opportunities and barriers for the logistics industry. Table 1 summarises the most common opportunities, which were recognised by several authors.

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Sources</th>
</tr>
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</table>

Table 1: Opportunities - Autonomous Driving

Most authors believe that autonomous driving will have a positive impact not only on logistics but also on society in general. In accordance with project papers it becomes apparent
that an improvement in safety (i.e. less accidents) represents a major opportunity for logistics service providers, road participants and the government. Furthermore, trend reports identify a connection between the introduction of autonomous driving and the environmental footprint. Another factor mentioned concerns the improved utilisation of resources and improved efficiency. Authors expect that truck downtimes will decrease; safety distance will be minimised; and drivers can be used in a better way, due to lower stress levels or demand. This will have implications for lead times, delivery times and performance levels of logistics service providers.

Nevertheless, authors also outlined central issues and barriers. Table 2 provides an overview of the mentioned barriers, which currently hinder autonomous trucks to enter the market.

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Roland Berger, 2016.</td>
</tr>
</tbody>
</table>

Table 2: Barriers - Autonomous Driving

Laws, regulations and liability issues represent a major barrier for autonomous trucks. Currently autonomous trucks are not authorised for public roads. Furthermore, technological barriers and security concerns, such as hacking, are mentioned by most authors. This is closely related to the infrastructure such as highways, communication with other vehicles and processes, which needs to be compatible with the new technology. Reports also indicate social and ethical issues as a major concern. This has further implication for user’s acceptance of self-driving trucks. However, our contention is that these barriers will be removed in the
near future. Once the technological feasibility and reliability is proven, user acceptance, regulations and infrastructure will follow.

Insights drawn from the reports show that self-driving trucks can offer a variety of benefits for logistics service providers, society and customers, once the mentioned challenges and barriers are overcome.

2.1.3. Drivers of Research

The need for research within the field of fully automated vehicles is mainly driven by a rising focus on accident-prevention and safety, environmental impacts and road congestion. The term vehicles in this literature review includes cars, public vehicles and freight vehicles. Different research projects on the improvement of mobility quality and development of autonomous driving in general can be found since the 1980s, such as PROMETHEUS, SATRE, DRIVE, NAVLAB or the PATH project (Chan, Gilhead, Jelínek, Krejčí & Robinson, 2012; Bengler, Dietmayer, Färber, Maurer, Stiller & Winner, 2014). Nonetheless, these research projects focus primarily on technical aspects of autonomous driving. A sighting of 399 papers on the topic of autonomous driving has shown, that 91.2% were conducted with a focus on their technological development, 4.8% looked at the trend itself with the remaining percentages looking at user acceptance (1.3%), regulations (1.5%) and the environmental impact (1.3%) (Rosenzweig & Bartl, 2015).

![Figure 2: Research projects - Autonomous Driving (adapted from Rosenzweig & Bartl, 2015)](image)

To find common technical characteristics and evaluate the technological realisation of autonomous driving, different case studies were examined (Wachenfeld et al., 2016); or statistical approximations and tests were performed (Kalra & Paddock, 2016; Bengler et al.,
2014). Research has shown that from a technological point of view autonomous driving is possible with the current technology being able to steer, brake and accelerate autonomously. Donges (2012) mentions, that the system which perform the tasks of “navigation, guidance and control” as well as communication interface between internal and external variables (i.e. other vehicles, road infrastructure and other system such as emergency braking) are necessary to perform an autonomous journey. According to Aramrattana et al. (2015) systems within autonomous vehicles perform decision-makings based on a “strategical, tactical, and operational” level. These levels refer to the common driver’s behaviour skills, such as risk evaluation, manoeuvres and traffic monitoring. Current research argues that although technological requirements are met and autonomous driving (level 3-5) will become reality within the next innovation cycles, there are still several challenges to overcome to implement autonomous driving on a large scale:

- Control transfer between driver and vehicle
- Vehicle behaviour, reaction and decision-making towards external factors (i.e. pedestrians, weather conditions)
- Communication reliability
- Impact on societal values (acceptable driving behaviour) and acceptance
- Laws and regulations (road infrastructure for autonomous vehicles)

(Habibovic, Englund & Wedlin, 2014; Bengler et al., 2014; Kalra & Paddock, 2016).

These challenges match with the findings from our sighting of consultancy and trend reports (see Chapter 2.1.2.). Additional to the technological research done in this field, researchers, project groups and OEMs have looked at the positive impact and potential of autonomous driving. Several researches found out, that there is a positive impact on the environment and a 20-30% energy saving in fuel consumption could be achieved by using platooning and autonomous vehicles (Payre, et al. 2014; Luettel, Himmelsbach & Wuensche., 2012; Weyer, Fink & Adelt, 2015; Wadud, MacKenzie & Leiby, 2016). In relation to this, platooning is a highly-discussed topic, which is aimed at decreasing pollution and the stress level for passengers (Rudin-Brown & Parker, 2004; Stanton & Young, 2005; Roland Berger, 2016).

According to SATRE the platooning concept refers to the idea that vehicles (especially trucks and busses) are connected through smart technology, hence, could travel together with automated control. This will improve safety, efficiency, congestion and emission levels.
Furthermore, the positive impact on congestion levels, accident and road accidents have been examined within the available literature (Van den Berg & Verhoef, 2016; World Health Organization, 2013). Additionally, current research takes the user acceptance into account. Research predicts, that an adoption of autonomous driving is more likely to occur within freight vehicles, due to existing mistrust and scepticism from other potential user groups (Merat, Madigan & Nordhoff, 2016; Fraedrich & Lenz, 2016). The loss of freedom, negative social consequences and the loss of the symbolic and emotional value were identified as potential barriers (Fraedrich & Lenz, 2016). Researchers argue, that the need for a more in-depth analysis on cultural, type and interdependencies remains for future studies.

It becomes apparent, that the current research is focused on attributes closely linked to autonomous vehicles but does not take interaction between actors and impact on competitive advantages into account. The potential autonomous vehicles offer in transforming the current transport industry has been largely neglected by research.

2.2. Resource Based View (RBV)

To tackle the described gap in literature we will look at strategic management concepts for developing competitive advantages. During the last decades, researchers have introduced different concepts and ideas in explaining how competitive advantages are achieved and sustained. Porter (1985), a widely recognised and cited scholar, defined a competitive advantage as a state where a firm creates value for their buyers either through cost leadership (providing lower prices) or differentiation (providing greater value). Here, a competitive advantage is determined by a company’s resources and capabilities and their ability to use core competencies to exploit opportunities (Feng, Morgan & Rego, 2017).

Daft (1983) defined resources as “all assets, capabilities, organisational processes, firm’s attributes, information and knowledge”. Wernerfelt describes resources as “anything which could be thought of as a strength or weakness of a given firm” (Wernerfelt, 1984, p.172). Other authors classify resources in three categories: physical, human and organisational capital (Barney, 1991). Physical resources include the technology and equipment available and used by a firm. Human resources describe skills and knowledge of individual workers or managers within a firm. Whereas, organisational resources refer to a firm’s internal structure, organisation and process workflows as well as the firm’s relation to its environment. These resources can be used to develop strategic advantages and strengths of a business.
Developing a strategy to achieve competitive advantages depends on the chosen view on organisations and their environment. Teece, Pisano & Shuen (1997) looked at efforts in the field of competitiveness and divided them into four different paradigms: (i) accentuating competitive forces, (ii) strategic conflict, (iii) Resource-based perspectives and (iv) Dynamic capabilities perspective. These paradigms relate to underlying models introduced by several different authors, which can be used to derive strategic management implications.

In the 1980s, the model of “Porter’s five forces” was introduced (Porter, 1980). This theory correlates with the first paradigm. It represents a systematic approach to examine how competitive forces influence the industry and how firms can differentiate themselves from competitors and find a position within the market (Porter, 1980). Companies can derive suitable strategies to change their position within the market and gain competitive advantages (Teece, Pisano & Shuen, 1997). Porter’s five forces model helps to identify the drivers of competitiveness. However, Barney (1991) and Teece, Pisano & Shuen (1997) noted that little attention was paid to a firm’s internal attributes.

Another concept was introduced by Shapiro (1989) in the article “The theory of business strategy”. The model of the “strategic conflict” uses game theory to explore the interactions between firms and their competitors. It helps to identify ways of influencing behaviours and actions of other firms. Shapiro argues that by “manipulating the market environment, a firm may be able to increase its profits” (Teece, Pisano & Shuen, 1997). Although, Porter’s and Shapiro’s models highlight the importance of external forces and the strategic awareness of the environment, a micro-level perspective is needed to assess how firm’s individual resources and attributes influence their competitive position (Shapiro, 1989; Teece, Pisano & Shuen, 1997).

In the book “The Theory of the Growth of the Firm”, Penrose (1959) already accentuated the importance of a firm’s internal resources for its growth. The idea that resources represent a key factor to succeed was pursued by other authors and aligned to a resource-based view (RBV) as a third paradigm (Wernerfelt, 1984; Barney, 1991; McGrath, MacMillian & Venkataraman, 1995; Amit & Schoemaker, 1993; Prahalad & Hamel, 1990). Since the 1980s and 1990s this approach forms the basis for strategic management considerations. Supporters of the RBV believe that a firm’s existing resources are sources of competitive advantages and can be used to exploit opportunities within the market (Wernerfelt, 1984; Barney, 1991; McGrath, MacMillian & Venkataraman, 1995; Amit & Schoemaker, 1993; Prahalad & Hamel, 1990). The RBV argues that resources are either tangible or intangible assets within
the firm and need to be heterogeneous (mix of resources differ from one company to the other) and immobile (bound to the company) (Werner felt, 1984, Barney, 1991).

Wong and Karia (2010) combine the resource-based view to identify strategic logistics resources, which are used by logistics service providers (LSPs) to achieve a competitive advantage. By examining 15 selected LSPs, the study demonstrates that different bundles of resources (physical, human, information, knowledge and relational) are used by LSPs to create unique capabilities (Wong & Karia, 2010). For LSPs assets such as warehouses, trucks, IT systems or skilled labour as well as relationships with customers are resources which can be bundled (Wong & Karia, 2010). Wong & Karia (2010) main findings are seven common characteristics of financially successful LSPs:

- Medium to high level of all types of resources
- Advanced effort in developing firm-specific information resources
- Interested in integrating unique human resources from other sectors
- Investment into knowledge creation to achieve unique knowledge advantages
- Long-term relationships with key customers and horizontal alliances
- Efficient management of their physical resources
- Competence to bundle own resources with resources of their partners

It becomes apparent, that building competitive advantages represent a key focus of research done in the field of RBV. Barney states that a firm has a

*competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors* (Barney, 1991, p.102).

For an advantage to be sustainable, competitors need to be unable to imitate these bundles of resources. Thus, Barney (1991) describes four characteristics, namely the VRIN attributes:

1) Resources should be valuable 3) Resources should be hard to imitate
2) Resources should be rare 4) Resources have to be non-substitutable

Only if a firm possesses a sustained competitive advantage over its competitors it will be able to be successful in business. A sustained competitive advantage can be achieved by fulfilling all the attributes of the VRIN framework (Barney, 1991). The first attribute
considers resources to be valuable if they help companies to increase the perceived value for the customer (Barney, 1991). Resources are rare is they are not available to every firm (Barney, 1991). Inimitable refers to the costs involved in duplicating or substituting the resources, so that competitors find it difficult to have the same resources (Barney, 1991). This can be achieved by historical advantage, causal ambiguity, i.e. firms cannot identify the resource that leads to a competitive advantage or social complexity due to implications based on cultural and interpersonal factors (Barney, 1991). Whereas, the last attribute refers to potential substitutes available in the market (Barney, 1991). Figure 3 shows how the existence of certain attributes lead to different competitive advantages.

![Figure 3: VRIN framework (adopted from Rothaermel’s (2013) ‘Strategic Management’, p.91)](image-url)

Although this framework was refined by Barney at a later stage into the VRIO framework, we chose to focus our research on his earlier work. The VRIO and VRIN framework are similar in their composition and implication. However, the VRIO framework introduced the attribute of a firm’s ability to capture value “organized to capture value” from the available resources (Barney & Hesterly, 2008). Since our research focuses on the logistics industry in general and looks at different companies, we consider the factor of non-substitutional (VRIN framework) to be important to derive implications for the market structure. The VRIO might become important, once individual firms assess their resources and capabilities.

In addition to the general resource-based view, taking a firm’s ability to bundle and coordinate the resources with the underlying VRIN attributes is important to exploit competitive advantages:
demonstrate timely responsiveness and rapid and flexible product innovation, coupled with the management capability to effectively coordinate and redeploy internal and external competences (Teece, Pisano & Shuen, 1997, p.515)

This ability to achieve new forms of competitive advantage is defined as a “dynamic capability” and represents the fourth paradigm. Here, “path dependency” plays an important role, because it implies that the development of new competitive advantages of a firm is predetermined by its previous path (Teece, Pisano & Shuen, 1997). Thus, “dynamic capabilities” are defined as follows:

Dynamic capabilities [are a] firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. Dynamic capabilities thus reflect an organization's ability to achieve new and innovative forms of competitive advantage given path dependencies and market positions. (Teece, Pisano & Shuen, 1997, p.516)

Additionally, to the findings of the available literature on competitive advantages Sirmon, Hitt and Ireland (2007) state, that it is uncommon for a single resource to be the sole basis for a competitive advantage. Advantages are achieved by having a distinct resource portfolio with specific resource bundles (Sirmon, Hitt & Ireland, 2007). They describe that existing resources need to be assesses, combined and bundle to represent a strategic resource portfolio to achieve competitive advantages (Sirmon et al., 2007).

We presented a number of different school of thoughts devoted to the topic of competitive advantage. Although the presented ideas differ slightly in their set-up, they all indicate that only a combination of resources helps to achieve a competitive advantage. Furthermore, research indicates, that firms should aim to develop sustained competitive advantages to position themselves successfully within the market. The VRIN framework represents a suitable model to assess resources and derive sustained competitive advantages. Thus, we will examine our research question based on a RBV, with VRIN being the underlying model for our research approach.
2.3. Logistics Service Providers – Transport Service Providers

Trucks are used by different players within a supply chain. Thus, these players could be affected by an introduction of self-driving trucks. In order to understand which type of companies are potential users of autonomous trucks, we will look at the wider context of logistic service providers and transport service providers.

The Council of Supply Chain Management Professionals (CSCMP) compiled a glossary for supply chain management terms. The supply chain is defined as a link between firms which starts with unprocessed raw materials and ends with the final customer using the finished goods (CSCMP, 2013). Vendors, service providers and customers are linked within the supply chain (CSCMP, 2013). Figure 4 illustrates a simplified supply chain system and its actors.

Suppliers represent the starting point of a supply chain. They provide the resources and raw materials, which are needed by other actors in the supply chain to produce products and services (Law, 2016). The customers buy the end products or make use of the services provided by other actors within the supply chain. In between, there are different actors such as the manufactures who produce the goods, vendors who are responsible for selling and a multitude of different service providers. However, with the scope of our thesis being logistics we will specifically focus on logistics service providers (LSPs).

An LSP is defined as “any business which provides logistics services [such as] provisioning, transport, warehousing, etc.” (CSCMP, 2013, p.117). Transport service providers represent a sub-category of LSPs. Other LSPs are integrators, third party logistic (TPL) providers or specialists.

Hertz and Alfredsson (2003) explore the strategic development of TPL providers in terms of customer coordination and adaptation and how it changes over time. They classify LSPs and TPLs by using the two dimensions of general problem solving ability and the ability to adapt to customers. Figure 5 illustrates their framework. (Hertz & Alfredsson, 2003)
The framework can be used to classify service providers specialised in transportation. Sorrn-Friese (2005) describes different types of transportation firms, which can be incorporated into the framework described above. The author identifies large hauliers utilising economies of scale, as well as, small and more flexible hauliers offering specialised solutions for their customers and serving niche markets (Sorrn-Friese, 2005). The number of small hauliers, serving not only customers but also other LSPs with specialised services is of particular interest for the logistics industry (Sorrn-Friese, 2005). The findings of this study were later confirmed by other authors (Cui & Hertz, 2011; Cruijssen, Dullaert & Fleuren, 2007). This has further implications on the competitive environment of logistics, the importance of relationships and network density. The authors describe three different types of LSPs, TPL firms, logistics intermediary firms (e.g. freight forwarders) and carriers, which horizontally and vertically collaborate with each other (Cui & Hertz, 2011; Cruijssen, Dullaert & Fleuren, 2007). Figure 6 shows the network of transport firms and their collaboration:

Road hauliers are firms that provide road transport services (Law, 2016), while logistics intermediary firms are responsible for freight forwarding services and the consolidation of material flows (Coyle, Gibson, Langley & Novack, 2013). A third-party logistics firm “is an
external provider who manages, controls, and delivers logistics activities on behalf of a [customer]” (Hertz & Alfredsson, 2003, p.140). Although many companies are involved in the process of fulfilling customers’ transport demands, the underlying transport activities are often outsourced and executed by road hauliers (Cui & Hertz, 2011). TPLs and intermediary firms manage and control these logistics services (Cui & Hertz, 2011). The most important resources for TPLs and freight forwarders are relationships, warehouses, information and the competence to integrate resources into their portfolio (Wong & Karia, 2010). Road hauliers however, rely on their physical and human resources, such as trucks and truck drivers, to improve their profitability (Rushton, Croucher & Baker, 2010).

Previous research on the topic of logistics service provider indicates that transport companies are essential to execute distribution activities within supply chains. Thus, trucks are utilized along the supply chain, from raw material manufacturer to the final customer. There are several different types of transport companies, who work together to carry out these services. The interconnection between the different actors highlight the impact autonomous trucks could have on supply chains.

2.4. Conceptual Framework

The road transport industry is shaped by its actors. The position of logistics firms is determined by their ability to form competitive advantages and differentiate themselves from competitors. Insights drawn from literature based on the RBV consider a firm’s internal resources and capabilities as success factors. This is determined by the ability to use existing resources and their underlying attributes to transform these into a sustainable competitive advantage. However, sustainable competitive advantages are vulnerable to change such as disruptive innovations. Barney (1991) argues that

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[...] unanticipated changes in the economic structure of an industry may make what was, at one time, a source of sustained competitive advantage, no longer valuable to a firm, and thus, not a source of any competitive advantage
(Barney, 1991, p.103).
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Although resources might disappear or their attributes be affected within the VRIN framework, new resources or capabilities could become new sources of competitive advantages. Innovations such as self-driving trucks have the potential to reshape an entire industry and affecting existing competitive advantages. These structural revolutions are called “Schumpeterian Shocks” (Schumpeter, 1934).
For example, human resources such as qualified drivers represent a competitive advantage for some transport companies. The introduction of self-driving trucks could minimise or even eliminate such a competitive advantage, since it has an impact on the driver itself. This would help other firms to compete on the same level and influence the structure of the logistics industry. Thus, other resources and capabilities might be necessary to succeed in the market. Furthermore, such “Schumpeterian Shocks” could enable new actors to enter the industry. The presented frame of references shows, that a disruptive technology such as autonomous driving could have an impact on the competitive advantage of a company. If competitive advantages of transport companies change, the whole industry and its customers will change accordingly.

By examining available literature, it becomes clear that changes in competitive advantages with autonomous driving entering the market are neglected. This represents a gap in research, which we aim to close by looking at the impact of the innovation from a research-based view. Figure 7 illustrates the conceptual model of our thesis.

**Figure 7: Conceptual Model**

Based on the RBV, competitive advantages of transport companies are determined by their resources and capabilities. To find these competitive advantages the VRIN framework is used to identify resources which help to achieve a sustainable competitive advantage. If these characteristics alter due to disruptors such as autonomous trucks, different implications for the logistics industry can be derived. These implications include topics like: changes in the structure of the industry or impacts on the types of companies within the industry.

Autonomous trucks could fundamentally change the transport sector. Resources which once were valuable, rare, imitable and non-substitutable might not be relevant anymore and new resources could arise to form competitive advantages. This could have further implications for the logistics industry.
3. Methodology and Methods

This chapter shows our methodological approach and sets the framework for our data collection and data analysis. The aim of this section is to justify the chosen research method and describe the process with which the qualitative research was conducted.

3.1. Research Philosophy

To provide a framework and rationale for the interpretation of the following research findings, the underlying research philosophy of this thesis needs to be identified. When conducting research, there are different assumptions about the nature of reality (ontology) and the nature of knowledge (epistemology) that can be applied (Easterby-Smith, Thorpe & Jackson, 2015). There are four different views, namely positivism, realism, interpretivism, and pragmatism (Saunders, Lewis & Thornhill, 2012).

Saunders et al. (2012) suggest the research onion (Figure 8) to describe the methodological stages of a conducted study. It is divided into philosophy, approach, methodological choice, strategy and techniques of data collection. The following chapter will use the research onion to describe the underlying research approach and design of this thesis.

![Research Onion](image)

*Figure 8: Research Onion (own illustration based on Saunders et al., 2012)*

Regarding the present thesis, a relativist ontology is chosen, where facts and figures depend on the viewpoint of the observer and are subject to their perception and consideration.
(Easterby-Smith, Thorpe & Jackson, 2015). With this relativist perspective, it is determined that there is no single reality and that research is created by people and their understanding. According to Saunders et al. (2012), interpretivism is the most suitable approach when looking at complex issues, which cannot be measured through objective methods, laws, theories or replicated in a numerical way. Since the following thesis looks at issues regarding complex future scenarios and business management topics, an interpretivist research philosophy will help to understand the underpinning circumstances (i.e. disruptive technology), involved individuals (i.e. actors within the logistics network) as well as implications for logistics (i.e. impact on competitive advantages). This approach is closely linked to a social constructionist position, which uses mixed research methods to gain deeper insights and interpret the whole situation to reach theoretical abstraction (Easterby-Smith, Thorpe & Jackson, 2015). This approach will help to develop a concept and theory for autonomous driving within logistics.

Positivism takes a contrary view of interpretivism looking at the external world and the observed facts as well as, deducting and testing theories through hypotheses (Easterby-Smith, Thorpe & Jackson, 2015). However, since the idea of autonomous driving within logistics affect different individuals and their interactions, human interest becomes the main driver of science. Thus, a positivist view on this research question would lead to artificial, inflexible and narrow results (Easterby-Smith, Thorpe & Jackson, 2015). Therefore, interpretivism offers the opportunity to examine the topic of autonomous driving in a subjective and detailed manner (Saunders et al., 2012). An understanding of why actors will act and how it will impact certain behaviours in future due to the introduction of autonomous driving can be derived. Yet, interpretivism might lead to very personal perspectives which might be difficult to generalise (Saunders et al., 2012). Emotions and biases are included in this research approach which might undermine reliability and representativeness. However, we aim to get a first understanding of the topic and derive a tendency of perceptions with our research rather than a generalisation. This can then be used for further investigation for other researchers.

Saunders et al. (2012) argues that qualitative methods are used to draw conclusions and build theories. These suit our topic better, since quantititative methods only look at theory verification or falsification (Saunders et al., 2012). Due to novelty of our topic, a theory building approach is more appropriate. To summarise, we chose interpretivism with qualitative research methods approach to gather data, draw conclusions and achieve validity. To answer the proposed research questions, this thesis will use semi-structured interviews to collect the necessary information and conduct a concept for future logistics transport industry.
3.2. Research Approach

There are three different research approaches: deductive, inductive or abductive (Saunders et al., 2012). With a deductive research approach hypotheses and theories are tested, to reach theory falsification or verification (Easterby-Smith, Thorpe & Jackson, 2015). Induction, on the contrary, uses research questions moving from a specific observation to a generalisation of the issue (Easterby-Smith, Thorpe & Jackson, 2015). Deductive is usually related to quantitative methods, while an inductive approach makes use of qualitative methods. Inductive reasoning looks at the question of why and how to find an explanation or theory.

Since autonomous driving represents a new phenomenon within the logistics industry and research about its impact is not available yet, induction represents a suitable approach to construct a conceptual framework to provide a first understanding of the topic. An inductive perspective on the topic of autonomous driving will help to build a theory, which is based on observations and narrative descriptions (Saunders et al., 2012). This will help to identify patterns and compare results to draw reasonable conclusions for a conceptual framework for autonomous driving. An inductive approach represents a straight-forward method to derive findings from the collected data (Saunders et al., 2012). This approach will further help to create new knowledge about autonomous driving and make first broad generalisations of the result. Thereby, the necessary data can be collected via qualitative interviews and conclusions can be derived from facts and observations.

According to Dubois and Gadde (2002), with an interpretivist view an abductive approach can be used to build new theories or modify existing ones. Thereby, abduction represents an intersection between induction and deduction. An abductive approach offers the opportunity to puzzle the research around an existing phenomenon and identify common themes and patterns. This approach uses qualitative and quantitative methods to reach a conclusion about a specific research question and to reach a generalisable theory. However, it should be noted that an abductive approach demands an iterative process of comparing empirical data to surprising facts and draw suitable explanations (Bryman & Bell, 2015). This process is very challenging and time-consuming. It is difficult to determine the right balance between testing and discovery. Furthermore, abduction is often being criticised in being incomplete, since it is based on surprising facts and not definite probabilities for justification (Plutynski, 2011). Due to time constraints of this thesis and the novelty of the topic, an
in an inductive approach is chosen instead and offers the necessary base to achieve our aim with this research.

3.3. Strategy and Research Design

Choosing the methodological approach and research strategy helps to carry out our research in a logical way to enable a reproduction of the study. According to the research onion, there are qualitative, quantitative and mixed methods available (Saunders et al., 2012). As described above, due to the explorative nature of the topic of autonomous driving and the need for theory building, a qualitative method is the most suitable one. The research choice can be divided into mono-, multi- or mixed methods (Saunders et al., 2012). For our research a multi-method qualitative approach is chosen. A multimethod approach uses different data collection methods but stays within qualitative techniques (Saunders et al., 2012). This will help to increase the validity of our research and help to draw conclusions.

Autonomous driving represents a phenomenon which this thesis is trying to explore in the context of logistics. We want to look at what?, why? and how? autonomous driving will impact the competitiveness within road logistics and outline possible future scenarios. Thus, we believe that conducting case studies will help us to gain insights into the current situation, estimations and opinions of experts to predict possible future concepts for road logistics. The case study approach will help to gain a deep understanding of real-life context of the topic and enable an exploration of the research (Eisenhardt and Graebner, 2007). This can be done by single or multiple cases (Yin, 2009). While a single case study looks at unique or critical incidents, incorporating multiple cases into a research study helps to achieve replicable results (Yin, 2009). The presented research topic looks at actors within the logistics industry and competitive advantages. Furthermore, it aims to create possible future scenarios on how logistics service providers could adapt their capabilities and resources to stay competitive once self-driving trucks are in place. Thus, we believe that taking multiple cases into consideration is a suitable approach to receive the necessary empirical data to predict a future concept regarding logistics firms and autonomous driving. We selected five main case groups to represent different perspectives on the topic.

3.3.1. Sampling and Choice of interview partners

To maintain a representative sample, we used non-probability sampling (Easterby-Smith et al., 2015). This helped us reach out to specific experts to obtain the necessary data. In accordance with a purposive sampling technique, we identified five case groups with two to
four interviewees to fulfil our research purpose (Easterby-Smith et al., 2015). We have chosen four specific company groups and additionally, companies who did not fit into these groups but had valuable insights were included in a fifth group. This was done by establishing specific eligibility criteria, such knowledge in transportation and logistics (Easterby-Smith et al., 2015).

Since we used a multi-perspective approach, it is important to ensure comparability of the data between the different company groups. Therefore, we used a funnel approach to precisely determine which companies we want to ask for interview partners. We focus on two characteristics and targeted a specific geographical to ensure that the experts fit into our research.

- **Connection to trucks**: For our study, it is not necessary that all companies belong to the same industry. It is more important to get a variety of companies to gather opinions on the topic from different angles. However, all subjects had to have some connection to trucks, i.e. road transportation experts (companies with own truck fleets), a responsible person for logistics service providers (customer perspective), producer of autonomous trucks (OEMs and system providers) or knowledge about logistics industry (consultants).

- **Expertise of interview partners**: Since we base our thesis on the perception of experts in the field, it was important that the interviewee had the necessary expertise. To be eligible for an interview, we asked potential companies to connect us with an internal expert on the topic of trucks or preferably autonomous trucks. Especially experts who are involved in innovative processes within their company were of high interest.

- **Geographical Location**: As pointed out in our delimitations, this study focuses on the standards set by the European Union. Thus, we solely focus on highly developed countries within Europe. This criterion ensures that relatively similar legislative standards and infrastructure standards apply to all partner companies.

To reach out to suitable companies, we used our personal networks as well as the alumni network of the Jönköping International Business School. Additionally, we posted requests for contact persons in LinkedIn, Xing and Facebook or contacted experts directly. Moreover, to get in touch with appropriate experts we reviewed trend reports, published papers, newspaper articles and company websites for appropriate contact details. Once promising contact persons were identified, we sent an email (see Appendix 1) with a description of our research purpose
and why we believe that their company fits into our research. We also included a description of the kind of employee we would like to speak in order to reassure that they qualified as an expert for our study. Table 3 illustrates the different company case groups which are used to categorise our interview partners.

<table>
<thead>
<tr>
<th>Group</th>
<th>Connection to Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transporters</td>
<td>Own and use trucks to provide transport services</td>
</tr>
<tr>
<td>Customers</td>
<td>Collaborate with trucking companies to transport their products</td>
</tr>
<tr>
<td>Developers</td>
<td>Are involved in the development or production of trucks</td>
</tr>
<tr>
<td>Consultancies</td>
<td>Are involved in research on the topic of autonomous driving or trucks</td>
</tr>
<tr>
<td>Others</td>
<td>Have an interface with trucking companies</td>
</tr>
</tbody>
</table>

Table 3: Overview of Company Groups

All case groups are revolving around the predominant topic of autonomous driving in logistics. Yet, since our thesis focuses on logistics, we were especially interested in the perception of transport companies. Potential candidates were contacted via email or directly via telephone. Once suitable interview partners stated their interest to participate, we made an appointment for a phone or face-to-face interview. With the invitation for the interview, the interested respondents received an interview guide, providing a rough outline of the interview. This gave our interview partners the opportunity to become familiar with the topic of autonomous driving. In our opinion, it was especially valuable for interview partners who had not yet thought about autonomous driving. However, it was only a short guide rather than a detailed questionnaire to ensure that answers during the interview were not biased by their own preparation. We think this improved the quality of our interviews. Since all interviews were based on the given interview guide with several topics around autonomous driving in logistics, it helped us to compare the results between the different case groups.

### 3.3.2. Interview Structure

Hesse-Biber and Leavy (2010) explain that guidelines are based on a set of pre-defined open-questions. This helps to guide through the interview process without taking away the flexibility to react to answers and adapt the interview to receive more detailed and in-depth responses. Additionally, guidelines make interviews with different firms easier to compare and ensure that pre-defined topics are addressed (Hesse-Biber and Leavy, 2010). Therefore, we structured our interview guide with open-questions about experts’ perception. By choosing a semi-structured interview approach, we gave the opportunity to elaborate on interesting points raised by the interviewee with follow-up questions. Moreover, by using this approach,
the interviewee answers were not biased due to preparing their answers in advance. By doing that, it is possible to get unprejudiced and meaningful insights.

After providing our interviewees with a general introduction about ourselves, our research topic, research purpose and a short overview of our interview structure, we asked whether the interviewees had any clarifying questions or concerns beforehand. Additionally, we assured that data will be handled confidentially and asked for their permission to record the interview to enable an easier transcription for our analysis. This helped us to build trust.

Trust is an essential factor for the quality of interviews and richness of answers (Hesse-Biber & Leavy, 2010). Due to the innovativeness of our research topic and the underlying sensitive data, this was of special importance. For example, developers might suspect to be required to share details about their own or valuable R&D results; we ensured that this was not the case. For transport firms, the topic is a sensitive one due to trucks and drivers being one of their main assets and the potential of autonomous driving having a great impact on that. Therefore, we emphasized that our research looks at perceptions and opinions of experts rather than demanding sensitive data. We explained that no internal sensitive data is needed to enable developers and OEMs to freely share their opinions.

The interview guides were divided into three parts (see Appendix 2). The first part of the interview was focused on the position, tasks and responsibilities of the interviewee, as well as some background information about the company. This further helped to establish trust and ensure the interviewees expertise in the field. It included questions about current unique selling points, strengths, expectations and requirements for transportation providers and the importance of innovation in logistics for their company. Although the general interview guide was the same, the questions in this section were adapted according to the subject’s case group. This means, that for transport companies, questions about strengths and unique selling points were of interest. Customers could share their requirements and selection criteria for transport partners. Whereas, OEMs were asked about the customer demands in buying trucks and innovation experts shared the results of conducted studies. This helped to consider the topic from multiple perspective of the different actors involved and achieve a better understanding of the context.

The second part of the interview looked at the development, megatrends and the future of logistics. Here, we incorporated questions about the definition of autonomous driving, perception about the concept and its potential implementation.
While the third part examines the perception and opinions on future scenarios once autonomous driving will be in place. Here, we were interested in how experts assess the impact of self-driving trucks on the logistics industry. Among others we asked whether current sources of competitive advantage will remain important, why and how they will change. Furthermore, we were interested in the potential manifestation of new players within the market. To close the interview, each interviewee had the possibility to express additional comments and to request a copy of our research after the study is finalised. Table 4 shows the structure of our interviews in detail:

<table>
<thead>
<tr>
<th>Part</th>
<th>Topics covered</th>
</tr>
</thead>
</table>
| 1    | Interview Partner:  
- Background  
- Current Job  
- Task and Responsibilities  
Interviewee's Firm/ Employer:  
- Field  
- Facts and Figures  
Specialisation of the firm / USPs / Differentiation from competitors  
Development of USPs / Strengths  
Collaboration with (other) Transportation and Logistics Firms  
Expectations of Transportation Partners  
Requirements of Transportation Firms  
Importance of Innovation |
| 2    | Recent Developments in Transportation  
Future of Logistics - Which Megatrends will influence it and why  
Autonomous Driving - Understanding of the term  
Challenges and Barriers for Autonomous Driving  
Changes and Opportunities through Autonomous Driving |
| 3    | Impact of Autonomous Driving on the Future of Logistics:  
- Potential Changes  
Importance of current Resources and Capabilities regarding Autonomous Driving  
Changes in transportation market:  
- potential new players  
- current players which might disappear  
- impact on interviewee’s firm / customers  
In-house logistics process:  
- adaption to autonomous driving trucks  
- potential |

*Table 4: Interview Structure*

### 3.4. Data Collection

All 17 interviews were conducted between 28\textsuperscript{th} March 2017 and 4\textsuperscript{th} May 2017. On average, the interviews took 55 minutes each. We conducted the interviews either in English
or in German. We used German whenever it represented the mother tongue of our interview partners. This enabled our subjects to speak freely and increased the quality of our interviews. All except two interviews were conducted via phone. This was necessary because we wanted to include a variety of different companies. The possibility to travel to each interview was limited by time constraints and distance. Therefore, phone interviews represented an adequate solution. Since we received permission by all our interview partners to record the interviews, we could use these recordings to transcribe, translate and analyse the responses. Additionally, we took notes during the interviews. Table 5 lists all interviews conducted during the process of this thesis.

<table>
<thead>
<tr>
<th>Group</th>
<th>Nickname</th>
<th>Position</th>
<th>Company Size (number of employees)</th>
<th>Interview</th>
<th>Length in min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Type</td>
<td>Date</td>
</tr>
<tr>
<td>Transporters</td>
<td>T1</td>
<td>CEO / Owner</td>
<td>&lt; 100</td>
<td>Phone</td>
<td>March, 28th</td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>Fleet Manager</td>
<td>&lt; 1.000</td>
<td>Phone</td>
<td>March, 29th</td>
</tr>
<tr>
<td></td>
<td>T3</td>
<td>Innovation &amp; Sustainability Manager</td>
<td>&lt; 10.000</td>
<td>Phone</td>
<td>March, 31st</td>
</tr>
<tr>
<td></td>
<td>T4</td>
<td>Head of Corporate Strategy</td>
<td>&lt; 10.000</td>
<td>Phone</td>
<td>April, 6th</td>
</tr>
<tr>
<td></td>
<td>T5</td>
<td>Transport Manager</td>
<td>&lt; 100</td>
<td>Phone</td>
<td>May, 4th</td>
</tr>
<tr>
<td>Customers</td>
<td>C1</td>
<td>Head of International Sales</td>
<td>&lt; 100</td>
<td>Phone</td>
<td>April, 4th</td>
</tr>
<tr>
<td></td>
<td>C2</td>
<td>Logistics Manager</td>
<td>&gt; 10.000</td>
<td>Phone</td>
<td>April, 5th</td>
</tr>
<tr>
<td></td>
<td>C3</td>
<td>Logistics Manager</td>
<td>&gt; 10.000</td>
<td>Personal</td>
<td>April, 7th</td>
</tr>
<tr>
<td></td>
<td>C4</td>
<td>Project Manager - Logistics</td>
<td>&gt; 10.000</td>
<td>Phone</td>
<td>April, 10th</td>
</tr>
<tr>
<td>Developers</td>
<td>D1</td>
<td>Developer – Trucks</td>
<td>&gt; 10.000</td>
<td>Phone</td>
<td>April, 4th</td>
</tr>
<tr>
<td></td>
<td>D2</td>
<td>Specialist – Autonomous Driving</td>
<td>&lt; 100</td>
<td>Phone</td>
<td>April, 6th</td>
</tr>
<tr>
<td></td>
<td>D3</td>
<td>Head of Predevelopment</td>
<td>&gt; 10.000</td>
<td>Phone</td>
<td>April, 11th</td>
</tr>
<tr>
<td></td>
<td>D4</td>
<td>Autonomous / Automated Driving Director</td>
<td>&gt; 10.000</td>
<td>Phone</td>
<td>May, 2nd</td>
</tr>
<tr>
<td>Consult.</td>
<td>B1</td>
<td>Senior Consultant</td>
<td>&lt; 10.000</td>
<td>Phone</td>
<td>April, 7th</td>
</tr>
<tr>
<td></td>
<td>B2</td>
<td>CEO / Owner</td>
<td>&lt; 10</td>
<td>Phone</td>
<td>April 11th</td>
</tr>
<tr>
<td>Others</td>
<td>O1</td>
<td>Traffic Planner - Train</td>
<td>&lt; 10</td>
<td>Phone</td>
<td>March, 28th</td>
</tr>
<tr>
<td></td>
<td>O2</td>
<td>Project Manager – Warehousing</td>
<td>&lt; 100</td>
<td>Personal</td>
<td>April, 19th</td>
</tr>
</tbody>
</table>

Table 5: List of interviews
Almost all interviews were conducted as a team. This enabled us to have one person responsible for moderating and the other person responsible for making notes. By doing this, we could obtain additional data on the interview process and any observations. By carefully listening to how the interviewees responded, we could write down if a response was given with conviction or doubt. For our research approach, this data was extremely helpful during the analysis of the interviews. Overall, we think it was extremely helpful to conduct the interviews as a team because it helped us to stick to the topic guide and obtain sufficient and good results.

In addition to the interviews, we also considered secondary sources. Examples of those sources are consultancy papers, newspaper articles, online video clips or websites. However, these sources were mainly used for preparation of the interviews and to improve our own understanding of topic.

3.5. Data Analysis

We chose a thematic analysis approach as outlined by Saunders et al. (2016). In line with the inductive research approach of this thesis, it represents a straight-forward method of analysing data. Braun and Clarke (2006) explain that thematic analysis provides a “flexible and useful research tool, which can potentially provide a rich and detailed, yet complex, account of data”. It offers an “orderly and logical way to analyse qualitative data” (Saunders et al., 2016).

The underlying idea of thematic analysis is to construct a hierarchy of central themes and related subthemes out of codes (Bryman, 2012). According to Saunders et al. (2016), a code is a single word or short phrase, which is used to label data units within a data item. A data item refers to documents such as interview transcripts. A data unit refers to statements (single words or whole paragraphs) within the transcript, which can then be summarised into a code (Saunders et al., 2016).

Saunders et al. (2016) describe that this type of analysis is not tied to a philosophical position or research approach. However, while a deductive approach links themes to existing theory, we use thematic analysis from an inductive approach where themes are derived from the data itself (Saunders et al., 2016). According to this approach, four different steps need to be undertaken, namely familiarizing with data; coding; identifying themes and relationships; refining themes and testing propositions.
We became familiar with our data through conducting the interview, listening to our recordings, individually transcribing and translating the interviews and thereafter, comparing the results. Working together as a team helped us to ensure a high quality of transcripts and accuracy of translations from German to English. Furthermore, discussing the transcripts of the interviews enabled us to achieve an in-depth understanding of their content.

Hereafter, we reviewed our transcripts and divided each individual data item into single units of data. These units were then labelled with different codes, which we identified in the data. We did not base any of those codes on existing literature and instead derived them directly from the data collected. As suggested by Saunders et al. (2016), we used our research questions to select which data to code. Nevertheless, after finalizing the initial coding, we reviewed our material to ensure that no valuable data had been ignored. We obtained a large number of different codes through this process. To analyse the data, the amount of codes had to be reduced. As suggested by Miles, Huberman & Saldana (2014), we used data condensation to reduce and rearrange our data into a more manageable and comprehensible form.

Throughout the course of this research, we already compiled possible themes by combining codes which we assigned to our data. Thereafter, we reviewed the themes and built relationships between them. Main themes were closely linked to our research questions, sub-themes were associated with these main themes. We paid attention to refine this construct as it served as a framework for our analysis.

Testing propositions is the last step of the thematic analysis process. Every proposition we came up with was compared to the original data. Only if our proposition was tested successfully and no alternative explanation or negative case was found, we considered our conclusion to be valid. We believe that using the described thematic analysis process allowed us to transform the large amount of data gathered in a comprehensible and accurate manner.

3.6. Research Ethics and Quality

Since the 1960s, research ethics was included in the research process (Leavy, 2014). The importance of ethics has been confirmed by many authors in the field of business research (Saunders et al., 2012; Easterby-Smith, Thorpe & Jackson, 2015; Bryman, 2012). Nowadays, it represents a central topic to consider when conducting research.

Ethics concerns key principals towards the human subject and other participants regarding the four areas of: (i) protection of participants, (ii) informed consent, (iii) right of
privacy, (iv) confidentiality and transparency (Diener & Crandall, 1978; Bryman, 2012). Ethical considerations help to elevate the quality and value of research (Bell & Bryman, 2007). Therefore, it is important to take the four areas into account to inflict no harm on the chosen interview partners and their companies. This was ensured by following the ten key ethical principles by Easterby-Smith, Thorpe & Jackson (2015) as presented in Figure 9:

| 1. Ensuring that no harm comes to participants | 6. Protecting the anonymity of individuals or organizations |
| 2. Respecting the dignity of research participants | 7. Avoiding deception about the nature/aims of the research |
| 3. Ensuring a fully informed consent of participants | 8. Declaration of affiliations and conflict of interest |
| 4. Protecting the privacy of research participants | 9. Honesty and transparency in communicating the research |
| 5. Ensuring the confidentiality of research data | 10. No misleading or false reporting of research findings |

Figure 9: Key principles in research ethics (own illustration based on Easterby-Smith, Thorpe & Jackson, 2015)

To guarantee an ethical approach within our research, potential interview partners were presented with an overview about our topic and purpose of the research. This enabled our potential subjects to decide whether they wanted to participate in this study or not. It also ensured that the right contact person was chosen for our research. Once an interview date was agreed upon, an interview guide was shared with our participants to ensure a transparent process and give them the opportunity to prepare or ask clarifying questions regarding our process. This enabled the interviewees to give informed consent to take part in our study.

Since we offered our subjects the option to stay anonymous, the participants received nicknames and no company names are mentioned within this thesis. Any obtained information or data was anonymized to protect our research partners from any harm. In our opinion, this helped us to receive honest and detailed answers from our interview partners and thus, increased the quality of this thesis.

Research quality reflects the concept of reliability and validity to ensure high quality, mainly applicable in quantitative research (Bryman, 2012; LeCompte & Goetz, 1982). However, in qualitative research these two variables are difficult to apply. Lincoln and Guba (1985) introduce a commonly used framework in qualitative research. The two primary criteria proposed by them are trustworthiness and authenticity (Lincoln and Guba, 1985). Bryman (2012) points out that authenticity focuses on the wider political impact of the research and has not been influenced. The four criteria of trustworthiness are credibility, transferability, dependability and confirmability (Guba, 1981). Each of these criteria have a similar relationship to the criteria used in quantitative research (Bryman, 2012; Guba, 1981).
The criterion of credibility assesses how our research will be accepted within the field. Credibility can be ensured by spending a long time in the field and thus, having a reputation as an expert in this specific field (Krefting, 1991). Due to time and location constraints of our study, this way of achieving credibility was not possible. By using multiple perspectives, we aimed to take advantage of triangulation to increase the level of credibility of our study. Furthermore, since this study was executed by a team of two students, we could conduct interviews and other methods as a team, code results individually and compare our results to produce credible work. In addition, results of our research were not altered and we were focused on explaining all deviations within our data.

Transferability of research needs to be fulfilled to apply the research in a different context. Lincoln & Guba (1985) argue that qualitative research cannot easily be transferred due to small sample sizes in comparison to quantitative research. However, by providing an in-depth description of the setting of our research, other researchers will be able to take our study and judge to which degree our results are applicable to their research. This process is called thick description and we used it to ensure transferability of our research (Lincoln & Guba, 1985).

The criterion of dependability is concerned with our research being consistent, transparent and comprehensible (Lincoln & Guba, 1985). We aim to confirm the dependability of our research by carefully documenting all our steps. Our research process, including coding and analysing the data, was described in a transparent way to ensure clarity. Additionally, we ensured to keep a complete record of all activities during the research process. This includes interview transcripts, selection of research participants and decisions in data analysis.

Lastly, the criterion of confirmability depends on the objectivity of our research. Even though “complete objectivity is impossible in social research” (Bryman, 2012, p.392), we try to be as objective as possible. We clearly root all findings in our data and do not influence the results with our personal opinions. Working as a team and triangulation of data further helped to support the confirmability of our study (Bryman, 2012).
4. Empirical Findings

In this chapter, the results from our interviews are being summarized and demonstrated. Our interviews were divided into five case study groups, namely Transport Companies, OEMs & Developers, Customers, Consulting Firms and Others. All the information given in this section arose from the semi-structured interviews which were conducted. We will use a descriptive style to present and display the in-depth insights from our qualitative research.

To present the empirical findings from our interviews, the following section is divided into the three main areas: autonomous driving in logistics, resources and capabilities of logistics service providers, and autonomous driving trucks and future scenarios. These areas are derived from the interview guide used for our data collection. In accordance with our chosen thematic analysis approach, this chapter presents the units of data which were extracted from the transcripts (Saunders et al., 2016). For each area, the most important insights and findings from our different case study groups are described to not artificially extend the length of this chapter.

4.1. Autonomous driving in logistics

4.1.1. Perception of Autonomous Driving

When asking our interview partners for their understanding of the term “Autonomous Driving”, all participants from the case groups of developers and consultants used the definition provided by the SAE International’s New Standard j3016 (SAE). Participants from other case groups described the term in different ways. For example, T5 stated “My definition of autonomous driving is that a truck is able to drive completely without a driver from one place to another”. Three out of four participants of the customer group did not mention the different classifications into levels of autonomous driving.

Thereafter, we provided all interviewees with a common definition and classification of the levels provided by SAE to achieve a common definition for subsequent questions. All interview partners agree that autonomous driving will eventually enter the market but have different opinions on how and when it will happen. For example, D1 stated that their “plan is to develop autonomous driving step by step”. D2 said that “level 5 autonomous driving will take a long time until it is available” and emphasized that “lower levels of autonomous driving will appear in the near future”. B1 explained that, “if appropriate legal conditions are in place, level 3 autonomous driving could probably be used as early as 2020 or 2021”. While C2 mentioned: “our company already did a test run with a driverless truck in the
and “I think, once a few transport companies are able to work with autonomous or semi-autonomous trucks, all other transport companies will follow”. C4 explained: “I think autonomous driving could work in highly developed countries, while in other countries it is highly unlikely that this development will succeed anytime soon”.

Furthermore, developers, consultants and transport companies indicated that autonomous driving will change the market. For example, T1 pointed out that, “autonomous driving is the future” and T2 said, “I expect autonomous driving to drastically change the transport industry” and that “platooning is a first step towards more autonomous driving”. However, T2 clarified that they will only use autonomous trucks if the “driver always stays in charge of the situation since we deal with hazardous goods”. T5 is more sceptical about autonomous driving and stated that “for me currently, it is unimaginable how autonomous driving should work”.

The clear majority of developers agree that the technology is already advanced enough to enable lower levels of automation, however, D2 points out that most examples of successful test phases of fully autonomous driving in media are only applicable and executed under very special circumstances. D3 corresponds with that statement and mentions that “[under those special circumstances] we can go for full automation”. Additionally, D3 explained that: “we are working together with other companies to develop autonomous driving”. Interviewees from transport companies also mentioned collaboration with OEMs in the development of autonomous trucks. For example, T2 stated “I took part in several workshops, where OEMs and truck purchasers discussed about this topic” and T4 mentioned that “OEMs ask us for feedback”. T3 published a study about how they could use autonomous vehicles in the future.

4.1.2. Barriers and Challenges

When asking for barriers with autonomous driving, B1 stated, that “technical issues are the smallest barrier for autonomous driving”. B2’s statement regarding technological barriers was similar. However, current infrastructure was identified as a barrier by all participants. D2 explained that “infrastructure has to be built to fully utilize the advantages of autonomous driving”. O1 is convinced, that there is a need for updating current infrastructure, thus, “high investments are necessary”. T3 is certain that investments into infrastructure will “help to speed up the implementation process” of autonomous trucks.

Most interview partners raised the topic of ethical and social issues associated with autonomous driving. C1 explained that “people might lose their job because of this new technology”. B2 stated: “social acceptance is a barrier to autonomous trucks”. T3 saw
“ethical issues [as] one barrier” out of many. T4 is also aware of ethical and social barriers towards this topic.

B1 and B2 identified political resistance and current legislature as a main barrier for autonomous driving. B1 stated: “the biggest challenge to implement autonomous driving is legislature”. B2 sees “political resistance towards new concepts in transport are the main reason why the development is slow”. B2 thinks that transport companies “do not engage enough in lobbying activities or public relations” to change the situation. The other case groups generally agree on legislature being a major barrier. T1 is certain that “development of autonomous trucks will be greatly influenced by legislature”. T4 went so far as to say that “legislative changes will take more time than technological development”.

Many participants mentioned removing the driver as a challenge which would become reality if level 5 autonomous driving was available. C1 is concerned about communication with autonomous trucks, C1 said: “currently, drivers are absolutely necessary for communication”. C1 also explained that especially for international transports, the drivers are responsible for document management and communication with agencies during the trip. T5, whose company is transporting freight across borders, also identified document management as a barrier for fully autonomous trucks. O2, an expert for warehouses, mentioned that “for some products, drivers are responsible for custom seals in addition to regular documents”. Adding to that, C2 mentioned that fully autonomous trucks “would remove a direct contact person. If any issues would arise, the process of solving them would be more complex”. C4 also confirmed this concern. C2 suggested that, “digitalisation is needed to do the necessary paperwork without any human interaction”.

Right now, “the drivers are always responsible for their trucks” as described by T2. When it comes to load securing, especially with hazardous goods, the driver is in charge. Talking about a similar issue, T3 stated: “some services are not feasible without humans”. This barrier is also confirmed by other case-groups. C2 stated that, “truck drivers are responsible for load securing” and that their “loading and unloading areas look different every day”, C3 was very clear about that this is “a big barrier for autonomous driving”. D2 raised a concern about: “Who is responsible in case of an accident?”

Additionally, there is a significant concern for companies who would want to invest in autonomous trucks. T2 supposed that “autonomous trucks might be expensive at first” and that this “might stop some companies from buying them”. T5 expects that autonomous trucks
will cost “30-40% more than conventional trucks”. T3 agreed on this issue but pointed out that, “purchase costs [...] will be high initially, but will decrease over time”.

### 4.1.3. Advantages and Opportunities

Two main advantages of lower transportation costs and higher road safety are mentioned that are related to autonomous driving. C3 projected that “autonomous trucks could be bigger than current trucks” because safety would be no longer a reason for legislation to limit the size of trucks. Cost is a major factor when companies decide on their future investments. D1 said that truck purchasers “primarily look at ‘how much money can I make if I buy this truck instead of the other?’”. B2 stated that “the biggest advantage of autonomous trucks is a decrease in costs”. C1, O1, O2, D2 and D3 referred to similar statements. T1 explained that “reliability [...] will be positively impacted”, T3 stated: “personnel costs will decrease” and T5 mentioned autonomous driving as “a possibility to decrease the time trucks are not moving”.

Furthermore, B2 stated: “the amount of accidents caused by trucks will decrease drastically”. Experts with a customer’s perspective also mentioned safety. C2 explained that “if all trucks would be able to communicate with each other, safety would increase”. C4 pointed out that there would be no more “human mistakes” and thus, “higher safety will be one of the biggest advantages of autonomous driving”. Developers made similar statements about safety. D1 pointed out safety as their primary “purpose” for the development of autonomous trucks. D4 stated that “it will help all road users because safety will be increased”. While T2 and T5 mentioned safety in a similar context, T4 pointed out that “overall accident rates will drastically decline”.

Additionally, lower fuel consumption has been mentioned by many of our interview partners as a benefit. B1 stated: “autonomous driving will greatly decrease fuel consumption due to platooning and more efficient driving”. Moreover, T5 described the possibility to “decrease rest times and increase the amount of time their trucks are actually driving” as “main advantage of autonomous driving”. Because of this, customers expect to benefit from short delivery times. C1 and D2 expect that “delivery times will be shorter”. Another opportunity stated by T4 is that “autonomous trucks could be a solution to the current lack of drivers”. Others are also confident in lower levels of automation having a positive effect on this topic. They believe that the possibility to decrease downtimes and rest periods along with other opportunities as described above will help to decrease the need for drivers.
Regarding the innovativeness within logistics, all experts from transport companies interviewed in this study are motivated to adapt quickly to new innovations. Each interviewee stated similar quotes to highlight the importance of innovation (Table 6). T5 is convinced that “if you don’t go along with innovation you are not able to work internationally”. Developers mentioned it as being a major aim - D1 stated: “We want to be the first who introduce new technology to trucks. So far, we always have been!”

Concerning technological development for trucks, B2 explained that “there has been no major change”, since “gigaliners or platooning” are not yet implemented. While D1 pointed out that “the emergency brake system” is one of the most important innovations in this regard. The interviewee claimed that “every new truck is equipped with this system” due to legal requirements. B1 mentioned “legislation can put pressure on companies to use new technologies”. T5 holds a similar viewpoint and highlights “new emission classes for trucks” as an example.

### Table 6: Findings from Interviews - Innovation and Megatrends

<table>
<thead>
<tr>
<th>Group</th>
<th>Innovativeness of transport companies</th>
<th>Other megatrends</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>We attempt to stay as up to date and innovative as possible, when it comes to technological development – T2</td>
<td>Globalisation is still happening and will influence the future of the transport industry and leads to more transport – T1</td>
</tr>
<tr>
<td></td>
<td>We put enormous efforts into being innovative. We don’t just follow current trends, but also try to develop our own innovations – T4</td>
<td>Demographic change is a reason why there is a lack of drivers – T1</td>
</tr>
<tr>
<td>C</td>
<td>One criteria for selection of transport partners is how open they are towards innovation – C4</td>
<td>Digitalisation can be used to ensure transparency – C4</td>
</tr>
<tr>
<td></td>
<td>Innovations are introduced very fast in our company. We need to adapt to customers' demands as quickly as possible – D2</td>
<td>More and more data is available and could be used to analyse and improve existing processes – C3</td>
</tr>
<tr>
<td>D</td>
<td>I am very sceptical towards innovativeness of logistics or transport companies”, “transport or logistics companies usually just […] implement innovations developed by others – B2</td>
<td>Connectivity will help to improve disposition, planning and scheduling of trucks – D1</td>
</tr>
<tr>
<td></td>
<td>Autonomous trucks are only a small part of the puzzle - B2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connectivity is a major trend that will have a big impact on transportation. Connectivity platforms will connect everything! – B1</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Order picking with drones could be an upcoming trend – O2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental and sustainable solutions will become more important for logistics – O1</td>
<td></td>
</tr>
</tbody>
</table>
Additionally, mega trends such as connectivity, digitalisation, networking, globalisation, demographic change, environmental solutions and next day delivery or short delivery times were mentioned during the interviews (Table 6). Participants mentioned that connectivity between participants of road traffic is important to ensure that autonomous trucks work properly. D1 stated that it will also help to improve “planning and scheduling of trucks”. Moreover, according to C4, “digitalisation can be used to ensure transparency”. Lastly, T1 explained that in relation to transport “demographic change is a reason why there is a lack of drivers”. C4 and T3 mentioned that there is a trend towards shorter delivery times as well as more precise timeframes for delivery.

4.2. Resources and capabilities of logistics service providers

Our interviews incorporated questions on resources and capabilities of logistics service providers and how they will be influenced by self-driving trucks in future. While there were many different opinions, we tried to summarise and display the most important findings in Table 7. The main resources and capabilities mentioned were price and quality, add-on services, relationships and specialisation, driver’s qualification, location and size as well as IT and management capabilities.

Our interview partners agreed that offering competitive prices is “one of the main selection criteria for transportation partners” (C4). The other experts from the customer case group mentioned something similar. However, C4 emphasized that quality is a prerequisite and all other selection criteria is only relevant if quality is given. C3 also expects their partners to have a good transport quality, because some “products can be easily damaged if not handled correctly”.

Experts from the transport companies focused more on quality “price is not everything!” (T2). According to our interview partners, there is a trend towards better services - T3 stated: “in recent years the customer landscape has changed. Customers demand faster delivery and better service”. Experts stated that criteria like reliability, timeliness and prices are influenced by the driver. However, regarding a future scenario with autonomous trucks, “timeliness and reliability will be ensured by autonomous trucks and the price factor is the only criterion left” (T2). Furthermore, T3 explained: “currently, our customers focus on the price of our service. In the future, there might be a demand for special services instead of solely focusing on price”. Other transport companies focus heavily on additional services, T4 explained that they “offer complex value-added services, which requires a lot of know-how, and cannot be easily copied by other companies”.
Regarding capabilities, our interview partners mentioned relationships as an important factor, i.e. the ability to build close and strong partnerships. C2 indicated that a good relationship with a transport company allows them to “solve any issues directly with this company”. Here, “trust” (C2) between the company, the transport partners, employees and drivers is an important factor. Participants of the transport case group also mentioned trust, for example for T1’s drivers are usually only driving for a few customers to enhance trust between customers and drivers. Other interviewees mentioned the high requirements of customers. T5 stated: “We adapt individually to our customers. We either buy special trailers for their products or build them by ourselves”.

The driver was mentioned as an important resource for transport companies by almost all experts. In this context, the driver’s communication skills, qualification, ad-hoc maintenance ability, loading and unloading skills and document management are mentioned as additional skills, which are of value for both customers and logistics service providers. Some experts from the transport case group explained that the driver’s education is of high importance. For example, T2’s approach is they “offer an e-learning solution for [their] drivers” and they pay attention to adapt their drivers’ education in relation to their drivers’ age. As current challenge C2 stated that communication with drivers in the export section can be “really difficult because of the language barrier”.

Our interview partners shared different opinions on how the position of drivers will change once autonomous trucks are commonly used. D2 pointed out that “the human factor will be less important” in future. D3 expects the “actual driving skill [to] be [less] important if autonomous trucks are used”. B2 shared a similar perception: “requirements for drivers will decrease” once autonomous trucks are in place. However, B2 also stated that “higher qualifications are needed for people who are responsible for configuring these systems”. T1 is certain that “humans will remain important within transport” and that “a driver will [never] be fully replaceable”. T2 explains two scenarios in this regard, where the drivers are either “very well trained” and take over other tasks or “almost not trained at all”. The opinion of C4 was similar to this statement.

Many participants also mentioned location as crucial criteria for success. For example, T2 stated: “We operate from a single location for each truck. A truck will leave one location in the morning and will return to this location in the evening”. Regarding future scenarios, T1 suggested that “hubs could be close to the highway”, so that autonomous trucks can drive without human intervention from A to B. Furthermore, the size of the truck fleet was
mentioned by several experts. D1 stated: “Especially big fleets are able to optimize their utilization through better digital networks”. The customer case group highlighted this to be an important criterion. C2 stated that they “do not consider very small transportation firms as partners”.

IT and management capabilities are other important factors mentioned in our interviews. T3 specifically points out that “IT knowledge is absolutely necessary [and] whoever already has good IT knowledge right now has an advantage in the future”. According to C2, “technical reliability is going to become an important factor for autonomous trucks”. Already today, customers require their transport partners to use state-of-the-art-technology. For C3, it is important that their customers use modern trucks. They also “expect [their] transport partners to fulfil a certain degree of sustainability efforts”. These requirements are part of a whole catalogue of requirements which C3’s company uses for its partners.

In fact, almost all the transport companies we have interviewed stated that they make use of modern trucks. T4 described their truck fleet as very modern: “all our trucks are very young. Regarding driver assistance systems, etc., we use the newest technology available”. Our interview partners expect that supply chains in the future will be closely connected. D2 expects the ability to deliver goods just-in-time and just-in-sequence to become more important. According to D2, “self-driving trucks will [lead to] more just-in-time solutions” and shorter delivery times will be demanded by customers. D3 also explains that a more precise prognosis for the expected time of arrival of trucks will be important to customers. In C4’s opinion, “transparency is already important [today] and it will become even more important”. Another important ability of transportation firms is their innovativeness. In T4’s opinion, it is important for a company to have the ability to react fast to upcoming changes and innovations. T4 pointed out that they “have a systematic approach to handle innovation”. They are already implementing an innovative logistics service which they have developed on their own. Even today, this capability is appreciated by some customers. C4’s employer uses innovativeness as a criterion to evaluate their transport partners.
<table>
<thead>
<tr>
<th>Group</th>
<th>Price and quality</th>
<th>Value added services</th>
<th>Relationships and specialisation</th>
<th>Driver qualification</th>
<th>Location and size</th>
<th>IT and management capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T</strong></td>
<td>Price is not everything! – <strong>T1</strong></td>
<td>We offer additional services on top of transportation – <strong>T1</strong></td>
<td>We usually have a strong relationship with our customers and do a lot of business with them – <strong>T1</strong></td>
<td>The quality of our drivers is very important – <strong>T1</strong></td>
<td>Because of our regional central location, we have a competitive advantage. – <strong>T1</strong></td>
<td>One of our strengths is the ability to react fast to upcoming changes and innovations – <strong>T4</strong></td>
</tr>
<tr>
<td></td>
<td>In future, timeliness and reliability will be ensured by autonomous trucks and the price is the only criterion left – <strong>T2</strong></td>
<td>We offer complex value-added services, which require a lot of know-how, and cannot be copied easily by other companies. – <strong>T5</strong></td>
<td>We adapt individually to our customers. We either buy special trailers for their products or build them by ourselves – <strong>T5</strong></td>
<td>We are the competitor with the highest standards in driver training – <strong>T2</strong></td>
<td>We focus on a specific region and have multiple locations within that region to deliver mineral oil to our customers – <strong>T2</strong></td>
<td>IT knowledge is necessary; The ones who already have good IT knowledge will have an advantage in the future – <strong>T3</strong></td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Because transport companies will become more alike, price will be a more important factor to us than it is right now – <strong>C2</strong></td>
<td>The most important criteria for the trucks of our transportation partners are cargo securing criteria – <strong>C2</strong></td>
<td>Trust between our company, and transport partner as well as our employees and their drivers is an important criterion for us – <strong>C2</strong></td>
<td>We require our transport partners’ drivers to have some communication skills – <strong>C1</strong></td>
<td>We do not consider very small transportation firms as partners – <strong>C2</strong></td>
<td>IT know-how is a key skill needed to do well in the future transport industry – <strong>C1</strong></td>
</tr>
<tr>
<td></td>
<td>Quality is a prerequisite! – <strong>C4</strong></td>
<td>Companies can only evade this price pressure if they are able to offer special services – <strong>C3</strong></td>
<td>Specialists in transportation are used if they can offer something unique. – <strong>C4</strong></td>
<td>Drivers [...] support our local staff in unloading and loading of their trucks – <strong>C2</strong></td>
<td>We are bundling our transportation activities. Larger transporters have an advantage – <strong>C4</strong></td>
<td>We want our transport partners to use modern trucks – <strong>C3</strong></td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Autonomous driving technology helps to make the trucks more efficient and helps to enable a lower fuel consumption by optimising driving behaviour - <strong>D1</strong></td>
<td>If we can use driverless trucks, it is likely that we will offer more services to our customers than just providing the vehicles. – <strong>D3</strong></td>
<td>The human factor will be less important – <strong>D2</strong></td>
<td>Actual driving skills will be less important if autonomous trucks are used – <strong>D3</strong></td>
<td>Large fleets are able to optimize their utilization – <strong>D1</strong></td>
<td>Self-driving trucks will [lead to] more just-in-time solutions – <strong>D2</strong></td>
</tr>
<tr>
<td></td>
<td>Currently, small transport companies are able to compete because they can offer very low prices – <strong>B1</strong></td>
<td>Fleet management will become important. For example, coordinating platoon formations – <strong>B1</strong></td>
<td>Requirements for drivers will decrease – <strong>B2</strong></td>
<td>Companies with a larger fleet will have an advantage to use autonomous trucks – <strong>B1</strong></td>
<td>IT knowledge is important due to technological implications of autonomous trucks– <strong>B1</strong></td>
<td>A more precise expected time of arrival [...] will be important – <strong>D3</strong></td>
</tr>
<tr>
<td><strong>O</strong></td>
<td>Costs will decrease with autonomous trucks. But it will take time until the initial investment is amortized – <strong>O1</strong></td>
<td>We transport goods which are usually not transported by trucks. At some point in the supply chain, there might be specialized trucks transporting the goods. – <strong>O1</strong></td>
<td></td>
<td></td>
<td>We suggest using an IT-solution as an interface between customer and transport company – <strong>O2</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Findings from Interviews - Competencies
4.3. Implication for logistics service providers

As last section, we were asking our interviewees questions about future scenarios and how self-driving trucks will impact current logistics service providers. Table 8 provides an overview of the most important quotes.

During the interview, all case groups mentioned that it will affect a logistics service provider depending on their size. Most participants noted that small companies will “struggle to survive” (D2) and “will vanish in long-term” (B2). According to B1, this means that “small or medium sized transport companies need to find niche segments” to stay in the market. Reasons mentioned by several interview partners were that large companies can benefit from “optimisation” (B1), can operate at “lower costs” (B2), “margins in logistics will decline even further” (T4) and transport companies need to be able to “afford the initial investment” (C2). C4 pointed out that a transport company with “around 50 employees” will be able to survive in this new competitive field with autonomous trucks. Additionally, B1 stated that larger transport companies will be the driver for innovation (see Table 8) and others will follow. From a follow-up question in our semi-structured interview, B2 elaborated that freight forwarding might be replaced by automated processes in future. However, 4PLs and 5PLs will remain relevant because customers need assistance in selecting the right partners.

When asking our interviewees about an outlook of what will happen once autonomous driving is in place, most participants mentioned the emergence of new services. For example, B1 suggested that there could be additional service providers responsible for maintenance services, platform services and platooning service providers. Other participants mentioned “loading and unloading” (B2), “document management” (B2), “break-down services” (B2), “hazardous freight handling” (B2), “IT services” (D1) and “cloud services” (D3). D3 went as far as saying that they could earn more money by selling those services than selling the actual truck. Most experts stated, “value-adding services” as source of “competitive advantages”.

Currently, drivers are perceived as important resource for transport companies by all our interviewees. Thus, we were asking our participants about possible impacts on the driver’s job. There were different opinions on future scenarios for drivers. For example, B2 believes that driving times will increase and stated: “truck drivers will spend even more time on the road. The job will become even less attractive” and that for level 5 “there is no reason for drivers to travel along with autonomous trucks” only to fulfil minor tasks. Other participants
pointed out that “there are services which are not easily replaceable by autonomous trucks” (T1). According to C4, this leads to two possible developments, either driver qualification will increase and they are responsible for additional, more specialised services or driver qualification will decrease.

<table>
<thead>
<tr>
<th>Group</th>
<th>Large vs. small companies</th>
<th>Service orientation and new service providers</th>
<th>Role of drivers in the future</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Margins in logistics will decline even further – T4</td>
<td>Our value-added services are the source of our competitive advantage – T4</td>
<td>There are services which are not easily replaceable by autonomous trucks – T1</td>
</tr>
<tr>
<td></td>
<td>Transport companies need to be large enough to afford the initial investment – C2</td>
<td>Services will be more differentiated between competitor – T3</td>
<td>In future, drivers will either be required to have very high qualifications or very low – T2</td>
</tr>
<tr>
<td>C</td>
<td>Smaller transport companies will struggle to survive – D2</td>
<td>Transport companies will become increasingly like each other because of autonomous driving and only the companies who are able to offer additional services will have a competitive advantage – C3</td>
<td>There are two possibilities, either driver qualification will increase and drivers will take care of additional tasks or driver qualification will decrease and drivers will just drive along – C4</td>
</tr>
<tr>
<td>D</td>
<td>Larger [transport] companies will push and use this technology. Small companies won’t be able to do so – B2</td>
<td>Companies with an IT background might enter the transport market and offer IT services – D1</td>
<td>It is questionable, whether drivers can be replaced. Some activities [...] cannot be done by the truck itself – D2</td>
</tr>
<tr>
<td></td>
<td>Small or medium sized transport companies need to find niche segments – B1</td>
<td>We work together with communication companies to develop new (cloud) services for our trucks – D3</td>
<td>If drivers are still necessary, they could take over other jobs while driving – D3</td>
</tr>
<tr>
<td>O</td>
<td>Small transport firms could vanish – O2</td>
<td>The division of labour will increase because of lower transport costs – B2</td>
<td>Special service providers could take over loading and unloading. There is no reason for a driver to travel along with an autonomous truck, only to do those kinds of tasks. – B2</td>
</tr>
<tr>
<td></td>
<td>I think specialised transportation companies will profit from this development. – O2</td>
<td>Special service providers could take over loading and unloading. There is no reason for a driver to travel along with an autonomous truck, only to do those kinds of tasks. – B2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Warehouse employees could be enabled to steer autonomous trucks on their company grounds to solve some of the issues emerging when there is no more driver – O2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Findings from Interviews - Implications

We inquired about the participants’ opinion on current media headlines of IT giants like Google, Uber and Apple indicating interest in the development of autonomous driving. Most interviewees stated that they do not believe that this will change the competitive landscape for developers nor for logistics companies. Reasons given were that these companies “are not
experts in building cars or trucks” (D1) and “large companies like Amazon usually don’t transport on their own, they hire [large transport companies] or subcontractors instead” (T5). While T3 and T4, highlighted “their IT knowledge” as potential disruptor of the competitive landscape, if these companies “start building their own fleet” (T4).

Another question in our interviews addressed the scenario of customers of transport companies operating their own fleet with autonomous trucks in the future. However, all interviewees indicated that although that could be an option, they do not believe that it will eliminate logistics service providers. For example, C1 argued that they “could not provide the same services for the same cost as transport companies do”, while C2, suggested that it would be a good decision to own some trucks to increase flexibility in addition to subcontractors.

We could gather relevant insights with multiple perspectives from different experts and companies. The presented findings above are only an extract of the information collected from the interviews to enable an easier comprehension for the reader. The presented data will help to interpret current trends, identify common themes as well as perceptions and draw conclusions for our research questions. This will be done in the analysis part based on established codes to manage the data as described in our methodology part (Saunders et al., 2016). During the analysis, some statements which have not been described in detail might be picked up. If this occurs, quotes and explanations are given ad hoc.

4.4. Additional Findings

Additional to the findings from our interviews, we observed carefully the way things were said by our participants. Working as a team helped us to focus on emotions and verify the validity of the statements given. By having only one team member responsible for interview questions, the other member could make notes on what has been said and observe underlying hints towards the certainty of the spoken words. During the transcription of the interviews, we listened to the recordings multiple times, which gave us the opportunity to revise and confirm our notes.

To obtain findings for our observation of the interview process we assigned different connotations, i.e. positive, negative or neutral. For example, one of our interview partner said, “I am not sure whether it’s easier for autonomous trucks to operate on highways or on smaller roads” (C3). The statement “not sure” and the underlying emphasis and pronunciation indicated a negative connotation. This information helps us to give meaning to
the statements and analyse whether experts stated their opinion clearly and in a confident manner.

We found out that none of our interviewees had a negative perception towards autonomous driving being an upcoming trend that will enter the market in the future. However, some participants were not sure about when and how it will happen. Most interview partners were rather positive towards safety, since they expected human errors to decrease and overall road safety to increase with self-driving trucks. Yet, some interview partners indicated scepticism towards the current reliability of the technology. These where either developers and consultants who raised concerns towards the influence of unexpected factors, such as weather conditions or hacking or transport companies and customers who dealt with hazardous or fragile goods. Additionally, we discovered that almost all experts were certain that autonomous driving will decrease the cost of transportation. In general, all experts were certain that the industry will change with the implementation of self-driving trucks.

Our findings towards perception and knowledge about the topic of autonomous driving were in accordance with the information given by media, trend reports and consulting papers. These findings were summarised in our frame of references and can be used together with the data presented in this chapter to derive conclusions in the following chapters.
5. Analysis and Interpretation

In this chapter, we use the thematic approach, as outlined in the methodology section of this thesis, to analyse our findings. By discussing findings from our interviews with regard to findings derived from observations, secondary literature and theory introduced in the frame of reference, we pave the way to answer the research questions of this thesis.

As outlined in the methodology section, the main themes of our thematic analysis are based on research questions. Thus, this section is divided according to our research questions to analyse the gathered data. For each research question, a detailed illustration of the hierarchical structure of themes is presented. The hierarchies include three levels, a main theme, relevant subthemes and a third level of themes, which are assigned to the subthemes.

For clarity reasons, illustrations in this chapter will only include the first two levels. In Appendix 3 a detailed example including all levels is attached. We proceed with describing and interpreting the result of our analysis for each individual subtheme.

5.1. Differences in definition and impact of megatrends

In order to answer our research question about the perception of self-driving in logistics, we analyse how participants perceive each subtheme which is associated to the theme *Perception of self-driving trucks*. The hierarchy of this main theme is illustrated in Figure 10.

![Figure 10: Themes - Perception of self-driving trucks](image)

The subthemes presented in Figure 10 are connected to research questions I a), b) and c). Additionally, a fourth subtheme, “*Autonomous Driving*” is included in this section, because it
contains information relevant to research question I which are not covered by the other subthemes.

5.1.1. Innovation & Megatrends

Our thematic analysis (see Appendix 4) showed that all interview partners connect other megatrends with the development and implementation of autonomous trucks. Some trends fuel the development of autonomous trucks, while other trends need to advance for autonomous driving to be implemented. Demographic change is a trend, which currently challenges the transport sector. Truck driving as a job is becoming less attractive for potential employees. Especially the younger generation is not interested in truck driver positions anymore, which creates a lack of drivers for transport companies. This development puts pressure on transport companies to find new solutions. Self-driving trucks could be the solution to this issue.

Connectivity and digitalisation is needed for autonomous driving to be feasible on a large scale. If trucks are not connected with each other and information (e.g. transport documents) is not digitally available, self-driving trucks cannot yield the expected improvements and savings. Our participants see autonomous trucks as part of many innovations, which will enter the market within the next decade. B2 accurately described this by stating “Autonomous trucks are only a small part of the puzzle” (B2).

Interesting insights can be drawn from our empirical findings regarding the innovativeness of logistics firms. Our data revealed that transport firms perceive themselves as innovative and state-of-art. Yet, comparing this to perceptions of consultants and customers, innovativeness within logistics was seen with scepticism. Nonetheless, customers demanded innovative logistics partners. This indicates the importance of innovation for this sector. We found out that although it was demanded by customers, transport firms only adopted to existing innovation developed by others. T4’s employer is an exception within their case group as they “do not just follow current trends, but also try to develop [their] own innovations” (T4). This is in line with results of other research studies conducted by consultancies or companies within the logistics sector. A study conducted by Garner (2016) describes logistics companies as early or late majority adopters, representing later innovation acceptance groups. These groups tend to adapt to new technology after a varying degree of time and after the average members of society. From a customer perspective, innovativeness is the main shortcoming of logistics companies according to Garner (2016; 2017).
It can be concluded that transport companies are open toward innovation but are not drivers of innovation. Our analysis has shown that logistic companies tend to follow trends rather than to develop their own innovations. This is especially important since other trends are directly or indirectly intertwined with the development of autonomous trucks.

5.1.2. Barriers

Different barriers to autonomous trucks were mentioned during interviews with our participants (see Appendix 5). According to our analysis, the main barriers, which were identified, are: political, legislative, ethical and social issues and issues, which are expected if drivers are to be completely replaced (level 5).

Our participants believe that current legislature does not allow autonomous driving and it is necessary to ease regulations for further development of this innovation. Our data suggests that although transport companies are the ones who will be using this new technology in future, they are not fully engaged in promoting it. B2 points out, that transport companies “do not engage enough in lobbying activities or public relations” to change the situation. In contrast, OEMs are the ones engaged in those activities. It can be concluded, that it is unclear how to deal with the responsibility of political lobbying to push autonomous driving.

Another issue is the handling of accidents. There is currently no concept which solves the question of who to blame in case of an accident with a self-driving truck involved. As long as these barriers are in place, society and government will remain sceptical towards this innovation, which determines the acceptance of customers.

Removing drivers completely was another concern raised by our interview partners. Although perceptions of self-driving trucks indicate that major cost savings can be achieved, customers and transport companies are certain that this would lead to additional issues. Many activities currently done by drivers cannot easily be replaced in the current setup. Even if all other barriers are removed, companies need to develop solutions for activities like loading or document management, before drivers could be removed completely.

In addition, there are some smaller barriers which we could identify. Infrastructure needs to be adapted to autonomous trucks. Since a well-developed infrastructure mainly prevails in highly developed countries or regions, these geographical areas will be the first to allow self-driving trucks on the roads. Another factor is potential investment costs. Some transporters were concerned with having to face high investment and purchasing costs of autonomous
trucks and their maintenance service. This could also represent a major concern for smaller transport firms, which might lack the necessary capital.

Technical barriers represent the final point, identified as a barrier within our study. Although technological barriers were expected to be mentioned, most of our interview partners either did not comment on it or explicitly stated that technology would not limit this development. Yet, OEMs did point out that there are certain gaps and issues, which need to be solved to use autonomous driving under any circumstances and weather conditions.

Our results are coherent with findings from the available literature outlined in Chapter 2.1.2. However, it should be noted that prevailing research identified technological barriers as more inhibiting than results from our own research. This might have been influenced by the media attention autonomous driving is currently receiving, due to tests with platoons and autonomous trucks. Furthermore, we found out that the mentioned classification of autonomous driving in the media does not conform with the existing classification defined by experts (level 0-5 by SAE International). This influences user acceptance but also manipulates user understanding of the topic. Currently, the most prominent barriers based on our analysis are legislative and political as well as ethical and social issues. Participants of our study were confident that issues related to technology and infrastructure can be solved in the near future.

5.1.3. Opportunities

The implementation of self-driving trucks is seen as very beneficial for logisticians. Several different opportunities can be identified on the basis of our interviews (Appendix 6). Expected benefits are: decreasing transport costs, higher safety, efficient use of resources, tackling the lack of drivers and an overall more efficient service performance.

Based on the results of our interviews, it becomes clear that autonomous driving will have an immense impact on the transport costs of the companies. The removal of the driver or even just the more efficient use of them represents the most prominent reason within this theme. However, also additional opportunities which autonomous driving offers, such as a potential to increase the truck size can arise with the implementation of autonomous trucks. This could not only benefit transport companies, by lower their operating costs but also help customers to get the best quality/price ratio. However, cutting costs and price represents a two-sided outcome of autonomous driving. Although it is beneficial for companies and customers alike, it could further fuel the price competition within the market.
Another central category is the expected increase in safety. Our study indicated that people associated accidents with human error. Thus, it is assumed that an increase in safety can be achieved by eliminating the human factor. Another important finding was that compliance of truck drivers with specifications were not always met, for example several cases were mentioned where the truck drivers used their private laptops to watch movies while driving or did not rest enough which caused fatigue. Decreasing the dependency on the human factor and increasing the automation levels can help to decrease accidents caused by human errors. These factors could also represent important arguments for lobbyists, since political and governmental institutions such as the European Union are interested in decreasing accidents on the roads. It might also explain why most project papers such as SATRE or PROMETHEUS mentioned in chapter 2.1.3 concern this topic and push the trend of autonomous driving. While participants see the removal of human factors as a crucial factor for improved road safety, increased connectivity between vehicles on the road as well as automated decision-making are underlying were underlying reasons mentioned.

Furthermore, autonomous driving leads to a more efficient use of resources. Our interviews revealed that better performance and fuel consumption is expected. Driving behaviour of the truck can be improved and adapted to achieve a more economic fuel consumption. This will help to decrease transport companies’ expenditure but also prolong the life of trucks and additionally decrease the environmental footprint. Decreasing CO2 emissions is another important finding which correlates with topics discussed in project papers. Moreover, lower accident rates and better connectivity can help to decrease road congestion. This is in line with findings from trend reports, project papers and consultancy reports.

Within this theme, it was also mentioned that trucks can be used in a more efficient way which could lead to an improved service performance. Driver break times would not limit the active driving times of trucks anymore. This means that the trucks could drive longer and eventually also increase the distance covered within a day. As a result, delivery times decrease and better lead times could be achieved for the customer.

The transport sector is confronted with a lack of drivers, it was pointed out that autonomous driving could be a solution to this issue. Even with level three automation current drivers can be used more efficiently due to lower stress levels and break times. Thus, fewer drivers are needed to perform the same tasks. On long-term level five automation aims at removing the drivers completely, thus, the issue for the transport sector would be removed.
The results of this analysis are mostly in line with the opportunities presented in chapter 2.1.2. Cost decreases, safety increases, more efficient use of different resources and countermeasures to driver shortage were listed. Current research additionally lists a positive impact on environmental performance of companies using autonomous trucks. While fuel efficiency was pointed out multiple times by our participants, environmental performance did not seem to be their top priority.

5.1.4. Autonomous driving

Our analysis revealed noteworthy differences in the perception of autonomous driving (see Appendix 7). This concerned on one hand, the definition of autonomous trucks and on the other, how experts expect the implementation of autonomous trucks to take place.

Our study accentuates that there are different definitions of autonomous driving; more specifically experts had varying understandings of the range in which trucks are classified as autonomous. Transporters, developers and consultants were aware of the standard set by SAE, which includes different levels of autonomous driving. Whereas, customers defined autonomous driving as driverless driving, i.e. level five automation. Yet, in comparison to other customers, C4 was aware of multiple levels of autonomous driving. An explanation for this could be that C4’s works for a large supplier of the automotive industry. The closeness to developers could enable an awareness of the levels of autonomous driving. While transport companies and developers either develop, or will use autonomous trucks, customers do not necessarily have the expertise the field. They are exposed to headlines and statements in the media. Information from the media are newspaper articles about platooning or about successful test rides, as described in our introduction chapter. Also, information presented on automobile manufacturers’ websites help to inform customers. However, here a clear definition of autonomous driving is sometimes neglected, which leads to wrong perceptions. For example, trend reports indicate that autonomous driving will enter the market in 2020-2035, yet, it is barely highlighted in the reports that this only concerns level three automation (McKinsey&Company, 2016a; BI Intelligence, 2016; DHL, 2016; Stoll, 2016).

However, it was interesting to see that all interview partners were aware of the trend towards autonomous driving. There was little doubt that self-driving trucks will eventually enter the market. Opinions mainly differed on when this will happen, but not if it will happen. Our analysis showed that our participants expect autonomous driving to develop step-by-step. This is in line with the classification into different levels of automation. Similar results were found in trend reports. It is expected that autonomous driving will be implemented according
to the different level of SAE as time passes (Roland Berger, 2016). It can be expected that completely driverless trucks still need some time to develop and enter the market. Yet, as soon as companies start using autonomous driving technology, other companies will follow and this will promote the development of higher automation stages. C4 compared this implementation to the introduction of flat screen TVs. It is only a matter of time until old technology is replaced by a new one and used by everyone.

To summarise the first part of our analysis, transporters and truck developers have a very clear picture of what autonomous driving is about and how it could be implemented. While lower levels of autonomous driving are expected to be available in near future, fully driverless trucks will not be used anytime soon. Yet, customers have a different understanding of the term autonomous driving. Furthermore, the development of the technology is driven by megatrends and developers themselves. Transport companies, however, are expecting to adapt to this technology once it is available. Logistics experts agree that other trends are connected to autonomous driving and that there are certain barriers as well as opportunities and advantages connected to autonomous driving. These are influenced by the prevailing mega trends the transport sector is facing.

5.2. Impact on firm’s resources and capabilities

To answer our research question about how logistics experts view current resources and capabilities of logistics service providers considering the introduction of self-driving trucks, the themes illustrated in Figure 11 are derived.

![Figure 11: Themes - Resources and capabilities](image-url)
As described by Wong and Karia (2010), resources can be categorized into different groups, physical (e.g. hubs or vehicles), informational (e.g. IT capability), human (e.g. number of skilled employees), knowledge (e.g. expertise and know-how) and relational resources (e.g. long term contracts with customers). Table 9 illustrates the coherence of topics mentioned and their resource category. For example, the ability to offer competitive prices and quality is not a resource or capability per se but a combination of knowledge and physical resources.

<table>
<thead>
<tr>
<th>Themes found in data</th>
<th>Relation to resource category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>Physical, Knowledge</td>
</tr>
<tr>
<td>Quality</td>
<td>Physical, Knowledge</td>
</tr>
<tr>
<td>Service orientation</td>
<td>Physical, Knowledge, Human</td>
</tr>
<tr>
<td>Relationship</td>
<td>Knowledge, Relational</td>
</tr>
<tr>
<td>Specialisation</td>
<td>Physical, Knowledge, Human, Relational</td>
</tr>
<tr>
<td>Drivers</td>
<td>Knowledge, Human</td>
</tr>
<tr>
<td>Location</td>
<td>Physical</td>
</tr>
<tr>
<td>Size</td>
<td>Physical</td>
</tr>
<tr>
<td>IT capabilities</td>
<td>Knowledge, Information</td>
</tr>
<tr>
<td>Management capabilities</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Technology</td>
<td>Physical</td>
</tr>
</tbody>
</table>

*Table 9: Resource category of themes derived from data*

Our analysis showed that the ability to offer competitive prices is important for transport companies. For customers, price is a main selection criterion for transport partners. However, this does not mean that customers compromise on quality aspects. Transport companies have to possess the resources and capabilities required to provide a certain level of quality to satisfy customer needs. The level of quality which is required is closely tied to the type of product. For some of our interviewees, quality is more important than price. Especially in T2’s case (hazardous goods), quality is the most important criterion. In general, it is expected that cost savings can be achieved due to the introduction of autonomous trucks. Hence, the ability to offer competitive prices in combination with high quality will become more important. A combination of physical and knowledge resources is necessary to fulfil this criterion. Suitable equipment, e.g. trucks, and the knowledge of how to use it is required.

Service orientation is another theme derived from our data. Customers expect their LSPs to provide a wider range of services. This is in line with the results of research conducted by Garner (2016; 2017). In Garner’s studies from 2016 and 2017, more than 75% of participants...
stated that it is at least “somewhat important” for LSPs to offer services to solve all their logistics needs. If a transport company is able to fulfil other logistics demands on top of transportation services, this company is more appealing to potential customers. If a company is able to obtain resources and capabilities to offer a special service, it can separate itself from its competitors. This development will be amplified by the implementation of autonomous trucks. Our data suggests that transport firms will become more alike. Thus, additional service offerings can be used by transport companies to differentiate themselves from their competitors. A combination of special equipment, knowledge and personnel are required to provide this kind of special service.

Services can be developed specifically for individual customers. The focus on relationships and specialisation represent another theme, which was derived from our data. Transport companies, who invest in resources and capabilities to specialize according to their customer needs create a basis for long-term relationships. The general ability to build close and strong relationships is something customers and transport companies strive for. This can be done by either working closely together for a long time. Some companies like T5, even customise their physical assets (trucks) to fit their customers’ needs. The relevance of this theme is validated by research papers. Garner’s study from 2016 shows that a mid- to long-term relation between transporter companies and their customers is pursued. In 2017, this was further emphasized (Garner, 2017). Thus, the conclusion can be drawn that relational resources are a significant factor which need to be considered even if autonomous trucks are in place.

Our data gives strong evidence, that truck drivers are currently valuable for transport companies. Skilled drivers contribute to the success of a companies’ performance. Hence, companies who have good drivers are cautious about discussing the possible devaluation of drivers with implementation of autonomous trucks. The current lack of drivers represents a challenge for the whole transport sector. However, it can be assumed that this is a special concern for industrialised and highly-developed countries like Germany and Sweden. T5 mentioned that, for example in Poland, enough truck drivers are available, since the job is comparatively well paid, whereas, companies in Germany and Sweden try to counteract by offering superior education to their drivers and thereby, being more appealing to potential jobseekers. After the implementation of autonomous trucks, two opposing developments can be predicted based on our data. The actual driving activities will become less important. Therefore, drivers will either be expected to have higher qualifications to perform new administrative tasks or they will only be responsible for minor tasks (e.g. monitoring of the
autonomous truck). Research conducted by Roland Berger (2016) indicates that drivers remain important and autonomous trucks will increase the attractiveness of the driver position. Autonomous trucks will increase driver comfort and optimize rest periods (Roland Berger, 2016). Human and knowledge resources are components of this theme.

Location and size of transport companies were summarized as additional themes within our data. Smaller transport companies can build strong, regional expertise and relationships based on their location. In contrast, bigger companies use their size to cover a large geographical area. Currently, large truck fleets are less flexible than small fleets. Therefore, large transport companies subcontract smaller transport firms. Once autonomous trucks are available, large truck fleets can increase their flexibility and benefit from enormous savings, due to platooning and connectivity within a company’s own fleet. Current reports emphasize the advantages of large fleets of autonomous trucks in a similar way (Roland Berger, 2016). Flexibility, which currently is a main advantage of smaller transport companies, can be offered by autonomous fleets due to their increase capacity and efficiency. Location and size of transport companies are part of their physical resources.

Finally, IT and management capabilities and technology are mentioned. Participants from transport companies within our sample emphasized the importance of state-of-the-art technology. Close collaborations between OEMs and different types of transport companies help to stay up-to-date with new developments. Customers expect innovative solutions from their LSPs. In Garner’s research from 2017, almost 60% of participants saw technology driven logistics companies as an opportunity to save money and increase efficiency (Garner, 2017). To use this kind of technology, IT and management capabilities are necessary. Based on our data, logistics experts expect these capabilities gain significance once autonomous trucks enter the market. Knowledge and information resources are necessary to build these competences.

To conclude, the participants of our study introduced different competences, which will be influenced by autonomous trucks. Competencies like the ability to offer competitive prices in combination with high quality are already important today and will remain relevant. Other competencies like driver quality might become less relevant, depending on how they are included in future processes. In contrast, fleet size of transport companies might play an important role to gain competitive advantages in the future. The third and final part of our analysis will focus on how the changes to the previously described competencies will impact competitive advantages of transport companies in future.
5.3. Future competitive advantages and further implications for logistics

To examine our third research question on how logistics services providers can build competitive advantages, once self-driving trucks are available, we use the VRIN framework as introduced in the frame of reference. Table 10 summarised the resources, which were identified to be affected by the implementation of self-driving trucks. It is analysed from the aspect of level five automation because the impact for transport firms is the highest. We consider this information to be important, because by knowing possible future changes companies can prepare themselves. Yet, level three automation already indicates first impacts on the prevailing resources. The major difference to level five is the resource of the driver. While it is still a relevant resource in level three and can be used to achieve a competitive advantage it might become dispensable higher automation levels.

<table>
<thead>
<tr>
<th>Resource Theme</th>
<th>Valuable</th>
<th>Rare</th>
<th>Inimitability</th>
<th>Non-Substitutability</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Price</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>b) Quality</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>c) Drivers</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>d) Location</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>e) Size</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>f) IT capabilities</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>g) Management</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>h) Technology</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>i) Service orientation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>j) Relationship</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>k) Specialisation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Table 10: VRIN analysis under the aspect of the availability of self-driving trucks (level 5 automation)

While all resources are valuable and mandatory to compete, our analysis has shown that the ability to offer low prices (a) will not be rare anymore, once autonomous trucks are available. Autonomous trucks decrease transportation costs thus, more competitors will be able to offer economic prices for their customers.

Quality (b) represents a valuable and non-substitutable resource. Our interviews emphasized that today, quality is seen as a prerequisite to compete. Thus, it is not perceived as a unique selling point, since many companies are able to offer it. Yet, it is needed in combination with other resources to achieve a sustainable competitive advantage. Due to the
implications and benefits of self-driving trucks on a firm’s performance, efficiency and innovation, quality will not represent a rare resource anymore. Self-driving trucks help to achieve better lead times, faster delivery and decrease accidents levels and human errors, thus, quality can also be achieved by competitors.

A premium location will be valuable to whoever has one. However, other companies are able to move to similar locations and thereby, imitate this resource. Yet, proximity to highways is beneficial to operate autonomous trucks with level three automation to its full extent. IT and management capabilities as well as technological resources such as state-of-the-art trucks are given with autonomous trucks and thus, do not represent a competitive advantage by itself. Any company with autonomous trucks fleet will have an equal position regarding technological innovation. While all of them are certainly valuable, they can be imitated by any competitor by hiring experts in those areas.

Based our analysis, service orientation, specialisation on specific customers, a focus on strong relationships and size represent main sources of competitive advantages for transport companies. The results of the VRIN analysis match with the results from our thematic analysis. Figure 12 illustrates subthemes, which were assigned to our third research question about changes to LSPs and implications for the logistics industry.

![Figure 12: Themes - Changes to LSPs & Implications](image)

The participants of our study are convinced that large transporters maintain their competitive advantages in future. The main reason for this is the ability to offer flexibility and low prices through large fleets of autonomous trucks. Currently, large transport firms achieve flexibility by subcontracting smaller transport firms. Additionally, our analysis indicated that
fleets of autonomous trucks benefit from size to a larger extent than fleets of non-autonomous trucks. According to our participants, this will lead to the extinction of small transport firms. Literature illustrated that the logistic industry consists of many smaller transport companies. Therefore, such implications could entail major changes for the logistics industry. Our research has shown, that smaller transport companies will stay in the market if they are able to offer additional services or specialise for certain customers or on certain activities.

Referring to additional services, our analysis shows, that logistics experts anticipate a development of new services which are not available yet. For example, there might be special service providers for loading or unloading of trucks. Instead of having a driver responsible for this, a special service provider and a self-driving truck will arrive simultaneously at a customer’s site. These implications suggest that size, specialisation and service orientation will be sources of competitive advantages in the future.

Depending on the chosen approach, the role of drivers will change in future. For some services, drivers are not easily replaceable and thus, they will remain relevant to a certain degree. However, this leaves two options, either truck drivers will focus on few activities, which cannot be done without them yet; or truck drivers will take over additional tasks. No matter which option will prevail, from a long-term perspective, truck drivers will cease to be a source of competitive advantage.

Another implication, which was identified by our thematic analysis is the entrance of new players in the transport sector. In general, it is highly unlikely that customers will take over transport activities once autonomous trucks are available. Customers, transporters and other groups are certain, that it will remain more effective overall to have transport specialists. However, there are certain customers, who already engaged in transport activities. These have the necessary resources and capabilities available, which could facilitate the use of autonomous trucks. This would have major implications for the competitive landscape within logistics. Prime examples for this type of customer are multinational, digital e-commerce companies like Amazon or Alibaba. Both are currently investing own logistics and transport assets (e.g. airplanes, warehouses, etc.) and possess the mandatory capabilities and resources to potentially handle truck fleets (e.g. IT experts, servers, etc.). Some of our participants imply, that these companies could take over their own transport activities which are currently outsourced.

To conclude, service orientation, specialisation on specific customers, a focus on strong relationships and size can represent sources of competitive advantages for transport
companies, once self-driving trucks are available. Self-driving trucks will lead to the disappearance of small transport companies, if they are not able to find niche segments or offer specialised services. Some larger customers might even take over transport activities and invest in their own truck fleets.

Our research has shown, that autonomous trucks represent a disruptor, not only for the competitive advantages of transport companies but also for the logistics industry in general. The figure below combines the findings from our analysis into our conceptual model, which was introduced in the chapter frame of references. It highlights the different implications. Two scenarios of level three automation and level five automation are being derived from the findings.

![Conceptual Model with future implications](image-url)

**Figure 13: Conceptual Model with future implications**
6. Conclusions

This chapter draws the conclusion of our study. Therefore, the research questions, as outlined in the introduction, are answered. Furthermore, we refer to the purpose of our study and show the contribution to research provided by this thesis.

The purpose of this study was to explore the perception of self-driving trucks within logistics and the impact on competitive advantages of logistics service providers. Three separate research questions were raised to fulfil this purpose. Our study allowed us to answer those research questions.

I. What is the perception of self-driving trucks within logistics?

Innovation is crucial for a company’s success. However, innovations cycles within logistics are long and rare. Yet, the pace of logistics innovation and their impact on the industry is currently changing. Thus, logisticians are aware of the trend of autonomous driving. Transport companies and truck developers have a clear understanding of autonomous driving and its implementation process. Lower levels of autonomous driving are expected to be available in the near future. In contrast, fully automated trucks (level 5) are not anticipated to enter the market soon. Logistics experts agree that other trends are connected to autonomous driving. Overall, various barriers and opportunities come along with the innovation of self-driving trucks. In general, it is expected to fundamentally change the logistics industry once barriers such as regulatory and technological issues are solved.

II. How do logistics experts view current resources and capabilities of logistics service providers with regard to the introduction of self-driving trucks?

Competencies like driver quality might lose relevance depending on how the role of drivers will change in this new environment. Fleet size as well as the ability to offer special services will become more important in the future. Generally, physical and knowledge resources will become more important, while human resources will lose relevance, if companies find feasible solutions to replace them.

III. How can logistics service providers build competitive advantages once self-driving trucks enter the market and what potential new players will enter the industry?

Several possible solutions were presented with our research. Logistics service providers could either specialise and increase their customer orientation by serving niche segments or they could adapt to the trend with self-driving truck fleets. In case of incorporating self-driving trucks into their fleet, they can differentiate themselves by expanding their service
portfolio. New players such as special service provider for different sub-activities could develop with the implementation of self-driving trucks: Load Handling Service Partners, Maintenance and Repair Service Providers, Platoon Service Providers, Document Management Service Provider, Insurance Providers just to name possible examples.

The findings of our research question can be applied to our conceptual model, presented in Chapter 2.4. This helps to draw important conclusions for our study and fulfil the purpose of our thesis. The thesis contributes to existing literature because it gives first indication for possible future scenarios regarding the impact of autonomous driving on the logistics sector. Our thesis examines differences in current understanding of the concept of autonomous driving within logistics among experts. Furthermore, it emphasises that current core competencies might change due to the implementation of self-driving trucks and that companies need to reassess their resources and capabilities. Additionally, we revealed possible competencies, which could lead to future competitive advantages.

This thesis is a starting point for further research in the area of autonomous trucks within logistics. Similar to current trend reports, this thesis helps to accentuate the importance of this topic for the future of logistics.
7. Discussion

A funnel approach was used to examine our empirical data in relation to our research purpose. In this section, a reversed funnel approach is used to point out any additional findings, implications for managers and society as well as recommendations on what can be done differently if other researchers attempt to replicate our study.

7.1. Findings outside the scope of our research

The purpose of this thesis is to identify the changes and implications self-driving trucks have on logistics service provider’s competitive advantage. The presented results are deducted from the perception of experts within the market and their future estimations of possible changes to resources and capabilities of a company but also for the industry in general. Additional to the findings related to our research questions, we could derive further assumptions for self-driving trucks, which we would like to share in this section of the thesis.

One fundamental assumption of this research is that self-driving trucks will enter the transport market in the future. The interviewed experts indicate that lower levels of autonomous driving will be available within the next five to ten years. However, fully automated trucks (level 5) are not expected to enter the market anytime soon. These future estimations suggest that the driver will remain relevant, i.e. need to be present in a truck for another couple of years. Yet, the findings of our research can be used to form the future market and prepare actors for level 5 automation scenarios.

Furthermore, our participants mentioned that there are differences in infrastructure depending on the country. Thus, autonomous driving will not be applicable and available in all countries at the same time. This could imply that it will be a progressive process, which will start with a small group of pioneer countries and then spread across the globe with late adopters. Infrastructure, customers and transporters must be ready for the technology. This could also have future implications for international companies, which operate across borders.

While our study solely focused on road transportation, some of our interview partners suggested that autonomous vehicles in other forms, such as automated forklifts and drones among others, could have an equally large impact on logistics. Autonomous vehicles are already used today on private grounds and for internal processes. However, experts suggest that there is more potential and room for optimisation. Further advantages of this technology are expected and it is remarkable how some of our participants stressed this issue in comparison to autonomous trucks.
Moreover, implications for the emergence of new services and service providers can be derived from our data. Our paper presents an innovative view on customer retention and collaboration once autonomous trucks are on the market. It suggests that it will be even more important for transport companies to offer relevant services for their customers and be specialised to differentiate from their competitors. Some companies might start to focus on a niche and develop highly specialised services exclusively for their target market to survive.

Participants proposed possible suggestions for services that could emerge due to the implementation of autonomous trucks. Particular attention was paid to services which are currently performed by the truck driver. Interviewees suggested that tasks such as document management or vehicle preventive maintenance could be outsourced to special service providers or handled remotely. Another example given, concerns the loading and unloading operations. A separate service provider or employees from the customer itself could be responsible for the provision of these services. Instead of accompanying each truck, these service providers could be available on demand. The findings suggest that larger customers might be able to do these services on their own, while smaller companies might have to outsource these activities to external service providers.

An important implication concerned the handling of documents. While this is considered as a barrier for autonomous driving within this thesis, some participants suggested that new service providers could solve this issue. In future, documents and information could be submitted as an electronic file or via barcodes. This raises intersection point to the trend of internet of things and rising demand for connectivity and digitalisation.

Currently, truck drivers are also responsible for basic maintenance of their trucks and a first vehicle assessment in case of an emergency. However, due to technology advancing and becoming more complex, experts expect that at some point drivers will not be able to perform these tasks or will need to develop additional skills and knowledge to do so. Therefore, the participants predict a need for special service providers responsible for unexpected maintenance services. This could drive the emergence of new market entrants or expand current service portfolios of OEMs.

Lastly, the concept of platooning was mentioned as potential for possible new service providers. Our participants pointed out that platooning will be one of the first forms of autonomous driving on the market. However, matching schedules and coordinating trucks is a challenging task, which represents opportunities for new market entrants to provide these services.
In our paper, the focus of attention was given to implications for competitive advantages. However, the mentioned topics in this chapter arouse during our conversation with experts and indicate important implications for the structure of the logistics market. Although these results are not conclusive, they offer a great potential for further investigation and research.

7.2. Implications of this study

From the research that has been carried out, it is possible to conclude important implications for future strategic decisions. Thus, it can be used by managers of transport companies to provide them with a first overview of how their competitive advantages will change, once self-driving trucks are implemented. This will help them to adapt their unique selling points and prepare their business for future challenges.

The paper presents several solutions. Smaller transport firms, which are currently competing on price could invest in stronger partnerships with their customers. Thereby, they could specialise according to customer demands and resist the increased price competition caused by autonomous trucks by serving niche segments. Other implications are possible collaborations between transport firms and OEMs, stronger relationships with customers, specialised service portfolio and new services.

Even customers can derive important insights from our study. A company included within our case studies already detaches from the dependency of drivers by having their own employees responsible for the loading and unloading of freight. In this case, the introduction of autonomous trucks will not threaten existing processes, since they do not rely on truck drivers for their process execution. However, most companies still include drivers in their processes and might have to rethink their strategy once full automation is ready to enter the market. In this context, our study revealed several activities, which currently rely on drivers. Since changing and restructuring processes could take a long time, finding a suitable solution can help to improve the transition and incorporate innovations such as autonomous trucks smoothly. Being aware of possible effects of such trends helps customers to adapt their change management process.

Lastly, this thesis will help policymakers and society to understand the underlying advantages of autonomous driving for logistics. This could help to increase social acceptance and create a sense of urgency for tackling regulatory and legislative barriers. We believe that the advantages of autonomous trucks are too important to be impeded by such barriers.
7.3. Reflection on our own work

The analysis provided in this thesis does not enable us to determine exactly how the logistics industry will look like in future. Yet, it represents a novel solution to address possible effects and implications of autonomous driving on the logistics industry. The originality of our solution lies in the fact that a tendency can be derived from experts’ opinions to determine a direction in which the trend of autonomous trucks is heading. Furthermore, it addresses important factors for building competitive advantages and builds a fundament for future research. However, in retrospect there are several things which we could do differently if we had the chance to do this research again. This is interesting for anyone interested in replicating our study in a different environment or context.

We were fortunate to find a large number of good interview partners who were willing to share their knowledge and experience with us. It required hard work, networking skills, persuasion and time. Due to various reasons, it was difficult to get in touch with the right person and it took longer than expected. Employees of smaller transport companies are generally very engaged in their operations and have limited time to participate in such studies. Furthermore, it is noticeable that they usually do not have a person exclusively responsible for innovation development and implementation. In contrast, larger transport companies have specialists for innovation topics, however, getting in touch and making room for such studies was quite challenging. We put a lot of effort into finding the right interview partners and achieving the necessary number of interviews for our study. Another important factor was the collaboration with OEMs and developers. Although we focused on experts’ opinions, this case group was more hesitant to share knowledge or statements about new technologies, which are still in development stages, since this is a vital competitive advantage for them. We suggest that future researchers keep this in mind when reproducing such a study.

Furthermore, limited research done on the topic of opportunities and barriers of autonomous trucks represented a major challenge of our research. The available material deals with the topic of autonomous driving in general, i.e. other forms of vehicles. Thus, we decided to derive our information mainly through our interviews to provide a base for our main purpose of this thesis and specialise on the topic of autonomous trucks and logistics. In retrospect, the existing research on autonomous driving matched with our findings for autonomous trucks. If we would have made this assumption at the beginning, we would have been able to be more concise in conducting this thesis.
Another major challenge of our research was providing a clear definition of autonomous driving. We chose to focus our study on automation levels three to five. There were a couple of reasons for that. Level three automation is closer to reality and represents a scenario that is easier to grasp for our interview partners. However, level five automation is expected to have a bigger impact on the logistics industry. Thus, we considered the levels three to five to be important for our study. Yet, future researcher might consider limiting their study only to one of the upper automations level to derive more precise and level specific findings.

We conducted our interviews via telephone due to time constraints and geographical distance. We designed our methodology to obtain as much information as possible from our interviews. Thus, we chose to also take phone interviews into consideration to suit the time schedules of our interview partners better and gather more data to support our study. With more time and flexibility this research could be conducted with face-to-face interviews to improve the quality of research. Further limitations came with the methodology we have chosen, which were discussed in detail in chapter three.

In conclusion, autonomous driving in logistics represents a very interesting field. It is important for researcher to consider the necessary time when working on future orientated research topics with limited exciting literature and the involvement of research and development subjects.

7.4. Future research areas

With our thesis, we opened the black box of autonomous driving in logistics. Throughout this paper several intersection points to other areas of autonomous driving are mentioned. Section 7.1 highlights only a few possible future research areas. Based on the promising findings presented in this paper, work on the remaining issues such as implications for logistics networks, rising importance of collaboration or specialisation can be continued. Another interesting area is the implications of autonomous driving on current business models and how a possible structure of the logistics industry could look like in future. These results need further validation.

By choosing a cross-sectional study our thesis evaluates the topic of self-driving truck bound to the period of this study. Furthermore, it is limited by the chosen sample size and geographical area. The development of autonomous driving and the integration into logistics is an ongoing process. Therefore, a longitudinal study could help to illuminate whether the findings of this thesis remain relevant as the industry converges towards the implementation phase.
A multi-perspective approach was chosen to enable a certain level of generalisation of our results. However, there is a need for verification of the results from all different perspectives. Instead of multiple case groups with different types of companies, single cases with only one type of company, e.g. customers focused on retail or small road haulers with less than 10 employees, could be examined. These findings can be compared to validate our own results. Furthermore, since a qualitative research method was chosen, it would be interesting to support these findings with quantitative studies on a larger scale.

Focusing on specific areas of logistics, could be another area for future researchers. Autonomous driving was examined from a general perspective, however, specific areas such as last mile logistics would be of interest.

Assessing companies’ competitive advantages can be done using various methods. While we have chosen a resource-based approach, which focuses on internal resources of companies, the competitive position of a company could be examined by means of different theoretical frameworks, which could include external factors or relationships between the different actors.

In conclusion, we believe that the results and insights of our thesis contribute not only to the business but also the academic world. Managers benefit from important implications for their strategic planning, while for scholars’ important areas for future investigation were revealed. It will be interesting to see how the actual implementation of self-driving trucks will transform the logistics industry and if the current perceptions and predictions prove to be true.
I. References


Angerer, A. (2016). Retos de la industria automóvil por la conducción autónoma como innovación disruptiva: Análisis del mercado y recomendaciones estratégicas para el future. ICADE, Facultad de ciencias económicas y empresariales, Madrid


Payre, W., Cestac, J., & Delhomme, P. (2014). Intention to use a fully automated car: Attitudes and a priori acceptability. Transportation research part F: traffic psychology and behaviour, 27, 252-263.


World Health Organization. (2013). Global Status Report on Road Safety, s.l.: s.n

II. Appendices

Appendix 1: Example E-Mail request for interview partner

Subject: Master thesis on Autonomous Driving and the impact on the logistics industry

Dear Sir or Madam

I'm writing to you regarding our master thesis. My thesis partner and I are currently studying International Logistics and Supply Chain Management in our final year at the Jönköping University in Sweden. We are writing our thesis about the topic of 'Autonomous Driving and its impact on the logistics industry'. Thereby, we examine how the introduction of self-driving trucks could impact the current market structure, competitiveness and market players. To collect empirical data, we are currently conducting interviews with different players and experts within the logistics industry.

Autonomous driving is a very recent topic, which receives more and more attention. Trend reports predict that by 2025 forms of autonomous driving will enter the market. We want to examine how this disruptive technology could impact the logistics industry. Thereby, we are looking at market structures, resources and expert opinions on the future development of this technology.

Experts are sales manager responsible for trucks, R&D experts, innovation experts or logistics experts. Would it be possible to schedule an interview with one of your experts regarding the topic of autonomous of self-driving trucks?

The interview is held via telephone, Skype or face-to-face, according to your personal preference. The interview will take approximately 35-60 mins and we do not require any internal data, numbers or sensitive information. We mainly focus on expert opinions and perceptions towards how market structures and competitive advantages within logistics could change. Please find attach a sample of possible questions. If you require additional information regarding our thesis, do not hesitate to contact us (see signature).

Thanks a lot, in advance for your help and I wish you a wonderful weekend!

Looking forward to hearing from you.

Best regards,

Pia Riedel & Lukas Neuweiler

ILSCM Programme 2017 - Master (2 years)
Jönköping University - International Business School

Pia Riedel, Contact: EXAMPLE MAIL (mail), EXAMPLE PHONE NUMBER (telephone)
Lukas Neuweiler, Contact: EXAMPLE MAIL (mail), EXAMPLE PHONE NUMBER (telephone)
Appendix 2: Example Interview guide for semi-structured interviews

Draft: Example Interview Guide 17.03.17

Resources, Capabilities, Market Structures and Autonomous Driving
An analysis of competitive advantages and future developments

The following is only a draft of a possible interview guideline. The interview will be semi-structured and it focusing on an expert opinion on the topic of autonomous driving. No sensible internal data is required. Please note that ethical considerations are very important to us, hence, anonymity will be ensured.

Part 1:
- Tell us something about yourself, your position and your responsibilities
- Tell us something about the company you are working in
  > What are you doing? What are you focusing at? Please describe in detail.
  > What are your USPs? What does your company to better than its competitors?
  > Who are your competitors?
  > How have your strengths developed from the past until now? Do you have any future plans for maintaining or developing your strengths?

Part 2:
- Where do you see the future of logistics? Are there any trends that you find of special interest?
- Have you heard about autonomous driving? If yes, what is your understanding of that topic?
- What do you think of future development of logistics (especially looking at self-driving trucks)? Do you see any challenges, barriers or opportunities here?

Part 3:
- How do you see the impact of autonomous driving on the logistics industry? Where do you see future market structures, capabilities and resources?
- With regards to the future, do you see any capabilities or resources that might alter, need to be replaced or remain a source of competitive advantage?
- Has the topic of autonomous driving been of interest for your company yet?

Additional comments.

Thanks for your time!

Pia Vanessa Riedel & Lukas Neuweiler | ILSM 2017 | Jonkoping University – Business School
Appendix 3: Example Hierarchy

Perception of autonomous driving

Autonomous Driving

Innovation & Megatrends

- Demographic Change
- Digitalisation
- Innovativeness of LSPs
- Others

Opportunities

- Decrease - Transport costs
- Others - Safety
- Efficient use of resources

Barriers

- Responsibility
- Investment
- Driver replacement
- Legislative and politics
- Technical issues

Social and ethical issues

Definition Implementation
### Appendix 4: Innovation and Megatrends

<table>
<thead>
<tr>
<th>Group</th>
<th>Innovativeness of transport companies</th>
<th>Other megatrends</th>
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<tr>
<td>T</td>
<td>We attempt to stay as up to date and innovative as possible when it comes to technological development – <strong>T2</strong>&lt;br&gt;We have put enormous efforts into being innovate. We do not just follow current trends, but also try to develop our own innovations – <strong>T4</strong></td>
<td>Globalisation is still developing and will influence the future of transport – <strong>T1</strong>&lt;br&gt;Demographic change is a reason why there is a lack of drivers – <strong>T1</strong></td>
</tr>
<tr>
<td>C</td>
<td>One criteria for selection of transport partners is how open they are towards innovative – <strong>C4</strong></td>
<td>Digitalisation can be used to ensure transparency – <strong>C4</strong>&lt;br&gt;More and more data is available and could be used to analyse and improve existing processes – <strong>C3</strong></td>
</tr>
<tr>
<td>D</td>
<td>Innovations are introduced in our company very fast. We have to adapt to customers’ demands as soon as possible – <strong>D2</strong></td>
<td>Connectivity will help to improve disposition, planning and scheduling of trucks – <strong>D1</strong></td>
</tr>
<tr>
<td>B</td>
<td>I am very sceptical when it comes to innovativeness of logistics or transport companies”, “transport or logistics companies usually just […] implement innovations developed by others – <strong>B2</strong>&lt;br&gt;Autonomous trucks are only a small part of the puzzle – <strong>B2</strong>&lt;br&gt;Connectivity is a major trend that will have a big impact on transportation. Connectivity platforms will connect everything! – <strong>B1</strong></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Order picking with drones could be an upcoming trend – <strong>O2</strong>&lt;br&gt;Environmental and sustainable solutions will become more important for logistics – <strong>O1</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 5: Challenges and Barriers

<table>
<thead>
<tr>
<th>Group</th>
<th>Ethical and social issues</th>
<th>Political resistance and legislature</th>
<th>Fully autonomous truck – removal of the driver</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T</strong></td>
<td>Ethical issues are on out of many barriers to autonomous driving – T3</td>
<td>Legislative changes will take more time than technological development – T4</td>
<td>Our drivers are important to fulfil the security demands of our customers – T2 Some services are not feasible without humans – T3</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>People might lose their jobs because of this new technology – C1</td>
<td></td>
<td>Drivers are absolutely necessary for communication – C1 Truck drivers are responsible for load securing – C2</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>It is questionable, how autonomous vehicles should make moral decision – D2</td>
<td>A legal framework for fully autonomous trucks has to be created – D2</td>
<td></td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Social acceptance is a barrier to autonomous trucks – B2</td>
<td>The biggest challenge in order to implement autonomous driving is legislature – B1</td>
<td></td>
</tr>
<tr>
<td><strong>O</strong></td>
<td>People are very cautious about letting go of control – O2</td>
<td>Governmental support would speed up the implementation of autonomous driving – O1</td>
<td>Drivers are also responsible for custom seals in addition to regular documents – O2</td>
</tr>
</tbody>
</table>
## Appendix 6: Chances and Opportunities

<table>
<thead>
<tr>
<th>Group</th>
<th>Safety</th>
<th>Costs</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Overall accident rates will drastically decline – T4</td>
<td>The impact will be determined by new business models and only secondary by a decrease in costs. – T4</td>
<td>Autonomous driving decrease rest times and increase the amount of time trucks are actually driving – T5</td>
</tr>
<tr>
<td>C</td>
<td>There will be no more human mistakes – C4</td>
<td>Cost reduction the main benefit of autonomous trucks – C1</td>
<td>Autonomous trucks are more reliable. Transport lead times would decrease. – C3</td>
</tr>
<tr>
<td>D</td>
<td>Based on my experience, trucks drivers do not pay [enough] attention to this – D1&lt;br&gt;It will help all road user because safety will increase – D4</td>
<td>Truck purchasers primarily look into ‘how much money can I make if I buy this truck instead of another?’ – D1</td>
<td>Transport companies will benefit from autonomous driving because they can use their trucks more effectively - D1</td>
</tr>
<tr>
<td>B</td>
<td>The amount of accidents will decrease drastically – B2</td>
<td>Autonomous driving is more cost-effective – B1</td>
<td>Autonomous driving will greatly decrease fuel consumption due to platooning and more efficient driving – B1</td>
</tr>
<tr>
<td>O</td>
<td>Autonomous driving will decrease the amount of errors by removing the human factor – O1</td>
<td>Autonomous trucks will minimize costs – O1</td>
<td>Autonomous driving trucks will speed up transportation times – O1</td>
</tr>
</tbody>
</table>
### Appendix 7: Autonomous Driving

<table>
<thead>
<tr>
<th>Group</th>
<th>Definition of autonomous driving</th>
<th>Implementation of autonomous trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>We use the well-known definition: level 0 to level 5 autonomous driving – T1&lt;br&gt;My definition of autonomous driving is that a truck is able to drive from one place to another completely without drivers – T5</td>
<td>Platooning would be a first step towards more autonomous driving – T2&lt;br&gt;Right now, it is unimaginable to me, how autonomous driving should work – T5</td>
</tr>
<tr>
<td>C</td>
<td>Autonomous trucks are trucks which drive on their own – C3&lt;br&gt;There is a common definition including different levels of autonomous driving – C4</td>
<td>I think, once a few transport companies are using autonomous or semi-autonomous trucks, all other transport companies will follow – C2</td>
</tr>
<tr>
<td>D</td>
<td>Our definition of autonomous driving includes level 0 to 5. Level 0 includes no autonomy at all whereas level 5 describes a fully autonomous vehicle – D1</td>
<td>Our plan is to develop autonomous driving step by step – D1&lt;br&gt;It will take a long time until level 5 autonomous driving will be available – D2</td>
</tr>
<tr>
<td>B</td>
<td>My definition of autonomous driving includes multiple levels – B2</td>
<td>If appropriate legal conditions are in place, level 3 autonomous driving could be used as early as 2020 or 2021 – B1</td>
</tr>
<tr>
<td>O</td>
<td>Autonomous driving to me means, that no human interaction is necessary. The vehicle can do everything on its own – O2</td>
<td>I already heard about autonomous driving. In some image films it is portrayed very positively but I have also heard about accidents – O2</td>
</tr>
</tbody>
</table>