



## **ECG Academy**

### **Thesis**

## **Truck transportation needs in the Future**

### **Autonomous driving**

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[\[https://trucks.cardekho.com/en/news/detail/truck-platooning-history-benefits-future-945.html\]](https://trucks.cardekho.com/en/news/detail/truck-platooning-history-benefits-future-945.html)

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## Abbreviations

LSP	→	Logistic Service Provider
OEM	→	Original Equipment Manufacturer
PDI	→	Pre Delivery Inspection

## **1. Introduction**

### **1.1 Motivation**

Working in a company and dealing with the daily business you are facing because it is influencing you quite frequently makes you think about change and the role of your business in the future. Everybody is talking about buzzwords like "industry 4.0", "big data" or "autonomous driving" to name just a few of them. In general there is a development of more digital influence and commercial operations that have been existing in almost the same way for a certain period of time are going to be disrupted. If you look into the past, those companies which didn't realize there is a huge development going on and are not aware of changing frame conditions of their business used to disappear. Therefore, thinking about the possible future and taking into account the actual problems might help to prepare the company to be able to overcome such issues.

The BLG as a global finished vehicle logistics provider with its focus on the European and German market is offering compound and transportation services with different modes of transport.

If you take a look at this specific market and the surroundings, you can see a lack of capacity no matter if you are talking about storage or transport. On the one hand the market has been growing in the last few years, but the earnings of the involved companies have decreased and much-needed investments have been cut off or postponed. On the other hand, the expectations of the OEMs concerning lead time, service level, damage quote and the carbon footprint have increased.

On top of that, new drivers are much harder to find. This makes it difficult to keep the already existing fleet going, while not even thinking about a possible expansion. The working conditions are unattractive, as for long routes you are far away from home, the payment is quite low and the acceptance for the effort is small as well.

Driven by these problems and the technical development, this thesis deals with the idea of an implementation of autonomous driving trucks and cars. It will show an elaboration of how this could be realized and what could be the result.

## 1.2 Objective and Structure

This thesis is dealing with the idea of how future truck transportation can look like or if it will even be needed. As it is only an expectation of what could be the development, most of the ideas are my own considerations.

The objective of the thesis is an evaluation how the transport market for finished vehicle logistics on trucks might change. It will also show the advantages and disadvantages in comprehension to the existing system.

In order to make this evaluation comprehensible, at first there will be a short overview of the actual threats that have to be solved (2.). Afterwards, the current transport process will be described and its pros and cons will be lined out (3.). In the next step the idea of truck transportation in the future will be explained (4.).

To be able to make the concept work, in (5.) measures will be defined and an evaluation will be made along to (6.). In the end there will be a conclusion about the impacts that could go by with the change (7.).

## 2. Overview of future truck transportation

The general need for transportation is always based on the fact that you don't have the right good in the right condition at the place where it is needed. Therefore you can either move it by itself or you transport it with technical support and any possible mode of transport.

In this case, as we are talking about cars, it would be possible to transport them on their own axle to the place where they are needed. But then they wouldn't arrive in the condition they should, as "new" and "clean" and moreover the costs for individual transportation would be much higher. So in general there is a certain advantage of using trucks to fulfill the requested functions.

In the last ten years the road transportation volume in Germany has increased by more than 15% and the forecasts expect a further growth in the future.<sup>1</sup> But the infrastructure has not been exceeded accordingly, so the results are frequent traffic jams and congested motorway stations.

The expectation is that with the current transport system and the split between the different modes of transports, the situation will become even worse due to the expected growth. Moreover, the environmental contamination is increasing due to the additional volumes and official emission limits are surpassed on a regular basis.

On top of that, more than 25% of the drivers in Germany were older than 55 years in 2014, most of them will retire by 2024 at the latest.

Furthermore, the statistic says the number of foreign drivers has increased, which could influence the quality of the transport by adding communication problems to the equation.<sup>2</sup>

For example, a higher damage quota due to misunderstood loading instructions can't be in the interest of anyone.

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<sup>1</sup> <https://de.statista.com/statistik/daten/studie/2979/umfrage/entwicklung-der-transportleistung-des-strassengueterverkehrs/>

<sup>2</sup> <http://www.eurotransport.de/news/bag-bericht-zum-arbeitsmarkt-weniger-aelter-internationaler-6763630.html> of 2015-10-23

The view of an OEM or the dealerships to say it is not their problem would be quite shortsighted, as they are in need of the LSP and the transport service.

Another aspect is that the carbon footprint becomes more and more important and even though the engine technologies have been improved, there might still be potential in reducing emissions.

All these facts build up a surrounding that calls for a need of change in the transport system. Otherwise, the system could collapse and have huge impact on the German industry - not only automotive, but for the whole market. Also, the efforts to divert volume from the road on the rail or the inland water vessels haven't been fruitful yet and won't be a proper, permanent solution. Nevertheless, diverting volume from the road to other means of transport could be a supportive measure.

With all those challenges it is a crucial advantage that the technical development will offer us more and more solutions. Especially autonomous driving, platooning and new engine technologies will have a huge impact on how truck transportation can be organized in the future and even how the market issues and requirements will change.

### **3. Current transport process within Germany**

#### **3.1 Analysis of the as-is situation**

The current transport system in the finished vehicle car industry in the German market has been in place for more than two decades now. Even though the surroundings might have changed, there has been no modification of the general flows and processes. That means you can divide the vehicle transportation into two ways of process. They will be shown in the following illustrations and don't have any differences in the process itself, but only in the involved parties and directions.

The first one is the compound delivery structure. For a certain area in Germany, often defined by the 2-digits zip code, you have a specified compound. All the vehicle production for the dealership for the OEM within this defined zone is transported to the compound in a first flow and afterwards within the agreed timeframe delivered to the dealer the car was ordered by.

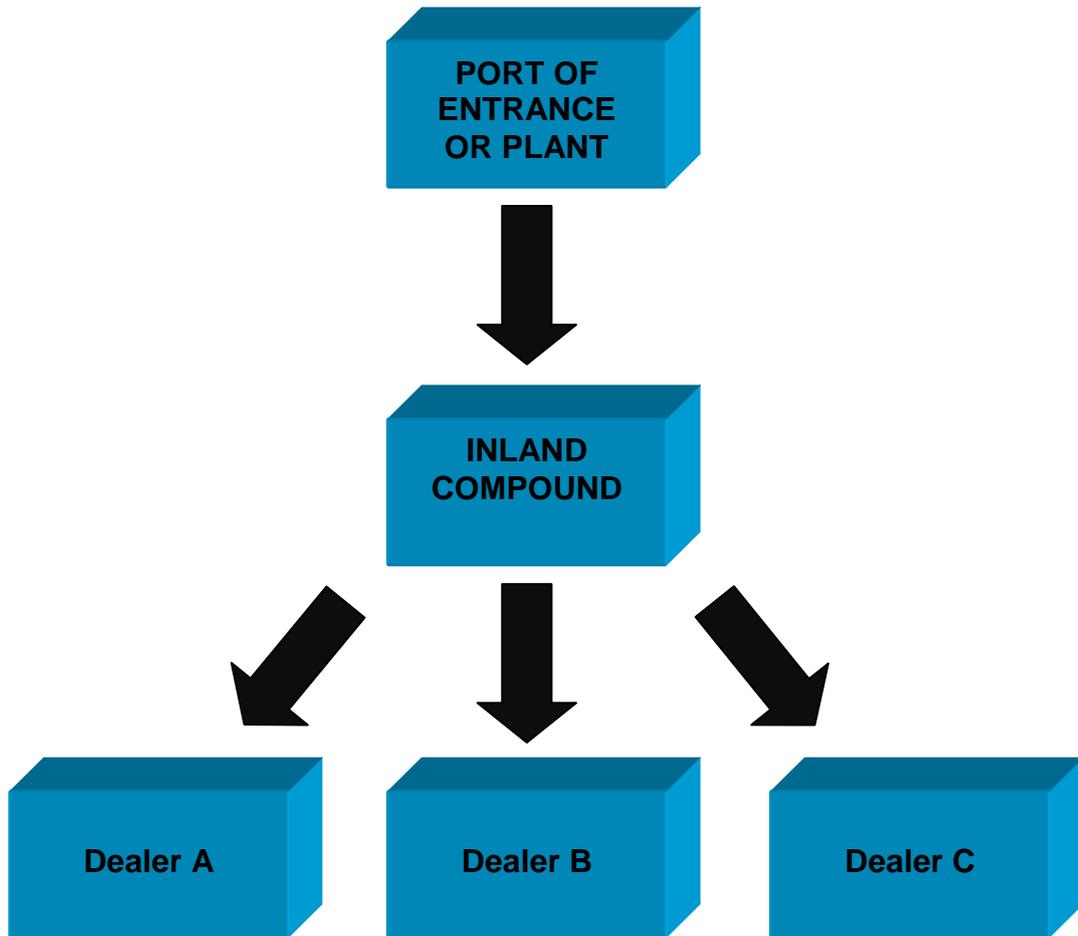


Figure 1: Current transport process - compound solution [own figure]

The second one is the direct delivery structure. From the port of entrance or the plant of the manufacturer the cars are directly distributed to the dealership within Germany. Therefore you have only one transport and no transshipment move.

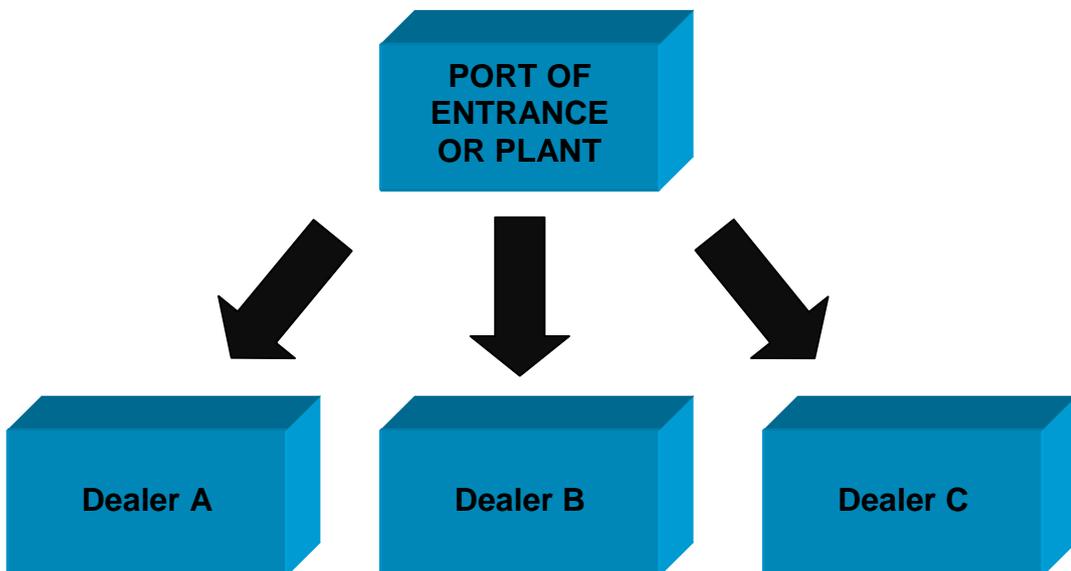


Figure 2: Current transport process - direct delivery solution [own figure]

It is also important to mention that both systems can go along with each other. That means for a certain area within Germany you can use a direct delivery solution and for others the cars are transported to the compound and delivered after transshipment. The reason to do so depends on the intention of the OEM and the given situation.

### **3.2 Advantages and Disadvantages of the current process**

In general you can't say what is the "best" solution for the dealer delivery, also the perspective of each OEM can be different.

There are good reasons to use a compound transport solution were you have a first leg by truck, train or inland water vessel and a second leg by truck.

You can store cars at the compound, which also might be quite important for the dealership as in tight city centers storage space is valuable and expensive.

Moreover, the PDI could be done before the delivery or other additional services like washing, putting on a transparency film or fixing damages in the paint work.

Another advantage is that if the OEM routes all his production over one compound for the area the dealer only has one contact person for all deliveries.

For the LSP organizing a point-point pre-transport is much easier to realize than a direct dealer delivery, as information like the opening hours don't have to be taken into regard as most of the compounds have a delivery frame of 24 hours and maybe even work 6 days a week.

Another fact is the possibility to combine volumes and improve the lead times by this. If there are only a few cars for a certain destination area and the truck for a direct delivery would have to wait several days to organize an efficient tour, it is a better solution to transport the cars to a compound where they can be combined with the volumes of other OEMs.

<b>Compound distribution</b>	<b>Direct delivery distribution</b>
<b>Advantages</b>	<b>Advantages</b>
<ul style="list-style-type: none"> <li>– pre-transport possible with different modes of transport</li> <li>– storage capacity at the compound</li> <li>– additional services can be integrated in the supply chain, i.e. PDI, refitting, individual foiling</li> <li>– one contact person for the dealer can be established</li> <li>– point-point pre-transport is easier to organize</li> <li>– combination of volumes from different OEM</li> </ul>	<ul style="list-style-type: none"> <li>– lower costs</li> <li>– reduced transport distances</li> <li>– shorter lead-times</li> <li>– easier to review and handle</li> <li>– less transport damages</li> </ul>

Table 1: Comprehension compound and direct delivery distribution [own table]

But there are also disadvantages of this system, as the costs can increase due to the additional compound handling and a backwards distribution. Moreover, the dwell time in the compound can be reduced, but the overall lead-time will be longer in comprehension to a direct delivery where you have no transshipment.

With the number of LSP involved within the whole transport chain it becomes more difficult to restructure or implement new processes and along with this to identify who has caused and is responsible for transport damages. Therefore it is easier to handle if you only have one LSP who is responsible from the plant or port until the car arrives at the dealership.

On top of that the damage quota itself is lower, as the cars have to be handled less often.

One important sub-segment has not been touched yet. In the above mentioned scheme we have always been talking about the transport of new manufactured cars. The explanation for that is quite easy. The transportation service requested by the OEM has less market players and can be analyzed much better than the used car market, where we have a whole lot more market participants and flows.

Nevertheless it is a relevant business segment and has to deal with the same problems the whole industry has to.

It can be assumed that a development in the new vehicle transport market will have an influence on the used car segment as well.

No matter how the finished vehicle distribution is organized, both methods are facing the same problems. The average age of truck drivers is quite high, the number of traffic jams is increasing and the working conditions are suffering. The attractiveness of the job as "knight of the road" has been fading over the past years. On top of that the regulations for environmental protection are increasing and big cities are already thinking about the possibility to ban diesel trucks out of their cities.<sup>3</sup>

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<sup>3</sup> <http://www.autobild.de/artikel/diesel-fahrverbot-was-autofahrer-zur-blauen-plakette-wissen-sollten-5832056.html> of 2017-03-07

#### **4. Idea of the future truck transportation services**

This part of the thesis will explain how a possible future of truck transportation services could look like, taking in consideration the current problems and technical solutions that are already existing or under development.

From my point of view the most important ones will be the possibility to implement autonomous driving and finding an adequate substitute for the diesel engine.<sup>4</sup> Even though there might be several steps to be implemented and the driver will still be needed in the near future, the thesis is outlining a quite far look into the future.

As described before there are two main delivery systems of new manufactured cars and it will be easier to implement self driving trucks for a point-to-point transportation than for a delivery including several dealers. The order would be submitted to the computer system of the supplier and at the beginning of the change process, the disposal would send the truck to the defined loading place of the manufacturer remotely controlled.

At the shipping yard a shunting team would wait for the several trucks of different suppliers to arrive, load them with the cars and secure them as it is already done today in rail transportation. Before the truck arrives they will get an instruction on their mobile devices in which positions they have to load the cars for the highest effectiveness.

After finishing the loading actions they would send a confirmation message to the disposal office and the truck will get the order to start the journey to the compound or port. During transportation the supplier, the compound or port and the OEM are able to track the location of the truck so they can monitor when the cars will arrive at the destination.

Once the truck has arrived, there is also a terminal managed shunting team that will do the entrance check, unload the truck and reply once it is finished. After that the disposal can use the asset right away as there is no need for a resting period of the driver.

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<sup>4</sup> [http://www.focus.de/auto/neuheiten/freightliner-daimler-testet-autonomen-lkw-unheimlich-so-faehrt-es-sich-im-truck-ohne-fahrer\\_id\\_4665029.html](http://www.focus.de/auto/neuheiten/freightliner-daimler-testet-autonomen-lkw-unheimlich-so-faehrt-es-sich-im-truck-ohne-fahrer_id_4665029.html) of 2015-05-08

As the loading and unloading process is not in the control of the transport supplier, he won't be reliable and liable for this.

The trucking itself will be more effective than it is right now, because the design will be changed as there is no need for a driver cabin anymore and you can use the additional space for additional cargo. On top of that platooning will reduce the needed energy for the impulsion as the trucks are using the slipstream of the previous one.<sup>5</sup>

### Manual Driving



### Radar-Based Collision Mitigation System



### Platooning System



Figure 3: Development scheme from manual driving to platooning [<https://trucks.cardekho.com/en/news/detail/truck-platooning-history-benefits-future-945.html>]

For long distance transports, the main engine technology will become hydrogen with two big advantages in comprehension to battery-electric vehicles. On the one hand they offer a larger range just by the size of the tank and they can be refuelled much faster than batteries even with a power charger station.

<sup>5</sup> <http://www.handelsblatt.com/unternehmen/industrie/lkw-platooning-schoen-der-reihe-nach/13399630.html> of 2016-04-04

Once the cars are at the designated compound for the delivery all additional activities can be done until the dealer transmits the release order. For the on-carriage there will still be drivers needed, as the cars have to be unloaded at the dealership and a handover has to be done.

The advantage for the driver is that we are talking about short distance trips and he will be home every day. Nevertheless it won't be his main task to steer the truck anymore but to fulfil the loading and unloading process.

If we look at the asset for those deliveries to the city centres, smaller trucks based on battery electric engines can be more effective and easier to handle without an additional semi trailer.

Also, the disposal will get assistance by the computer system combining loads for different dealer and arranging time slots so the dealer is informed prior to the arrival of the truck. In general monitoring, doing reviews and giving customer support will become more important.

For the used car sector I expect the above described subsequent transport flows to work as a hub and spoke system like it is known from the parcel service.

Each car will be transported to an inland compound within short distance. There it will be combined with other cars for the same area and a full truck load for the long route will be arranged. At the destination compound the delivery is done as in the description for the new cars.

In general the car market will decrease from a certain point of time.

The technical development described for the future truck transportation will also be implemented in the automotive sector.

That means the effectiveness will increase by autonomous driving as well and in growing cities it won't be necessary to own a car. You will be able to order what you need just with your mobile, companies like Uber, Drivenow or Car2go are already proving this, with the difference that there will be no driver anymore in the future.<sup>6</sup>

An average car in Germany is only used about one hour a day, which is a huge waste of money and with the easy access to individual mobility solutions will become more efficient.

To own a car will become an even more luxurious good than it already is.

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<sup>6</sup> <http://www.manager-magazin.de/fotostrecke/studie-mobilitaetsdienste-setzen-2030-bis-2-billionen-usd-um-fotostrecke-145704-13.html> of 2017-03-09

## 5. Measures for the implementation

Right now the draft of the future of truck transportation is facing some big threats which are mainly based on the reliability of the system and the legal framework.

The acceptance and success of an innovative idea is closely linked to the conviction of the customer. This means that you can't sell the product as long as the error rate is still too high, referring to the part of autonomous driving and platooning.

Once there is an accident and the communication between the trucks driving in a distance of only around 15 meter fails and there is still a driver on board, most likely he won't survive.

Also the question of how the platoon will split up when someone wants to cross is still not answered. The safety and feasibility are most important and until this can't be ensured this technology will only be tested but not implemented in general.

More-over, there is a moral discussion of how an autonomously driving vehicle should react in a critical or dangerous situation. The situation described shows that there will be an accident caused by some reason and the only outcome is that someone will be injured or overrun.<sup>7</sup> The software than has to decide what action the vehicle should do and if the passenger or the pedestrian will be injured or killed.

As long as such a question has not been answered, we will still be in need of driving on our own and only using technological support.

Furthermore the legal situation doesn't allow for autonomous driving right now, but only partial automation. That means once the reliability for the technique is given and the consumers broadly accept it, the government would have to change the law.

Moreover, if it is not the driver anymore being in control of the vehicle, the insurance policy would have to change as well as the responsible party would be the manufacturer.

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<sup>7</sup> <http://www.spiegel.de/auto/aktuell/autonomes-fahren-moral-machine-gewissensfragen-zu-leben-und-tod-a-1108401.html> of 2016-08-29

Another point that hasn't been looked at yet is the other function the truck driver currently has. The law is dividing the obligations of the shipper, who is responsible for the transport security of the goods and the driver, who is responsible for the reliability of the operating vehicle.

In the described scenario there will be no one who can assure the second point, what brings us to the conclusion that here as well the obligations through the law would have to be redefined completely for autonomous driving trucks.

The shunting or in the future more likely loading teams will need the expertise to take over those actions and secure the cars in conformity with the reliability of the operating vehicle.

An important fact will also be - as we are talking about Europe - that the several countries won't realise their own solutions and regimentations, but there will be a cross border agreement for all members. Otherwise the huge advantages can only be used in national transports and the complexity of cross border transports will be too high to be able to use the new techniques efficiently.

## 6. Evaluation

As described at the beginning of the thesis the transport sector is facing a lot of problems and as the transportation volume is expected to increase, there is a need to solve them.

The evaluation will prove if the idea of future truck transportation can help on tackle these issues and show which challenges could arise by this as well.

The main targets that have been analyzed can be listed as follows:

- Driver shortage
- Environmental contamination
- Congestion
- Lack of space at motorway stations
- Accidents
- Cost savings

The technical development of autonomous driving allows the suppliers to arrange transports without a driver sitting in the truck cabin for long distance transports.

Therefore it can help to reduce the driver shortage and make the job more attractive again. Using the additional space you receive if you resign the driver cabin the load factor will increase efficiency, which leads to cost savings and reduces the sum of needed loads. Another positive aspect will be the reduction in greenhouse gas that will decrease the environmental contamination.

For short distance trucks the cab assembly can be designed more convenient and the driver doesn't have to concentrate on steering but could do other things.

For example he could just be sleeping and would be relaxed once the truck arrives at the destination. That would mean there is no need for a rest period on a motorway station.

On top of that he will be at home every day and at the weekend so it is easier to live a normal family life.

But as some of the work he has been doing before like loading and unloading of the cars on routes from the plant to the compound or the port has now to be arranged by the local operator, they will need more work force at place.

Looking at the cause of traffic jams there are mainly two reasons. On the one hand congestion is caused by an lack of insufficient infrastructure and too many road users at the same time, and on the other hand by accidents blocking a lane or even the entire road.

Of course there is the possibility to expand the existing infrastructure, but it can't be realized everywhere and the costs will be very high. The maintenance of available tracks, tunnels and bridges also is a cost factor.<sup>8</sup>

As this won't be a single solution it can go along with the advantages you can gain by the platooning technology which will make the usage of the existing infrastructure more effective. In addition it can reduce the number of car accidents significantly by interacting communication between all road users shared information of the road conditions and potential dangers lying ahead.

Throughout the implementation of battery and hydrogen based engines the carbon monoxide and dioxide emissions will decrease substantially. But one important factor will be from which source this energy is created. Both technologies require electricity that has to be produced somehow. If this comes from a nuclear or coal-fired power plant it is just a relocation of the problem but no permanently green solution. That means we need to make sure that the electricity is produced using renewable energy sources like wind energy, hydropower or solar energy.

The two big threats that will have an impact on this consideration will be the modification of the legal framework and the development of the whole car industry and market.

Looking at the needs of transport and the technological development that will change the possibilities how the business could look like in the future there will be a similar impact on the car market itself.

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<sup>8</sup> <http://www.sueddeutsche.de/wirtschaft/-milliarden-luecke-riesiger-investitionsstau-in-deutschland-1.2432782>  
of 2015-04-13

That means that self-propelled payload also can benefit from the technical achievements. As long as the transportation on a truck offers advantages like lower costs and delivering a new and mostly unused car to the final customer who is still requesting this, there is a need of this service.

But as already described, in the context of urbanisation and innovative mobility solutions the ownership of a car in the next generations will decrease.

So it can be expected that a car could go on its own axle from the plant to the compound, where it would be prepared for the shared service and no one would care about the additional mileage.

The requirement of "new" would become more and more obsolete and only the higher effectiveness of several cars on one truck would offer a benefit for the OEM.

## 7. Conclusion

Within the thesis a lot of information was gathered, analysed and evaluated. The main problems of the as-is situation were pointed out and based on external sources a reasonable draft of the future of truck transportation has been elaborated.

The technical evolution in the computer business offers us possibilities which we weren't expecting only a few years ago. The combination of sensors, high capacity processors and inter device communication leads us into a completely new and alterative world. The innovative ideas that are being developed or already in an on-road test will have a disruptive influence.

Even though this might still take a few years as there are several steps left to be taken and the renewal of the truck fleets will need almost another complete decade, the outlined scenario would bring huge advantages and reduce the current problems. Nevertheless it also means the competition will increase, as more effectiveness causes over-capacity and market players will vanish, especially the ones who don't invest in new technologies.

Of course it is not foreseeable in which timeline this draft could be realized and if it will be exactly the way described, but I am sure it shows at least a direction which is expectable due to the information that was taken into regard.

In conclusion through all the innovations being developed, tested and already implemented, the transport market will undergo deep changes during the next years. Existing problems can be solved by the idea of future truck transportation and a drastic market transformation can be expected.

Especially for LSP specified in the transport of completely manufactured cars, the uncertainties will be high as there is a possible draft where the progress could make them completely unnecessary in the end.

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## **Word of honour statement**

I declare that I have written the thesis with the title

### **Truck transportation needs in the future**

#### Autonomous driving

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

Bremen, March 15<sup>th</sup> 2017



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