Indicators of Phase Transition within the Vehicle’s Lifecycle

A Case Study of Scania

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Extended Abstract

The total lifecycle of a vehicle contains many phases, from production to sales to first customer to second customer and so on until the end of life. Each one of these phases includes different activities in different business areas and under different conditions. This means that the customers' needs will vary depending on which lifecycle phase the vehicle is in and the offered services have to be adapted to this. Therefore it is important for truck developing companies to know when a transition, from one lifecycle phase to another has occurred.

This study is based on a case study provided by Scania, a company that develops trucks and busses. Delimitations were that the study would focus on connected long-haulage trucks that are in Europe under their first life cycle phase, that the developed services would be described on a conceptual level and not cover any economic aspects. With this in mind, the following research questions were created:

RQ1) What defines a transition phase?
RQ2) How can the long-haulage trucks' usage pattern be used to identify a transition phase?
RQ3) Which data is needed to identify a transition phase?
RQ4) Based on the results of RQ2 and RQ3, how could the transition alert service be designed?
RQ5) Which applications could the transitions alert service be used for?

The study included a literature study covering product lifecycle theory, servicification, second-hand market, big data, telematics, intelligent vehicles and statistic hypothesis testing. Further, two truck drivers were observed in order to get better understanding of the transportation business and the truck driving activities. Two qualitative interview studies were made with hauliers, service salesmen, truck salesmen and distributors from Czech Republic, Denmark, Italy, Poland, Spain and Sweden.

The results of the empirical studies were analysed and RQ1 could be answered. Transition phase is the period between two different vehicle owners and/or two different ways of utilizing the truck. The analysis also gave a good picture of how the trucks are used during their life and in the transition phases, which gave an idea about usage patterns that could answer RQ2. The answer was formulated as something named phase-DNA, composed by six parameters that should change during a transition phase: Geography, Route, Driver, Traffic Condition, Assignments and Services.

Through a group brainstorming with experts in connected services, ideas of which data that could be used to describe each one of the parameters in the phase-DNA were found. These were sorted and evaluated until at least one data type for each parameter was set. The specific data types were chosen because they reflected their parameter well and because they were data that were accessible in order to conduct tests and validations. The final set of data types consisted of: Route Shape, Amount of Stops, Run Time, Idle Time, Distance Driven, Coasting, Driver ID, Average Speed, Fuel Consumption and Workshop History Data. This set of data types was used for the formulation of a hypothesis, that said that after a transition phase at least some of these data types should change. This was also the point where RQ3 was answered.
The hypothesis was analysed using an exploratory analysis by plotting all the data types over time and observing if a change could be seen close to the change of ownership. The result showed that Amount of Stops and Driver ID were the most indicative data types, these two were further analysed with a statistical hypothesis test and a visualisation method. The results were used to develop an algorithm that is able to give an indication if a transition phase has occurred. The algorithm searches for changes in the six data types: Driver ID, Amount of Stops, Run Time, Distance Driven, Idle Time and Route Shape.

The results from the empirical studies were used to define requirements for the development of a service based on the information of phase transition called transition alert service (TAS), which is the answer to RQ4. Furthermore possible stakeholders that could be interested in the transition phase information were investigated together with an examination of their needs. TAS fulfils the five main needs identified from the stakeholders: ease start and cancellation of services, avoid unnecessary telecom expenses, avoid that information goes to the wrong customer, find new customers and customize services. In order to solve this, an algorithm detecting a transition phase was developed; it was done by searching for changes in the six data types: Driver ID, Amount of Stops, Run Time, Distance Driven, Idle Time and Route Shape.

Moreover if the TAS information is combined with other information it could be used for creating new services. Through different idea generation workshops a large number of new ideas and concepts were generated, which became the answer to RQ5. In total eleven applications for the transition alert service were developed: nine connected to change in ownership and two connected to change in utilization. Additionally, one support service named “Vehicle History” that is based on collected historical TAS was created.

Further, one total solution named “No Worries Second-Hand” was created that includes five of the developed services. This total solution offers the customer the perfectly suitable second-hand truck without having to spend time searching for it. It also consists of a contract saying that if the customer signs a R&M contract, the dealer will buy back the vehicle and offer a new used vehicle when the old one gets too old or used. TAS makes this total solution possible by giving the dealer access to information about the truck and through this predict phase transitions.

In conclusion, the developed services and especially the combination of them into a total solution would, according to the authors, favour the transition from a product focused company to a total solution provider, and extend the knowledge about the second-hand market.
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## Table of Contents

1 **Introduction** ......................................................................................................................... 1  
   1.1 Background ....................................................................................................................... 1  
   1.2 Objective .......................................................................................................................... 1  
   1.3 Research Questions .......................................................................................................... 1  
   1.4 Scania Case Description ................................................................................................. 2  
   1.5 Delimitations .................................................................................................................. 3  
   1.6 Report Outline ............................................................................................................... 3  

2 **Methodology** ......................................................................................................................... 6  
   2.1 Research Plan ................................................................................................................... 6  
   2.2 Problem Formulation ....................................................................................................... 8  
   2.3 Literature Study ............................................................................................................... 8  
   2.4 Observation of Truck Drivers ......................................................................................... 9  
   2.5 First Mapping of Characteristics of the Lifecycle Phases ............................................... 10  
   2.6 Second Mapping of Characteristics of the Lifecycle Phases ......................................... 12  
   2.7 Translating Parameters into Data .................................................................................. 12  
   2.8 Hypothesis on Detecting a Transition Phase .................................................................. 13  
      2.8.1 Hypothesis Creation ................................................................................................. 13  
      2.8.2 Exploratory Analysis of Hypothesis ......................................................................... 13  
      2.8.3 Statistical Validation of Hypothesis ......................................................................... 14  
      2.8.4 Visualisation of Hypothesis ..................................................................................... 14  
   2.9 Implementation of Transition Alert Algorithm .................................................................. 14  
   2.10 Mapping the System of the Transportation Business ................................................ 15  
   2.11 Possible Stakeholders for the Transition Alert Service .................................................. 15  
   2.12 Capture of Needs ............................................................................................................ 16  
   2.13 Transition Alert Service Development .......................................................................... 16  
      2.13.1 Idea Generation ....................................................................................................... 16  
      2.13.2 Description of Transition Alert Service .................................................................. 17  
   2.14 Possible Applications of Transition Alert Service ....................................................... 17  
      2.14.1 Idea Generation ....................................................................................................... 17  
      2.14.2 Concept Selection ................................................................................................. 18  

3 **Previous Work on Lifecycle Characteristics** ........................................................................ 19  
   3.1 Result Regarding the Vehicle’s Lifecycle Characteristics ............................................. 19  

4 **Scania and the Current Service Offerings** ........................................................................ 21  
   4.1 Scania CV ....................................................................................................................... 21  
   4.2 Long-Haulage Vehicles ................................................................................................. 21  
   4.3 Description of Fleet Management Services ..................................................................... 23  
   4.4 Scania Tachograph Services ........................................................................................ 23  
   4.5 Evolution by Scania ..................................................................................................... 24  
   4.6 Scania Communicator C200 ........................................................................................ 24  
   4.7 Connected Services Support Tool ................................................................................. 24  
   4.8 The Embedded Electronic System ................................................................................. 24  

V
10 Defining Transition Phase ...................................................... 59
  10.1 The Definition of Transition Phase........................................ 59
  10.2 Discussion and Conclusions of Definition of Transition Phase .......... 59
11 Parameters Describing the Lifecycle Phases ..................................... 61
  11.1 Phase-DNA ............................................................................ 61
    11.1.1 Geography ........................................................................ 61
    11.1.2 Route .............................................................................. 62
    11.1.3 Driver ............................................................................. 62
    11.1.4 Traffic Condition ............................................................... 62
    11.1.5 Assignments ..................................................................... 62
    11.1.6 Services .......................................................................... 62
  11.2 Discussion and Conclusions Phase-DNA ....................................... 63
12 Translating Parameters into Data ..................................................... 65
  12.1 Group Brainstorming ............................................................... 65
    12.1.1 Geography ........................................................................ 65
    12.1.2 Route .............................................................................. 66
    12.1.3 Driver ............................................................................. 67
    12.1.4 Traffic Condition ............................................................... 68
    12.1.5 Assignment ..................................................................... 69
    12.1.6 Service .......................................................................... 70
    12.1.7 Future ............................................................................ 70
  12.2 Discussion and Conclusions of Translating Characteristics into Data ........ 71
    12.2.1 The Ideas from the Group Brainstorming ......................... 71
    12.2.2 The Potential with Using Big Data when Translating the Parameters .......... 72
13 Hypothesis on Detecting a Transition Phase ....................................... 75
  13.1 Hypothesis Creation ............................................................... 75
  13.2 Exploratory Analysis of Hypothesis ........................................... 76
  13.3 Result of the Exploratory Analysis of Hypothesis ......................... 78
  13.4 Statistical Validation of Hypothesis ........................................... 79
  13.5 Result of the Statistical Validation of Hypothesis ......................... 80
  13.6 Visualisation of Driver ID ....................................................... 81
  13.7 Summary of the Results ......................................................... 82
  13.8 Discussion and Conclusions of Hypothesis on Detecting a Transition Phase .... 83
    13.8.1 The Assumption of the Graphs being Linear ....................... 83
    13.8.2 The Choice of Data in the Hypothesis Creation ................... 83
    13.8.3 The Exploratory Analysis .................................................. 84
    13.8.4 The Statistical Validation .................................................. 85
    13.8.5 Visualisation of Driver ID ................................................. 86
14 The Transition Alert Algorithm ...................................................... 89
  14.1 Two Types of Transition Phases ............................................... 89
  14.2 How the Algorithm Works ....................................................... 89
  14.3 Implementation of Driver-ID in the Algorithm ............................. 91
  14.4 Discussion and Conclusions of Transition Alert Algorithm ............. 91
14.4.1 Two Different Types of Transition Phases ......................................................... 91
14.4.2 How the Algorithm Works .................................................................................. 92
14.4.3 Implementation of Driver ID in the Algorithm ................................................... 93

15 Mapping the System of the Transportation Business ................................................. 95
15.1 System Map of the Transportation Business ........................................................... 95
15.2 Detecting a Transition Phase Today ................................................................. 96
15.3 Discussion and Conclusions of Mapping the System of the Transportation Business .... 97
15.3.1 System Map of the Transportation Business ................................................. 97
15.3.2 Detecting a Transition Phase Today .................................................................. 98

16 Possible Stakeholders for the Transition Alert Service ............................................... 99
16.1 Finding Stakeholders ............................................................................................ 99
16.2 Personas ................................................................................................................. 101
16.3 Discussion and Conclusions of Personas ............................................................ 103

17 Capture of Needs ....................................................................................................... 105
17.1 List of Needs .......................................................................................................... 105
17.2 Discussion and Conclusions of List of Needs ..................................................... 105

18 Transition Alert Service Development ..................................................................... 107
18.1 Idea Generation ..................................................................................................... 107
18.2 Description of Transition Alert Service .......................................................... 107
  18.2.1 Service Blueprint ......................................................................................... 108
18.3 Discussion and Conclusions of Transition Alert Service Development ............. 112
  18.3.1 How the Transition Alert Service Fulfil the Identified Needs ......................... 112
  18.3.2 The Servicification Perspective ..................................................................... 112
  18.3.3 Using Telematics and Intelligent Vehicles .................................................. 113
  18.3.4 Big Data in the Service Creates Business Opportunities ............................ 113
  18.3.5 An Ethical View on the Solution .................................................................... 114
  18.3.6 The Second-Hand Market ............................................................................ 114

19 Possible Applications of the Transition Alert Service ............................................ 115
19.1 Idea Generation .................................................................................................... 115
  19.1.1 Brainstorming ............................................................................................... 115
  19.1.2 Workshop with Distributor ............................................................................ 116
  19.1.3 Workshop with Experts at Scania .................................................................. 117
19.2 Concept Selection ................................................................................................... 118
  19.2.1 Services Connected to Change in Ownership .............................................. 119
  19.2.2 Services Connected to Change in Utilization ............................................. 121
  19.2.3 Example of a Total Solution – “No Worries Second-Hand” ......................... 122
19.3 Discussion and Conclusions of Possible Applications of the Transition Alert Service ... 123
  19.3.1 The Potential Services .................................................................................. 123
  19.3.2 Services Connected to Change in Ownership .............................................. 124
  19.3.3 Services Connected to Change in Utilization ............................................. 126
  19.3.4 Example of Total Solution – “No Worries Second-Hand” ......................... 126
  19.3.5 Eliminated Concepts ...................................................................................... 127

20 Methodology Discussion ............................................................................................ 129
Appendix I – Interviews with Resellers ...........................................................................................................195
Appendix J – Result of Group Brainstorming Translating Parameters into Data ........................................207
Appendix K – Visualisations from the Hypothesis Validation ......................................................................213
Appendix L – Brainstorming Transition Alert Service ..................................................................................249
Appendix M – Brainstorming on Possible Applications ..............................................................................257
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Visualisation of the research plan</td>
<td>7</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Shows the three different areas with its lifecycle characteristics</td>
<td>19</td>
</tr>
<tr>
<td>Figure 3</td>
<td>P-series</td>
<td>21</td>
</tr>
<tr>
<td>Figure 4</td>
<td>G-series</td>
<td>22</td>
</tr>
<tr>
<td>Figure 5</td>
<td>R-series</td>
<td>22</td>
</tr>
<tr>
<td>Figure 6</td>
<td>A schematic view over the communication system in the truck</td>
<td>25</td>
</tr>
<tr>
<td>Figure 7</td>
<td>A schematic view over the embedded electronic system</td>
<td>26</td>
</tr>
<tr>
<td>Figure 8</td>
<td>Levitt’s lifecycle model</td>
<td>27</td>
</tr>
<tr>
<td>Figure 9</td>
<td>The product lifecycle</td>
<td>28</td>
</tr>
<tr>
<td>Figure 10</td>
<td>The prioritization matrix</td>
<td>33</td>
</tr>
<tr>
<td>Figure 11</td>
<td>A two-sided test</td>
<td>36</td>
</tr>
<tr>
<td>Figure 12</td>
<td>Normal probability table for negative Z</td>
<td>37</td>
</tr>
<tr>
<td>Figure 13</td>
<td>Normal probability table for positive Z</td>
<td>38</td>
</tr>
<tr>
<td>Figure 14</td>
<td>Black box for transition alert service</td>
<td>43</td>
</tr>
<tr>
<td>Figure 15</td>
<td>A schematic view over the truck’s lifecycle</td>
<td>44</td>
</tr>
<tr>
<td>Figure 16</td>
<td>Movement of the truck when it starts being exported</td>
<td>49</td>
</tr>
<tr>
<td>Figure 17</td>
<td>Description of a truck’s lifecycle including type A and B phase</td>
<td>59</td>
</tr>
<tr>
<td>Figure 18</td>
<td>Phase-DNA with the six parameters described</td>
<td>61</td>
</tr>
<tr>
<td>Figure 19</td>
<td>Different data describing the parameter Geography</td>
<td>66</td>
</tr>
<tr>
<td>Figure 20</td>
<td>Different data describing the parameter Route</td>
<td>67</td>
</tr>
<tr>
<td>Figure 21</td>
<td>Different data describing the parameter Driver</td>
<td>68</td>
</tr>
<tr>
<td>Figure 22</td>
<td>Different data describing the parameter Traffic Condition</td>
<td>69</td>
</tr>
<tr>
<td>Figure 23</td>
<td>Different data describing the parameter Assignment</td>
<td>69</td>
</tr>
<tr>
<td>Figure 24</td>
<td>Different data describing the parameter Service</td>
<td>70</td>
</tr>
<tr>
<td>Figure 25</td>
<td>Different data describing the parameter Future</td>
<td>71</td>
</tr>
<tr>
<td>Figure 26</td>
<td>The phase-DNA parameters with belonging data types used in the hypothesis</td>
<td>75</td>
</tr>
<tr>
<td>Figure 27</td>
<td>Graph over a vehicle where there is no change in the gradient</td>
<td>76</td>
</tr>
<tr>
<td>Figure 28</td>
<td>Graph over a vehicle where there is a gap around the date for change in ownership</td>
<td>77</td>
</tr>
<tr>
<td>Figure 29</td>
<td>Graph showing Distance Driven over the whole lifecycle for vehicle 3233</td>
<td>79</td>
</tr>
<tr>
<td>Figure 30</td>
<td>Driver IDs for the eight vehicles over one owner change</td>
<td>82</td>
</tr>
<tr>
<td>Figure 31</td>
<td>The phase-DNA</td>
<td>83</td>
</tr>
<tr>
<td>Figure 32</td>
<td>A system map with actors involved in the transportation business</td>
<td>95</td>
</tr>
<tr>
<td>Figure 33</td>
<td>A picture of how it looks today when a transition phase is detected</td>
<td>96</td>
</tr>
<tr>
<td>Figure 34</td>
<td>Possible stakeholders for the transition alert service</td>
<td>100</td>
</tr>
<tr>
<td>Figure 35</td>
<td>A visualisation of how TAS works and how it fuls the five identified needs</td>
<td>107</td>
</tr>
<tr>
<td>Figure 36</td>
<td>Service blueprint describing how TAS is used when starting and cancelling a service</td>
<td>109</td>
</tr>
<tr>
<td>Figure 37</td>
<td>Service blueprint describing how TAS is used in order to customize services</td>
<td>110</td>
</tr>
<tr>
<td>Figure 38</td>
<td>Service blueprint describing how TAS is used to avoid unnecessary telecom expenses</td>
<td>111</td>
</tr>
<tr>
<td>Figure 39</td>
<td>Services, change in ownership</td>
<td>119</td>
</tr>
<tr>
<td>Figure 40</td>
<td>Services, change in utilization</td>
<td>122</td>
</tr>
<tr>
<td>Figure 41</td>
<td>A description of the total solution “No Worries Second-Hand”</td>
<td>123</td>
</tr>
</tbody>
</table>
List of Tables

Table 1 Literature search terms. .................................................................................................................. 9
Table 2 Application types ............................................................................................................................... 22
Table 3 The respondents participating in the first interview study. ............................................................... 43
Table 4 The respondents participating in the second interview study. ........................................................ 47
Table 5 Final results of the exploratory analysis ......................................................................................... 78
Table 6 Calculations of mean, standard deviation and sample size for the two last owners. ................. 80
Table 7 Calculations of point estimate, standard error, Z score and tail. .................................................. 80
Table 8 Results from calculating p-value and confidence interval ............................................................ 81
Table 9 Summary of which data types indicates a transition phase type T1 and T2. ............................. 89
Table 10 Respondents participating in the interviews for creating personas............................................ 99
Frequently Used Terms

C200..............................................Scania’s communicator, a telematics unit containing a SIM-card.

Euro5/Euro6.................................Emission standard defining the acceptable limits of exhaust emissions of vehicles sold in EU member states.

FMS.............................................Fleet Management Services

Haulier........................................A company transporting goods by truck.

ICT...........................................Information and Communication Technology

IS................................................Integrated Solution

Long-haulage...............................Transportation with an average distance of at least 600 km from the starting point to end destination. The vehicle is loaded and unloaded only a few times during one trip.

OEM..........................................Original Equipment Manufacturer

R&M ...........................................Repair and Maintenance

Second-hand vehicle......................In this thesis used as a description of trucks sold for the second, third, fourth time and so on.

SOPS ..........................................Scania Onboard Product Specification, a data file that describes a truck’s unique specifications. Can be seen as the vehicle’s DNA.

SQL...........................................Structured Query Language, a program language used when working with a relational database.

Tachograph.................................An automatic recorder of the vehicle’s distance and speed.

TAS...........................................Transition Alert Service, the developed service detecting a transition.

Telematics..................................The science of processing data for storage and retrieval, dealing with the use of computer technology in telecommunications.

The Swedish Transport Agency ......A Swedish government agency that regulates and inspects transportation systems in Sweden.
1 Introduction

In this chapter the background, objective and research questions are presented. This is followed by a description of the case used in this study, Scania. Finally the delimitations and report outline are presented.

1.1 Background

Due to the new information and communication technology (ICT), businesses tend to gather and use data for value creation instead of focusing on tangible benefits (Kowalkowski et al., 2013). In the past few decades leading companies have started to add services to their existing product offerings to create competitive advantage (Fang et al., 2008; Lee et al., 2015). Brady et al. (2008) stress that some of the leading firms in the world have started to focus on delivering solutions rather than separate products or services. These integrated solutions (IS) will enable the businesses to provide more customer specific offers (Brady et al. 2008).

Previous work on services through the truck’s lifecycle has been done by Vigmo & Sundkvist (2014). They showed that long-haulage truck’s lifecycle phases are characterized by differences in utilization and not by distinctive owners. According to Vigmo & Sundkvist (2014) business related characteristics show that the further away in the truck’s lifecycle, the focus on delivery precision, use frequency and complex business operations decrease. Vehicle related characteristics show that the further away in the truck’s lifecycle the demand for technically advanced functions, need for vehicle reliability and the tendency to turn to original equipment manufacturers (OEM) for repair and maintenance decrease (Vigmo & Sundkvist, 2014). Further they stress that driver related characteristics show that the further away in the truck’s lifecycle and the further away from Europe the loyalty towards the business, the incentive to use technical devices and the focus on drivers’ working environment decreases.

The total lifecycle of a vehicle includes many transition phases: from production to delivery, from delivery to sales, from sales to first customer, from first customer to second customer and so on until end of life. The different phases include different activities, business areas and conditions. This means that the customers’ needs will vary depending on which phase the vehicle is in and the offered services have to be adapted to this. Therefore it is important for truck developing companies to know when a phase transition has occurred to be able to provide the right services at the right time.

1.2 Objective

The objective is to define the transition phases in the lifecycle of a long-haulage truck from one lifecycle phase to another and develop concepts for a transition alert service (TAS). The focus is to study the transition phase based on the long-haulage trucks’ usage patterns and locate the data needed for the development of the service. Based on this, the developed service will be a tool for long-haulage OEMs, so that they can provide customers with the right services at the right time. In order to accomplish above objectives, Scania will be used as a case, see chapter 1.4.
1.3 Research Questions

In this section the research questions are presented and explained.

RQ1) What defines a transition phase?

The purpose of RQ1 is to gain deeper knowledge of the different lifecycle phases of a long-haulage truck and understand which usage patterns define the different phases. In order to be able to continue the study and answer the following research questions, it is important to have a thorough description of a transition phase.

RQ2) How can the long-haulage trucks’ usage pattern be used to identify a transition phase?

RQ2’s aim is to gain knowledge about the long-haulage truck’s business and usage patterns. Based on this knowledge, usage patterns are compared in order to identify a transition phase. The answer to RQ2 will be crucial to be able to progress to RQ3.

RQ3) Which data is needed to identify a transition phase?

RQ3 is used for creating a hypothesis concerning the translation of usage patterns into data. When the appropriate data is identified and a hypothesis is established, it will be tested. The answer to RQ3 includes the information needed for the development of the transition alert service.

RQ4) Based on the results of RQ2 and RQ3, how could the transition alert service be designed?

Using the knowledge gained, and the results created in the previous questions, RQ4’s aim is to describe how the transition alert service works and which activities are needed.

RQ5) Which applications could the transition alert service be used for?

The answer to RQ5 describes the importance of developing a transition alert service by presenting possible applications of the service.

1.4 Scania Case Description

The Swedish truck and bus manufacturer Scania CV has followed the trend of using ICT to create service offerings. In every truck there is a communicator collecting data that can be used to develop services customized for the specific customer needs (Scania Inside, 2013). Since 2011, Scania’s trucks are equipped with a telematics connection, that makes it possible to communicate data about the vehicle and the drivers (Scania AB, 2013A). Scania uses the collected data to offer services such as fleet management, maintenance and driver training (Scania AB, 2013A).

Today Scania has limited knowledge concerning transition phases, this could become a problem e.g. in the case of a change of ownership where Scania could deliver the wrong service to the wrong customer. This specific problem can be solved in Sweden by checking the vehicle register from The Swedish Transport Agency, but this method has to be done manually and does not work on a global scale. Therefore, a new independent solution that informs about a phase transition is needed.
1.5 Delimitations

Due to problems with identifying the owner of a vehicle when it is in one of its later lifecycle phases, stressed in the previous work and by employees at Scania, the study will focus on the early transition phases where the OEM can still earn money from the customers by providing services.

The study will not include economical calculations and estimations of eventual financial gain of the developed service.

The transition alert service will be presented on a conceptual level and not be described in detail. This means that there will not be any deeper descriptions on a technical level or full recommendations for the implementation of the service.

To delimit the study, this thesis will focus on long-haulage trucks that are connected through telematics and with the assumption that the vehicles are located in Europe in the first lifecycle phase.

1.6 Report Outline

1. **Introduction** – Aims at introducing the reader to the subject by presenting the background, objective, research questions, a description of the case and delimitations.

2. **Methodology** – A presentation of the research plan and the included steps. For each step the chosen methods are presented and motivated.

3. **Previous work on Lifecycle Characteristics** – A short presentation of the previous work done on lifecycle characteristics that this study is using as a starting point.

4. **Scania and the Current Service Offerings** – Presentation of the company Scania CV, its long-haulage trucks and the current service offerings. Finally a visualization of the embedded electronic system that enables the service offerings is presented.

5. **Theoretical Framework** – The theories supporting the study are described. This includes product lifecycle theory, second-hand market, servicification, big data, telematics, intelligent vehicles and theory about statistical hypothesis testing.

6. **Observations of Truck Drivers** – This chapter describes the observations of two truck drivers, presentation of the findings and discussions and conclusions of the result.

7. **First Mapping of Characteristics of the Lifecycle Phases** – A presentation of the first interview study’s result and discussion and conclusions of the findings.

8. **Second Mapping of Characteristics of the Lifecycle Phases** – General findings from the second interview study are presented. The chapter ends with discussion and conclusions.

9. **Validation of Previous Work on Lifecycle Characteristics** – A validation, based on the findings from the interview studies, of each of the lifecycle characteristics described in the previous work. The chapter ends with a summary of the findings.

10. **Defining Transition Phase** – A description of the definition of a transition phase made by the authors of this thesis. Further, the definition is discussed and conclusions are presented.

11. **Parameters Describing the Lifecycle Phases** – The chapter includes a presentation of the parameters that describe a transition phase, followed by a new way of describing the lifecycle of a truck, named phase-DNA. Finally, discussion and conclusions are presented.

12. **Translating Parameters into Data** – Presentation of the results from a group brainstorming done with experts at Scania, where the parameters described in the previous chapter are translated into measurable data. This is followed by discussion and conclusions of the findings.
13. **Hypothesis on Detecting a Transition Phase** – In this chapter the hypothesis creation regarding how the data from the previous chapter could be used to detect a transition phase is described. This is followed by an exploratory and a statistical validation. Finally discussion and conclusions are presented.

14. **The Transition Alert Algorithm** – This chapter describes the design of the transition alert algorithm on a high level, and the test of implementing one data type into the algorithm. This ends with discussion and conclusions.

15. **Mapping the System of the Transportation Business** – Presentation of a system map describing the flows of information, money, services, products and value between different actors. Further, a visualisation of the current process of detecting a transition phase is presented. Finally, discussion and conclusions are presented.

16. **Possible Stakeholders for the Transition Alert Service** – Possible stakeholders for the transition alert service are presented, and further summarized into four personas. The chapter ends with discussion and conclusions.

17. **Capture of Needs** – Presentation of the stakeholders’ primary needs, discussion and conclusions.

18. **Transition Alert Service Development** – Development of the transition alert service consisting of idea generation and a description of the chosen service concept. Ends with discussion and conclusions.

19. **Possible Applications of the Transition Alert Service** – Description of possible applications of the developed transition alert service. The chapter includes the result from the idea generation and concept selection, and ends with discussion and conclusions.

20. **Evaluation of Methodology** – The research plan and the including steps and methods are evaluated and discussed.

21. **Conclusions** – Summarizes the main results from the study by answering the research questions. Further, recommendations for future work are presented.

22. **Bibliography** – A list of all references used in this study.

23. **Appendix** – Interview questions, figures, tables and pictures referenced to in the report are presented.
2 Methodology

In this chapter the overall research plan and the different phases included in the study are described. Further, each method is presented with theory and justifications.

2.1 Research Plan

The research strategy chosen for this thesis was case study, where Scania was chosen as a case. According to Yin (1994) case studies are useful when “how” and “why” questions are posed, and they can be explanatory, descriptive and exploratory. This thesis includes a case study since the research questions RQ2 and RQ4 are “how”. The case study approach is also suitable because the thesis aims at, as Yin (1994) expresses it: “investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.” Yin (1994) stress that the case study has the strength to handle different kinds of information, e.g. interviews, observations and documents, which fits with this thesis.

Yin (1994) emphasizes the importance of “multiple sources of evidence” to ensure internal validity. In this thesis, this is considered by using literature, observations and interviews with people with different roles when gathering information. To get a good result, Yin (1994) argues that external validity is important. According to Yin (1994), case studies rely on analytical generalizations, which means that the result is being generalized to a set of broader theory. Yin (1994) emphasises that to be sure that the generalization is correct, it has to be tested. To meet all these suggestions, an analytical approach has been used and results have been partly generalized in order to fit long-haulage OEMs and not just the specific case. Further, hypothesis testing has been used to ensure that the results are reliable.

The research plan for this thesis included eight phases: Problem Formulation, Literature Study, Empirical Studies, Analysis, Hypothesis, Pre-Service Development, Service Development and Possible Applications. In Figure 1 below, the research plan is visualized. The plan was inspired by Adamopoulos et al. (2002) that describes a methodology for service development. To be able to use the model some changes were done. Since the method suggested by Adamopoulos et al. (2002) is developed for designing telematics services it is similar to agile methods for software development. The authors of this thesis have a background in design and product development, and therefore the method described by Adamopoulos et al. (2002) was complemented with methodology suited for product design inspired by Ulrich & Eppinger (2008). Ulrich & Eppinger (2008) advocate a linear approach, something that can be found in many models for design processes e.g. Cooper (1979), French (1971), Hall (1968) and Pahl & Beitz (1984). The reason behind choosing Ulrich & Eppinger (2008), was that the authors of this thesis were comfortable with this process. The linear process was used when creating the eight main phases and the agile approach was used when looping inside and between the phases. Combining the linear process with an agile approach in each phase, gave a methodology more suited for service development, which is supported by Bullinger et al. (2003).
Bullinger et al. (2003) and Sommer et al. (2015) stress that linear models are not flexible and can therefore become more time consuming than necessary and this kind of method makes it harder to adapt to changes in the project. Bullinger et al. (2003) argue on the other hand that, by using a linear approach, the development process becomes very transparent and easy to follow. According to Bullinger et al. (2003) agile models make it easy to adapt to changes during the project. By combining an agile and a linear process, the authors of this thesis hoped to be able to get the best from the two methods and eliminate some of the problems mentioned above.

The five stage model for concept development suggested by Ulrich & Eppinger (2008) could be summarized to: “Clarify the problem”, “External search”, “Internal search”, “Explore systematically” and “Reflection”. The mentioned activities could also be found in basic engineering design processes described by French (1971) and Pahl & Beitz (1984). Using the linear approach from Ulrich & Eppinger (2008) in the creation of the research plan, helped to ensure that all stages in the development process were done. The first activity suggested by Ulrich & Eppinger (2008) called “Clarify the problem” was done during the problem formulation. Ulrich & Eppinger (2008) “External search” consisted in this thesis of the literature search and the empirical studies, see Figure 1. “Internal search” which according to Ulrich & Eppinger (2008) is a phase when the internal expertise is used, was mainly executed during the idea generation in the phase called Possible Applications. The phases “Explore systematically” and “Reflection” were done during the phases called Analysis and Hypothesis but also more or less in parallel to all the eight phases.

Service development process should be iterative, incremental and that development cycles should be used (Adamopoulos et al., 2002; Abrahamsson et al., 2003; Sommer et al., 2015; Stickdorn & Schneider,
Adamopoulos et al. (2002) mention six steps that together create one service development cycle that should be iterated until the result has reached the required level of detail. Adamopoulos et al. (2002) suggest the first step to be “Requirements capture and analysis phase”, which includes assembling, documenting and structuring requirements on the service based on different stakeholders’ interests. This is done in this thesis during the Pre-Service Development, see Figure 1. The second step is “Service analysis phase”, where the functionality needed to ensure that the requirements are fulfilled will be defined (Adamopoulos et al., 2002). In this thesis this step consists of a concept selection and is done during the phase called Possible Applications, see Figure 1. This is, according to Adamopoulos et al. (2002), followed by “Service design phase” where the service is defined and the actions included in the service are described. In this thesis this is done in the phase called Service Development when creating service blueprints and in the phase Possible Applications when developing a final solution. “Service implementation phase”, as mentioned as the next step by Adamopoulos et al. (2002), was done in the phase Possible Applications, when applications for the transition alert service were investigated. The final step suggested by Adamopoulos et al. (2002), “Service validation and testing phase”, was not done because of the delimitations of this thesis.

2.2 Problem Formulation

The problem formulation consisted of a study of the previous thesis done by Vigmo & Sundkvist (2014) and internal information from Scania. In accordance with Ulrich & Eppinger (2008), the problem was broken down to sub problems, and the research questions and delimitations were created.

The aim with studying the previous work was to find partial results that could be interesting for this work. The initial problem, stated by Scania, was evaluated and adapted to fit the frame of this thesis. Studying the previous work gave a deeper understanding about the subject and gave suggestions on adequate literature. As the authors of the thesis gained more knowledge about the subject, iterations were done and the research questions were revised.

2.3 Literature Study

The literature study was done by following the five stages suggested by Hart (1998). The first step was mapping the topic and searching for background information and ideas, which resulted in a provisional list of authors, works and concepts. By analysing the information needs, online databases and internal databases at Scania were identified as sources of information. After that a detailed search of the sources was made in order to find articles, reports, books, and conference papers. Finally the literature was analysed by following a cyclical process for a traditional review suggested by Jesson et al. (2011). Starting with writing summaries for each paper and evaluating the evidence that was presented, the papers were later compared to find similarities and differences and this process was iterated until a suitable amount of information was reached.

The collected literature together with the previous work done by Vigmo & Sundkvist (2014), helped answering RQ1 and gave a deeper knowledge about the topic and previous research in the area. Through this it was possible to formulate more insightful questions, which is important when doing a case study research according to Yin (1994). He also stresses that theory development is vital before starting the empirical study. The topics that were studied to gain a better knowledge about services were: integrated solutions, service development and servification. To understand the background of this thesis, theories about product lifecycle and the second-hand market were studied. Since this study
includes analysing data from the embedded electronic system in the vehicle, articles about telematics, big data and smart vehicles were read. Theory regarding statistical testing was studied in order to be able to validate the hypothesis. A detailed description of used terms for the literature search is seen in Table 1.

Table 1 Literature search terms.

<table>
<thead>
<tr>
<th>Area</th>
<th>Terms</th>
<th>Database</th>
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<tbody>
<tr>
<td>Servicification</td>
<td>Transition strategies</td>
<td>Scopus</td>
</tr>
<tr>
<td>Service business orientation</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Service-based offerings</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Partnership</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Service engineering</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Second-hand market</td>
<td>Design for re-use</td>
<td>Science Direct, EBSCO</td>
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<tr>
<td>Remanufacturing</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Service development</td>
<td>Methodology</td>
<td>Scopus</td>
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<tr>
<td>Process</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Integration</td>
<td>Scopus</td>
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<tr>
<td>Design</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Integrated solution</td>
<td>IPSO</td>
<td>Scopus</td>
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<tr>
<td>Network</td>
<td>Scopus</td>
<td></td>
</tr>
<tr>
<td>Product service system</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Value creation</td>
<td>Scopus</td>
<td></td>
</tr>
<tr>
<td>Product lifecycle</td>
<td>Model</td>
<td>Scopus, ScienceDirect</td>
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<td>Simulation</td>
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<td>Automotive industry</td>
<td>Scopus, ScienceDirect</td>
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<td>ICT</td>
<td>Scopus</td>
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<tr>
<td>Communication technology</td>
<td>Scopus</td>
<td></td>
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<tr>
<td>Intelligent vehicles</td>
<td>Intelligent vehicles</td>
<td>Scopus, Springer Link, OAlster, InLine, Scania</td>
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<tr>
<td>Big data</td>
<td>Databases</td>
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<td>Analyze</td>
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<td>Use cases</td>
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<td>Engineering</td>
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<tr>
<td>Business opportunities</td>
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<tr>
<td>Ethics data security</td>
<td>Business Source Premier</td>
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<td>Ethics big data customer</td>
<td>Inspec</td>
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<td>Hypothesis testing</td>
<td>Statistics</td>
<td>Scopus</td>
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<td>P-test</td>
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<tr>
<td>Confidence level</td>
<td>Scopus</td>
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2.4 Observation of Truck Drivers

McDonald (2005) stresses that observation is a method that is used for understanding how people behave, interact and use artefacts within a given context. It can be used for understanding what people really do and not only what they say they do. Observation does not give information about feelings or wishes, then the method has to be complemented by interviews (Osvalder et al., 2010). There are according to McDonald (2005), three ways to carry out an observation: natural, controlled and participatory. Natural means that the observer is not interfering with the action that is being carried out. The controlled observation is when the investigator sets a task and observes it being carried out.
Finally, the participatory-type is when the investigator joins the activity and gains a first-hand perspective. In this study observations were carried out partially natural and partially participatory with two truck drivers driving long-haulage trucks. Since the truck was able to accommodate only one guest at the time, only one person was observing, taking notes and asking questions. Because of the secrecy restrictions it was not possible to take photographs. The driver was asked to “think aloud”, which means that the driver described what he was doing and why. According to Van den Haak et al. (2004), this method reflects the real usage of an artefact because the user does not have the time to add a judgment to his actions. Observations were done to understand how a truck driver works, which actions he or she does and especially to learn more about the truck itself.

The two observations were executed the 23 February 2015 to gain a better understanding of how the trucks were used and driven. The observations lasted two hours each, and were carried out on Scania’s test track in Södertälje with experienced drivers. Since the authors of this thesis had not been sitting in a truck before, this method was important to be able to connect the theory to a real case. The observations were therefore not performed to make new findings, but rather to understand the environment the driver is working in. To ensure that the two observations were carried out in the same way, observation protocols were prepared. These included a picture of the interior of the cabin and some questions. The observation protocols can be seen in Appendix A. The observations took two hours each.

2.5 First Mapping of Characteristics of the Lifecycle Phases

An interview study following the seven stages of an interview investigation described by Kvale (1996) were used in this study as a method for qualitative research. Kvale (1996) suggests that the investigation should consist of the following steps: thematising, designing, interviewing, transcribing, analysing, verifying and reporting. The aim with the study was to gather information about the long-haulage business, the use of the trucks, in-depth information about which artefacts are used, how they are used and how the communication flows among actors. Both new and used vehicles were considered in the study. Semi-structured in-depth interviews were chosen. Unstructured interviews were not chosen because of the need of specific information, neither were structured interviews, because they often produce quantitative data (DiCicco-Bloom & Crabtree, 2006), which is not the main focus of this study.

Interviews were used to collect data, and provided a basis for answering RQ1, RQ2 and RQ3 which have slightly different focus. RQ1 focuses on phase transitions and requires therefore a bigger picture of the transportation business and a general understanding of trucks’ lifecycle phases. RQ2 focuses on usage patterns and needs therefore information related to the users and RQ3 requires more technical information related to the usage patterns. This is why the sample of interviewees was composed by representatives from hauliers, distributor, service market salespersons and resellers. In total seven people were participating in the first interview study. According to McCracken (1988) it is important to have a fairly homogeneous sample of interviewees that share critical similarities related to the research questions. In this case homogeneity was created by the fact that all interviewees had a relation to Scania, which was important for this case study. Interviewees for the first interview study were found through personal contacts at Scania.

The semi-structured in-depth interviews were scheduled in advance, as suggested by DiCicco-Bloom & Crabtree (2006), in some cases carried out at the interviewee’s workplace and in others by phone. The
interviews had questions touching eight main subjects and the questions were adapted to the
respondent’s area of knowledge. This means that different interview schemes were prepared: one for
hauliers, see Appendix B, one for salespersons service market, see Appendix C, and one for resellers,
see Appendix D. For the internal specialists at Scania, the interview scheme that suited their area of
knowledge best was chosen. The time to carry out the interviews varied from 10 to 90 minutes. To
broaden the study, different actors involved in both first-hand and second-hand businesses were
participating in the interviews. The hauliers were both small and big companies and the resellers were
both captive and non-captive dealers.

Group interviews might have saved time, but were not used because of the risk of candidates
influencing each other and reducing the interviewer’s control of the situation, as mentioned as a risk
by Kvale (1996). Only in two cases the interview was done with two people at the same time and this
was because of time constraints. The interviews were audio recorded and notes were taken. In order
to maintain the anonymity of the interviewee no personal information is mentioned in this thesis. To
ensure that the interview questions covered the research questions, cross tables were made. Since the
questions mainly were based on the characteristics identified by Vigmo & Sundkvist (2014), the authors
of this thesis chose to create a cross table with the interview questions combined with the
characteristics, see Appendix F.

As soon as one interview was finished it was transcribed to minimize the risk that data got lost or were
misunderstood. According to DiCicco-Bloom & Crabtree (2006) and Kvale (1996) there are some risks
with using transcripts, since while transcribing judgments are done when trying to capture the spoken
words in text form. This was taken into account when using the interview data. As recommended by
Miles & Huberman (1994) the analysis of the collected data begun in an early stage since it would help
organizing and collecting data for further analysis. Analysis of the collected data was done by
comparing the answers that belonged to the same category. This was done by colour coding segments
with similar content and then sorting them under different themes. This method was inspired by Miles
& Huberman (1994). By doing so, trends and categories could be identified. Afterwards these were
analysed through a broader perspective and discussed between the authors of this thesis. The reason
behind using a structured method was that, according to DiCicco-Bloom & Crabtree (2006), just looking
into the data until interpretations can be done requires a lot of experience from qualitative research.
Combining the structured way to organize the data in different themes with a less structured approach
as discussing and reflecting over the collected data, ensured a certain depth to the analysis. Since the
main aim of the first interview study was to see whether the questions were good enough and had the
right focus, the first analysis was less detailed.

It was already in this early stage taken into account that the information gathered from the analysis
was supposed to be a basis for the later service development. Adamopoulos et al. (2002) suggest that
the service should be seen as a black box, where focus should be on the functionality that is needed
to fulfil the service. Using black box makes it easy to overview the system (Adamopoulos et al., 2002;
Mital et al., 2008), and focus can be put on inputs, outputs and the main purpose and not trying to
solve smaller problems (Mital et al., 2008). The aim with this method was to create a clear visualization
of the problem, the analysed observation and the interview data. The aim was also to start the idea
generation about how to translate the characteristics into real and measurable data. The reason
behind already in this early stage starting the idea generation, was that the study was inspired by
Adamopoulos et al. (2002) who stress the importance of having an agile working approach. According
to Bullinger et al. (2003) iterations make it easier to adapt to changes during the project, and therefore the authors of this thesis wanted to start the idea generation early to make sure that there was time to change and adapt the interview questions and analysis tools if necessary. This is confirmed by Briggs (1986) who sustains that to enrich the quality of the data the selection of interview participants is based on an iterative process, where some interviews are done, followed by preliminary analyses and then more respondents are selected in order to fill in emerging questions.

2.6 Second Mapping of Characteristics of the Lifecycle Phases

After the analysis of the first interview study it could be seen that more interviews had to be done. The interview questions to the resellers were modified after doing the first analysis and the black box. Also, focus shifted from resellers of new trucks to resellers of used trucks. Used truck resellers were found by looking at Scania’s used vehicle homepage, and hauliers were contacted through registers at the Swedish Scania distributor. The respondents answered to the interview questions in Appendix B, Appendix C and Appendix E. To gain a broader perspective, respondents from other countries in Europe: Czech Republic, Denmark, Italy, Poland and Spain were participating. In total 20 people participated in the second interview study. The second interview study was conducted in the same way as the first one, in accordance to Miles & Huberman (1994) and following Kvale’s (1996) seven stages of an interview investigation. Both the data gathered in the first and second interview study were analysed. First the transcripts of the recorded interviews were printed out and read a couple of times, then notes were taken and different colours were used to code different findings. These findings were then compared and sorted into different themes. The themes were analysed, and sorted again. Finally, six themes were defined. The coding suggested by Miles & Huberman (1994) was done in more detail, compared to the first interview analysis, to ensure that all data were analysed in the same way and in an adequate depth. The final analysis made it possible to validate the characteristics defined in the previous work done by Vigmo & Sundkvist (2014) and a definition of transition phase could be created, which was the answer to RQ1.

The colour coding from the analysis of the second and first interview study was used to identify different themes that could be used for describing the lifecycle phases of a truck. Especially the answers regarding transition phase, seen in Appendix I, were helpful. The analysis and combination of the colour coded themes resulted in a description of what parameters differ from one lifecycle phase to another. The authors of this thesis named this description as phase-DNA. Finding the parameters and describing the phase-DNA was the answer to RQ2. The parameters included in the phase-DNA were used in the following step: translating characteristics into data.

2.7 Translating Parameters into Data

Group brainstorming was used to generate ideas about how to translate the six identified parameters, from the interview studies, into data. A group of three people coming from different departments working with the connected services, together with the two authors of this thesis gathered for 1,5 hours to create ideas. According to Wilson (2013) the participants should have different backgrounds, and therefore the people participating were experts from different parts of the department of connected services at Scania. Wilson (2013) emphasises that group brainstorming aims at creating a lot of divergent ideas, which was suitable in this case since the writers of this thesis wanted to get inspiration and use the knowledge from other people. The group brainstorming was an excellent way to carry out the “Internal search”, stated by Ulrich & Eppinger (2008).
To generate more ideas, and encourage the participants to be creative, a provocation technique suggested by De Bono (1995) was used. According to De Bono (1995) the provocative operation should be labelled as a “PO” so that all the participants know for sure that it is just a provocation and should not be seriously concerned. De Bono (1995) also mentions that the movement is a crucial part of the brainstorming. This means that the first crazy idea is just the starting point, the interesting parts that make a difference are the ones that follow (De Bono, 1995). Therefore it was important to let the ideas during the brainstorming lead to new ideas and not reject any crazy ideas in the first stage.

To ensure that the participants were feeling comfortable in the group and with the task, the session started with an introduction about the thesis, the aim with the brainstorming and a presentation of the participants. Then the brainstorming session started and ideas were generated about one theme at the time. The collection and organization of all the information from the group brainstorming was done by using affinity diagrams. The method, also called K-J method, is according to Cheng & Leu (2011) used for translating data into information and organize it under different themes. The process is subjective, which has to be taken into account when using it (Cheng & Leu, 2011). To be able to create the diagrams every piece of information was written down on sticky notes and then put on the wall, according to the recommendations from Cheng & Leu (2011). Each of the six themes had its own colour on the sticky notes so that they could easily be distinguished. Next step, stated by Cheng & Leu (2011), was to sort the ideas, by grouping notes with the same theme until connections between them could be seen. After this a final discussions in the group was held, to ensure that all ideas were collected and nothing was misunderstood.

After the group brainstorming the sticky notes were sorted by the authors using affinity diagrams to find even more connections. By sorting and analysing the ideas, it could be decided how to translate the characteristics into data.

2.8 Hypothesis on Detecting a Transition Phase

This phase includes hypothesis creation regarding if the characteristics translated into data could be used to detect a transition phase. The aim with this phase was to answer RQ3.

2.8.1 Hypothesis Creation

The result from the translation of characteristics into data was used as a basis to create a hypothesis about which data could be used to identify phase transitions. According to Khan (2008) the hypothesis was formulated in a simple and general way, and its aim was to answer RQ3. Khan (2008) argues that it should be propositions that can be tested and validated. The reason why a hypothesis was created was that according to Khan (2008), it is a good way to use speculation assumptions, observations and findings from studies.

2.8.2 Exploratory Analysis of Hypothesis

Khan (2008) emphasises that a hypothesis should be tested in an empirical way. According to Khan (2008), there are two phases in the testing of a hypothesis. The first step was to design the test and set up under what conditions the hypothesis should be rejected. The second step was to execute the test and draw conclusions.

The exploratory analysis was executed visually in two steps, using data from Scania’s databases with all the connected vehicles’ FMS data. All vehicles were equipped with C200 and had a given date of
change in ownership. First, five trucks were studied, graphs including the data types from the hypothesis were created for each vehicle, showing the whole life of the trucks.

The second exploratory analysis consisted of creating graphs eight vehicles with an official change of ownership and one reference vehicle without owner change. Instead of showing the whole lifecycle, the graphs were plotted showing two weeks before and after the sales date. The reason behind this was that the authors of this thesis thought it was important to see the change in ownership and/or utilization as fast as possible and it was not considered to be relevant to search for changes occurring far away from the sales date. The analysis of the graphs was done by visually comparing trend lines and patterns before and after the sales date. To ease the comparison the graphs were assumed to be linear.

The data types that showed the best result were used as a starting point for the development for the transition alert service, and two of the most indicative data types, according to the exploratory analysis, were further investigated. One in a statistical hypothesis test, and one with a visualization.

2.8.3 Statistical Validation of Hypothesis

A statistical hypothesis test was conducted in order to complement the exploratory analysis, and it was done using the most indicative data type according to the previous analysis. For more hypothesis test theory see chapter 5.7. A normal model of hypothesis testing using a p-value approach could be summarized according to Diez et al. (2010) into five steps:

1. Express the hypotheses in plain language, and then write them down mathematically.
2. Choose an appropriate point estimate of the parameter of interest.
3. Ensure that the standard error estimate is sound and that the point estimate is nearly normal and unbiased.
4. Calculate the standard error. Construct a picture where the areas representing the p-value are shaded.
5. Use the picture and normal model to compute the test statistic, Z score, and find the p-value in order to evaluate the hypotheses. Conclusions should be written down in plain language.

The calculations were done both by hand and using Excel.

2.8.4 Visualisation of Hypothesis

In order to further investigate a data type that could not be examined by using statistical hypothesis test, a visualisation was done. The visualisation was done in collaboration with a specialist at Scania and included data from the eight trucks. The results were analysed and a further investigation regarding the ownership of some vehicles was made using internet and contacting the responsible dealers and hauliers.

2.9 Implementation of Transition Alert Algorithm

Based on the result from the hypothesis validation one parameter was chosen to be implemented, in order to see if it worked and also to get an example of how the algorithm could look like. This was done by using data from FMS and coding in SQL. SQL was used because this was the way data were stored at Scania. The ideas for the implementation were developed in collaboration with an expert at Scania, that later also helped with the coding. The development was carried out using an agile method.
An idea was discussed, the idea was translated into code, the test was run, the results were discussed and the idea was modified. All these steps were iterated three times.

The development of the algorithm can be seen as a little inspired by Schmarzo (2013), who suggests five steps to be able to define where and how big data can be used. The first step, targeting the business initiative or process, was done during the empirical studies. Step two, data preparation, was done by investigating FMS data and see what is available. Step three and four were done by discussing ideas together with the specialist at Scania and the last step was done by documenting the ideas and finally send in a patent proposal.

2.10 Mapping the System of the Transportation Business

System map was used in order to map the actors involved in the transportation business and the connections between them. The method is described by Morelli & Tollestrup (2007) as a tool used in an analytical phase in order to organize and collect information about an environment or a context, and create an overall picture. The system map includes all the actors that directly or indirectly influence the system, and all the possible interactions between them. This method usually aims at shaping the problem and it helps to generate models of a new system. After mapping the system, Morelli & Tollestrup (2007) sustain that the map can be modified by grouping and organizing actors by their function, this helps getting different points of view and helps identifying new possible combinations of the network. A variation of this method could be the mapping of the different types of flows between the actors, e.g. information, value, money, services and materials.

The method is, according to Morelli & Tollestrup (2007) and Lindahl et al. (2014), suited for developing product service systems. This is due to the fact that these type of offerings are complex and immaterial and are difficult to describe in a simple way (Morelli & Tollestrup, 2007). System map suits this thesis because the transportation business is complex and this method helps both getting an overview and give ideas of how existing elements can be recombined and generate a new solution. While mapping the system, the authors of this thesis also mapped what actors that are involved today when detecting a transition phase. This resulted in a picture showing the different connections between the actors.

2.11 Possible Stakeholders for the Transition Alert Service

According to Stickdorn & Schneider (2011) it is valuable to create a list of stakeholders in order to highlight their interests and motivations. The findings from the first and second interview study were used for listing possible stakeholders for Transition Alert Service (TAS). Also additional interviews with four Scania employees, all working with the connected services, were executed to gain more information and thereby ensure that the personas were described in a correct way. Since the data required were qualitative, and not quantitative, it was suitable with a guided conversation rather than a structured interview, which was in line with recommendations from DiCicco-Bloom & Crabtree (2006). According to Kvale (1996) the less planned the interview is, the more spontaneous the answers will be. The respondents selected for the additional interviews, were chosen because of their background and their knowledge about connected services. To get a broader perspective, the interviewees chosen all worked at different departments at Scania. During the interviews simple notes were taken and from these conclusions could be drawn.

To summarize potential needs and ensure that the service development was done with a user-centred approach, personas were created, as suggested by Martin & Hanington (2011) and Stickdorn &
Further, Martin & Hanington (2012) recommend the amount of personas being between three and five. As Guo et al. (2011) suggests, it was done early in the design process. This helps providing baseline and insights about the user and to define the product specifications (Goodwin, 2009). The personas should contain fictional characters describing the users’ personality, motivation and behaviour (Guo et al., 2011; Martin & Hanington, 2012; Stickdorn & Schneider, 2011). The advantage with using personas, stressed by Gou et al. (2011), is that exploring and evaluating service opportunities can be done easier since the personas include a summary of the information of all the users. Goodwin (2009) stresses that personas are useful for communicating with stakeholders about the audience, building consensus in a team and also help taking technical decisions and business choices. Further, according to Gou et al. (2011), personas can be used when prioritizing the service for the target users and defining service functions and content.

2.12 Capture of Needs

As a part of the service development, Ulrich & Eppinger (2008) mention that a specification of requirement should be created. In this thesis this was done to ensure that both data that was needed as well as requirements from the actors were taken into account. The list acted as a document to look back on during the rest of the service development, to have something to evaluate the different concepts against. Since it was a service that was developed, and not a physical product, and also because it was on a conceptual level no specification of requirement was created in terms of the one described in the literature by Ulrich & Eppinger (2008). Instead needs, stated by the stakeholders, were listed. This list was used in the service development during the idea generation. The design of the list was influenced by Adamopoulos et al. (2002) who argue about the importance of capture the requirements and needs.

2.13 Transition Alert Service Development

The aim with the transition alert service development was to be able to answer RQ4. This means that a concept was created describing how the transition alert service could be designed and how it fulfils the stakeholders’ needs. This phase consisted of idea generation and service blueprint.

2.13.1 Idea Generation

The idea generation started with brainstorming. This was because it, according to Wilson (2013), is a method to facilitate efficacy and creativity. Wilson (2013) argues it is a good method when creating ideas on a conceptual level, and according to Evardsson et al. (2000) brainstorming suits for service idea generation. Sketching was used to document the ideas created during the idea generation, but also as a method to produce more ideas. According to Ulrich & Eppinger (2008) the sketches can be used as a base when discussing different concepts since this often stimulates new ideas. When sketching, PMI was used as recommended by De Bono (1982). This means that sketches with ideas were marked with plus for pros, minus for cons and interesting points for matters that could not fall under either pro or con. The PMI could later, as emphasised by De Bono (1982), be used when evaluating the ideas.

A way to vary the brainstorming and the documentation of the ideas was to use Lego bricks to create simple models that symbolized the solution, which facilitated the discussion of the concepts. This hands-on method produced a deeper, more meaningful understanding of the system and it’s possibilities, which is stated by Tassi (2009) and Lego Serious Play (2015).
The sketching session and the Lego sessions lasted approximately 2.5 hours each and were done twice by the authors of this thesis. The activities were documented with photos and a short descriptive text.

2.13.2 Description of Transition Alert Service

The different ideas, created during the idea generation, were discussed and merged. This lead to a final concept of how the transition alert service works. Service blueprints were created in order to describe the concept, which according to Bullinger et al. (2003) is a method suited for modelling a service. Creating a service blueprint includes: identifying processes, isolating fail points, establishing time frame and analysing profitability (Shostack, 1984). The service blueprints consist of the main areas: physical evidence, customer actions, front stage interaction, backstage interaction and support processes (Fließ & Kleinaltenkamp, 2004). These actions were separated by the horizontal lines: “line of interaction”, “line of visibility” and “line of internal interaction” (Fließ & Kleinaltenkamp, 2004).

According to Shostack (1984) and Lee et al. (2014) a blueprint enables the service developer to use a method that is quantifiable and objective, and Kingman-Brundage (1989) emphasises that it eases the understanding of customer experience and service activities. Service blueprint was chosen as method because, according to Shostack (1984), it simplifies the service and presents it in small steps. This made it easier to describe the service offering, especially since it was a new service and it had to be defined in a clear way. Shostack (1984) mentions that service blueprints encourage creativity and help problem solving, which the authors of this thesis regarded as important aspects in service design.

A service blueprint can according to George & Gibson (1991) be used when personnel try to understand the process and find correlations between their responsibilities and other parts of the system. Since the blueprints were shown for a representative from the Swedish Scania distributor to ensure that the concept was relevant, this aspect was important. Feedback from the distributor was taken in and the concept could be modified.

2.14 Possible Applications of Transition Alert Service

The aim with this phase was to be able to see what other possible applications TAS has, except of fulfilling the needs found during the capture of needs. This phase started with generating ideas about how the transition alert service could be used, followed by a selection where some of the ideas were chosen. The result was the answer to RQ5.

2.14.1 Idea Generation

The idea generation started with the two authors brainstorming using the same methods as in the idea generation described in chapter 2.13.1. The reason behind once again using sketching, PMI and Lego was because the two idea generations were partly done at the same time since ideas led to other ideas. The ideas were documented by taking photographs.

Since the authors of this thesis thought it was important to get ideas from the distributor, a small brainstorming workshop was held. The two authors of this thesis and a representative from the Swedish Scania distributor generated ideas on how the information about a transition phase could be used. The workshop was held the 10 April 2015 at the distributor’s workplace Scania Vehicle Stockholm, and lasted two hours. The activity was inspired by theory about lateral thinking described by De Bono (1970). According to De Bono (1970) lateral thinking puts judgements aside and lets ideas and information interact and lead to new ideas. The result from the brainstorming was written down.
Next step in the idea generation was a brainstorming done as a workshop with three people recruited from different departments working with connected services at Scania, since according to Wilson (2013) mixed groups lead to a wider range of ideas. The workshop was held the 16 April 2015 in a group room at Scania and due to the time constrains, the workshop was conducted during one hour and composed by a short introduction, the Round Robin method described by Pavey (2015) and finally a discussion. Round Robin, according to Pavey (2015), means that ideas are developed individually and sketched on a paper and after some time the participants share their ideas and continue on each other’s. This type of brainstorming was used so that everyone could express their ideas, which is stressed by Pavey (2015). Finally a discussion was held in the group in order to further develop the ideas and trigger new ones, and a summary of the different ideas was written down.

2.14.2 Concept Selection

As a part of the service development the different ideas were evaluated and compared with each other. According to Ulrich & Eppinger (2008) a structured method for choosing concepts gives a good documentation basis for eventual continuous work, enables communication regarding the chosen concepts and gives a customer focused product. Ulrich & Eppinger (2008), Pugh (1990) and Haik & Roy (2005) all recommend using a selection matrix for this purpose. This type of method does not fit in this situation since the concepts created were vague and the requirements were not measurable and suited for this type of validation.

The concepts were selected running a design critique, as suggested by Berkun (2009). Pros and cons were discussed together with two internal experts at Scania the 21 April and 27 April 2015. The meetings were held in group rooms at Scania, lasting 1,5 hours each. The first time the discussion was held with a business analyst, and the second time with a business development manager. This was done by writing down the concepts on sticky notes and trying to organize them in different groups based on user flow, new concepts consisting of merged ideas from the idea generation could be created. Through discussions in the group some concepts could be eliminated. This work was done in an agile way: evaluate, eliminate and merge some concepts, creating new ones and then start over again. Between the iterations, the ideas were discussed with experts at Scania in order to get feedback. By using the specialists knowledge it could be ensured that the chosen concepts were relevant and interesting for Scania.
3 Previous Work on Lifecycle Characteristics

In this chapter the result from a previous work about services through the truck’s lifecycle is described. The finding from this study has been an inspiration to this thesis.

3.1 Result Regarding the Vehicle’s Lifecycle Characteristics

Previous work about services through the truck’s lifecycle has been done by Vigmo & Sundkvist (2014). The result of the study showed that long-haulage truck’s lifecycle phases are characterized by differences in utilization and not by distinctive owners. This means that a lifecycle phase cannot only be linked to a change in ownership, since a long-haulage truck can change its operation pattern within the same business (Vigmo & Sundkvist, 2014). The results from the study were divided into business, vehicle and driver related characteristics. The business related shows that the further away in the truck’s lifecycle the focus on delivery precision, use frequency and complex business operations decrease (Vigmo & Sundkvist, 2014). Further, vehicle related characteristics show that the further away in the truck’s lifecycle the demand for technically advanced functions, need for vehicle reliability and the tendency to turn to OEM for repair and maintenance decrease (Vigmo & Sundkvist, 2014). Driver related characteristics show that the further away in the truck’s lifecycle and the further away from Europe the loyalty towards the business, the incentive to use technical devices and the focus on drivers’ working environment decreases (Vigmo & Sundkvist, 2014). In Figure 2 the verified hypotheses are shown.

<table>
<thead>
<tr>
<th>Business related</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B1.</strong> The further away in the truck’s lifecycle, the lower the focus on delivery precision.</td>
</tr>
<tr>
<td><strong>B2.</strong> The further away in the truck’s lifecycle, the lower the needs of the businesses to have a high use frequency of the used trucks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Driver related</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D1.</strong> The further away in the truck’s lifecycle and from the starting point Europe, the lower the level of loyalty towards the owner and the business.</td>
</tr>
<tr>
<td><strong>D2.</strong> The further away in the truck’s lifecycle and from the starting point Europe, the lower the incentive to use technical devices in the driver environment.</td>
</tr>
<tr>
<td><strong>D3.</strong> The further away in the truck’s lifecycle and from the starting point Europe, the lower the focus on the driver’s working situation and comfort.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle related</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V1.</strong> The further away in the truck’s lifecycle, the lower the demand for technically advanced functions.</td>
</tr>
<tr>
<td><strong>V2.</strong> The further away in the truck’s lifecycle, the lower the need for vehicle reliability.</td>
</tr>
<tr>
<td><strong>V3.</strong> The further away in the truck’s lifecycle, the lower the tendency to turn to OEM for repair and maintenance.</td>
</tr>
</tbody>
</table>

Figure 2 Shows the three different areas with its lifecycle characteristics (Vigmo & Sundkvist, 2014).

Based on these findings, Vigmo & Sundkvist (2014) suggested four service areas: R&M, Transition, Safety and Security and Driver Convenience and based on this could service offerings be developed.
4 Scania and the Current Service Offerings

In this chapter the company Scania CV and the definition of long-haulage vehicle are described. Further, the current service offerings and how they work are presented.

4.1 Scania CV

Scania was founded 1891 and is today a global company delivering heavy trucks and busses, engines and services in more than 100 countries. The company has approximately 38 600 employees. The main office is located in the Swedish city Södertälje, and the production is based in Sweden, France, Netherlands, Argentina, Brazil, Poland, Russia and India. (Scania AB, 2013B)

The core values are customer first, respect for the individual and quality and this creates the base in which the business culture, values and working methods are developed. The costs for product development, production and handling of spare parts can be kept down because of the modular production system. The system consists of few main components that can be adapted to the specific transport requirement. Scania collaborates with customers, organizations and government to be able to provide products that are both operationally reliable and energy efficient. Contributing to a more sustainable society is seen as important when being market leading. (Scania AB, 2013C)

Except for just vehicles, Scania provides total solutions that aim to ease and make the customers’ businesses more efficient. This service includes e.g. maintenance program, drivers’ education and financing. (Scania AB, 2013D)

4.2 Long-Haulage Vehicles

Scania has products that cover the needs of the entire supply chain; vehicles for three kinds of purpose are identified: construction, long-haulage and distribution (Eriksson, 2012). According to Eriksson (2012), the most used type of truck and activity is long-haulage, 73% of the Scania customers operate with long-haulage.

Scania produces mainly three types of trucks: P-series, G-series, R-series (Scania AB, 2013E). According to Scania AB (2013E), the P-series is most suited for construction and distribution tasks due to its compactness and manoeuvrability (Figure 3), and the G- and R-series (Figure 4 and Figure 5) are good choices for tasks that combine long-haulage and construction. The difference is that the G-series are suitable for national long-haulage, distribution and virtually all types of construction applications and the R-series is designed to meet the demands regarding fuel economy and reliability (Scania AB, 2013E).

Figure 3 P-series (Scania AB, 2013F).
According to Viborg & Wilenius (2014) the general purpose of long-haulage is the long distance freight, the average distance of a trip is about 600 km from the starting point to the end destination. In Sweden the average annual mileage for a long-haulage vehicle is 173 000 km (Viborg & Wilenius, 2014). Viborg & Wilenius (2014) emphasis that typical routes are i.e. delivering cargo from harbours to factories, from factories to central distribution centres or from one factory to another. The main part of the job of a long-haulage driver is the driving, since the cargo is loaded and unloaded only a few times during the whole trip (Viborg & Wilenius, 2014).

According to Scania CV AB (2014) there are mainly six different types of applications for trucks: very lightweight long-haulage, lightweight long-haulage, long-haulage, heavy long-haulage, construction work and distribution. The main differences are described in Table 2. It is possible to observe that type 0:0, 0, 1 and 2 are the long-haulage categories that concern this study.

<table>
<thead>
<tr>
<th>Type</th>
<th>0:0 Very lightweight long-haulage</th>
<th>0 Lightweight long-haulage</th>
<th>1 Long-haulage</th>
<th>2 Heavy long-haulage</th>
<th>3 Construction work</th>
<th>4 Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel consumption</td>
<td>&lt; 28 litre /100 km</td>
<td>&lt; 33 litre /100 km</td>
<td>&lt; 42 litre /100 km</td>
<td>&lt; 42 litre /100 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>Without barriers, &lt;20 stops/100 km</td>
<td>Without barriers, &lt;20 stops/100 km</td>
<td>Without barriers, &lt;20 stops/100 km</td>
<td>Without barriers, &lt;20 stops/100 km</td>
<td>Heavy traffic, &gt;150 stops/100 km</td>
<td>Very heavy traffic, &gt;250 stops/100 km</td>
</tr>
<tr>
<td>Idling and PTO driving</td>
<td>&lt; 25% of the overall operation</td>
<td>&lt; 25% of the overall operation</td>
<td>&lt; 25% of the overall operation</td>
<td>&lt; 25% of the overall operation</td>
<td>&gt; 25% of the overall operation</td>
<td>&gt; 25% of the overall operation</td>
</tr>
<tr>
<td>Gross weight</td>
<td>&lt;36 ton</td>
<td>&lt;40 ton</td>
<td>&lt;45 ton</td>
<td>&gt;45 ton</td>
<td></td>
<td>&lt;36 ton</td>
</tr>
<tr>
<td>Average speed</td>
<td>&gt;70 km/h</td>
<td>&gt;70 km/h</td>
<td>&gt;60 km/h</td>
<td>&gt;50 km/h</td>
<td></td>
<td>&lt;40 km/h</td>
</tr>
<tr>
<td>Transport example</td>
<td>General cargo or bulk goods</td>
<td>General cargo or bulk goods</td>
<td>General cargo</td>
<td>Bulk, timber, gravel, construction equipment</td>
<td>Gravel, crushed rock, ore, concrete, waste</td>
<td>Local or regional distribution of goods</td>
</tr>
<tr>
<td>Application examples</td>
<td>Tractor with various semitrailers, vans or trucks chapel</td>
<td>Tractor with various semitrailers, vans or trucks chapel</td>
<td>Tractor with various semitrailers, vans or trucks chapel</td>
<td>Tractor with hook lift, swap bodies, platform truck, timber truck, tank truck</td>
<td>Dump-trucks, concrete mixer, platform truck with crane</td>
<td>Food, medicine, electronic products</td>
</tr>
</tbody>
</table>
4.3 Description of Fleet Management Services

Scania offers service packages called Fleet management services (FMS) and they are divided into four levels: Monitoring, Analysis, Control and Control plus. The Monitoring package is a free of charge offering that provides the customer with weekly, monthly and yearly overview report for the fleet. Information is gathered in 240 minutes intervals. This package includes a Monitoring report which gives an overview of changes compared to previous reports, fleet data regarding key basic performance and comparison of previous and last period showing trends. The package also contains a Service planner, a tool that helps customers manage fault reports and plan service and repair. To enable this, the service planer gives a weekly maintenance report, an equipment view with scheduled events, defect reporting and support for communicate required service and repair to the work shop. (REIE, 2014)

The Analysis package gathers information with 30 minutes intervals and includes Traffic light reports, which analyse and evaluate the vehicles’ and drivers’ performance. An example of parameters that can be monitored are idling, coasting, brake applications, speeding, fuel consumption and Scania driver support. Another service included is Performance and Driving Trends, which uses the information from the Traffic light report to visualize how it changes over time. This tool can be used to identify when a specific phenomenon occurs and to compare different drivers and vehicles with each other. The package contains an environmental report that shows calculated vehicle emissions. The vehicles condition is given by the Exception report. Examples of information provided by the report are if the driver uses seat belt and status of oil pressure. (REIE, 2014)

Next level of service offering is Control package which gathers information in 10 minutes intervals. This package contains: Fleet position, Driving time report, Vehicle tracking, Notification, Geofence alarm and Vehicle alarm. Fleet position shows where the vehicle is located on a map, the driving time and the status of the vehicle. Driving time report is used to control the driving time for each driver. This enables to monitor whether the drivers are using their driving and resting time according to the regulation based on (EC) 561/2006. Vehicle tracking shows where vehicles have been driving historically and can be used to evaluate routes and find alternatives. It can also be used to check that orders were delivered at the right place and right time. The Notification is an alert service that can be used to prepare the customer that the delivery soon will be done or that a vehicle is leaving. Geofence alarm is used to alert if a vehicle is leaving the planned route. Vehicle alarm is connected to any alarm in the vehicle and provides the owner with a message if an alarm is triggered. Examples of alarm causes are: driver or passenger door opened, storage box opened, panic alarm activated, driver or passenger door unlocked and cab tilted. Control plus is a service that is offered on a limited market. It contains the same offerings as the Control package with the difference that it is updated each minute. (REIE, 2014)

4.4 Scania Tachograph Services

The Scania Tachograph service downloads the tachograph data automatically and makes it accessible for the user through an online Scania Tachograph portal. Through the portal the user can schedule the downloads, see if driver or company cards are about to expire and get an overview of the infringements done per driver during the last month. The portal also provides activity reports to make the incoming data from drivers and vehicles more accessible and easier to understand. (Scania CV, 2013)
4.5 Ecolution by Scania

To minimize fuel consumption and carbon dioxide emissions Scania has a package solution called Ecolution by Scania. In this concept products and services are combined to create an individual goal regarding emissions and fuel consumption and thereby help the customer grow through energy efficiency. There are three main areas in Ecolution by Scania which are optimized vehicles, driver efficiency and coaching, and maintenance contracts. The vehicle is monitored by Scania and every month a report is delivered saying how the fuel consumption is in relation to the goal. (Scania AB, 2014)

The vehicle is optimized for the customers’ specific need but also to ensure that the fuel consumption will be as low as possible. This is ensured by using light weight components, aero dynamic and driver systems. Also the engines are suitable for bio gas, bio ethanol and bio diesel. The maintenance package includes controls not included in the normal maintenance, e.g. the state and the pressure of the tires and other controls done to maintain the vehicles fuel consumption at a low level. (Scania AB, 2014)

4.6 Scania Communicator C200

The communicator 200 (C200) is a telematics unit containing a SIM-card that communicates data to the FMS. It collects, saves and sends information for analysis with a predetermined frequency that is used by the FMS to create different services. The C200 is mounted as a standard unit on all Scania trucks since 2011. (Scania Fleet Management, 2010)

4.7 Connected Services Support Tool

Connected Service Support tool (CSST) is used by support personnel and in the future it is supposed to help the dealers as well. The tool is used to check the status of the connected services based on C200. CSST can be used to troubleshoot connected services without taking the vehicle into the workshop. The tool also provides information regarding: a vehicle’s auto-registration event, report settings configuration, service package subscription status, current operational status, detailed information on the system exception status, providing the user the possibility of checking problems e.g. poor GSM or GPS connectivity. Monitoring report recipients data, information about the specific vehicle and the customer’s personnel can be handled by the CSST web application. (Karagounis, 2013)

4.8 The Embedded Electronic System

The long-haulage vehicles at Scania have an embedded electronic system. To be able to create an overview of the system discussions with Oscar Blomkvist, Senior Engineer at Scania were held on 9 February 2015. This meeting resulted in two figures. Figure 6 shows a schematic view of the communication systems in a Scania truck. Inside the truck there are mainly three components that communicate with the environment: the tachograph, green dotted box in the figure, the communicator C200, blue striped box in the figure, and the radio also called AUS, orange in the figure. Furthermore there is a socket called OBD that is used during check-ups. The tachograph is statutory and is in charge of collecting data regarding e.g. driver, drive, rest and speed. This data is usually downloaded and stored into the database of the customer; in some cases the tachograph data is sent to the C200. The communicator C200 transfers driver data, vehicle data and tachograph data through a GPRS connection to Scania, which stores and uses the data in their service packages. Another connection that sends information to Scania is the data downloaded from the OBD socket, which is
operating data and is automatically sent from the workshop to Scania every time the truck is connected to the check-up software called SDP3. The radio, AUS, has the possibility to connect via Bluetooth to the driver’s smartphone.

Figure 6 A schematic view over the communication system in the truck.

Figure 7 gives an overview over the embedded electronic system inside the vehicle. Just the bigger parts are chosen to be displayed, to ease the understanding of the figure. The system consists of different electrical control units (ECU) that all have its own hard drive. The red double line, black dotted and green dashed lines are different busses classified respectively as critical, less critical and non-critical. The black lines symbolizes other connections.
Figure 7 A schematic view over the embedded electronic system.
5 Theoretical Framework

The theoretical framework includes theory regarding product lifecycle, servicification, integrated solution’s value and the importance of relationships within the integrated solution business network. Further, big data and its opportunities, telematics and intelligent vehicles are presented. Finally, theory about statistical hypothesis testing is presented.

5.1 Product Lifecycle Theory

There are several theories concerning the lifecycle of a product, the one by Levitt (1965) has been frequently used, and is still seen as a relevant publication. Levitt (1965) divides the lifecycle of a product in four stages: market development, market growth, market maturity and market decline. Levitt (1965) describes the stages as follows:

Stage 1, Market development:
In this stage the product is brought to the market, which brings uncertainties and unknowable risks. The time it takes to get to the following stage is unclear, but depends on the product’s complexity and the degree of newness.

Stage 2, Market growth:
This phase is characterized by an increased demand, this is when competitors usually enter the market, product and brand differentiation become important. This stage often requires changes in marketing strategies.

Stage 3, Market maturity:
This stage is characterized by the saturation of the market. Price competitiveness becomes intense and the producer usually has to intensify the distribution.

Stage 4, Market decline:
The demands decline.

Figure 8 shows these stages and describes them by time and sales volume.

![Figure 8](image.png)

Figure 8 Levitt’s lifecycle model, adapted from Levitt (1965).
Cao et al. (2009), have described a model of product lifecycle where both material and information flows are described. The model divides the lifecycle in three stages. The first one is called beginning of life (BOL) and includes design and manufacturing, followed by a second stage called middle of life (MOL) that starts when the customer has purchased the product and ends when the product is not used anymore. Information in this phase is going back to the BOL. From the last stage, end of life (EOL), both information and material flows are directed back to the MOL and BOL. This can be seen in Figure 9. Components can be reused or remanufactured and materials can be recycled or disposed. The information can e.g. be maintenance information or design and manufacturing information sustain Cao et al. (2009). The model by Cao et al. (2009) is inspired by Kristis et al. (2003) and shows a closed loop of information and material which helps the development and improvement of the product and its own value chain.

![Product Lifecycle Diagram](image)

Figure 9 The product lifecycle, in Cao et al. (2009), adapted from Kiritsis et al. (2003).

### 5.2 Taking Account of the Second-Hand Market

Guiot & Roux (2010) stress that there is a growing interest in alternative consumption channels and the second-hand shopping is growing among consumer products. Some customers look at the new market for gathering information and then buy on the second-hand market (Guiot & Roux, 2010). This, according to Guit & Roux (2010), could be due financial reasons. MarketLine Industry Profile (2014) mentions that second-hand medium and heavy trucks become common in both big and small transport businesses, and this could be connected to businesses trying to handle poor financial times.

Kwak et al. (2012) emphasise that the second-hand market is important to take count of since the value of a product is no longer only based on the market value it has when it is new, but also its market value when it is used. The second-hand market has grown and how the consumers perceive the value of a second-hand product has become important for the manufacturer (Kwak et al., 2012). The authors stress the importance for businesses to identify ways to increase the value of its products. The study done by Kwak et al. (2012) shows that it is impossible to retain high second-hand value based on the
technology. This is due to the fast technology advances and the fact that technological obsolescence cannot be avoided (Rachaniotis, 2008; Kwak et al., 2012), but according to Kwak et al. (2012) a potential way to minimize the obsolescence is to enable upgrading of the product. Kwak & Kim (2015) stress that the whole lifecycle must be considered when doing design decisions to maximize both the current profit and the future profit on a product. Design for life-cycle profit can especially be done in the concept design stage where the specifications are set (Kwak & Kim, 2015).

5.3 Servicification

Because of the fast technology changes, higher demands on shorter time-to-market and increasing lifecycle phases it is shown that product innovation is no longer a guarantee to stay competitive (Antioco et al., 2008; Matthyssens & Vandenbempt, 2008; Ulaga & Eggert, 2008). Antioco et al. (2008) stress the importance of being a total solution provider, which means that the company offers products and services like a package rather than offering them separately. According to Kindström et al. (2012) and Lee et al. (2015) manufacturing firms are today following this trend and start adding services to their existing product offerings.

5.3.1 Different Types of Services

Antioco et al. (2008) distinguish, based on Mathieu (2001), between services in support of the product (SSP) and services in support of the client’s action (SSC). Examples of SSP are services supporting the installation, use and maintenance of a tangible product (Antioco et al., 2008). According to Antioco et al. (2008), SSC are services that can be offered without the tangible product, e.g. management services as business consulting, financing and process-oriented training. SSC are often more customized and require a deeper customer relation in contrast to SSP that usually can be standardized (Antioco et al., 2008). Antioco et al. (2008) and Fang et al. (2008) argue that businesses that have a SSC focus get deep customer relations which leads to more loyal buyers. This will increase the relative product sales (Antioco et al., 2008; Fang et al., 2008). Since keeping the competitive advantage relies on the offerings’ rarity, difficulty to find a substitute and imperfect imitability it is challenging for the business to be competitive (Antioco et al., 2008). SSP are less unique and customized and therefore this problem is especially true for this types of offerings (Mathieu, 2001). Antioco et al. (2008) emphasise the fact that SSP therefore cannot give the supplier relative product advantage like as SSC can. Vargo & Lusch (2004) argue that by creating a total solution, integrating products and services, the business can provide the customer with a unique and valuable offerings that will lead to higher and more stable sales, cash flows and profits. The benefits and synergies that come with total solutions are hard to copy for a competitor that only offers services or products (Vargo & Lusch, 2004).

Another way of categorize services is suggested by Juheling et al. (2010) who argues that automotive services could be classified as product-related services due to the fact that they all create benefits for the vehicle owner during the vehicle’s lifecycle. The service could be divided into pre-sales, sales and after-sales (Juheling et al., 2010). Pre-sales and sales focus on sales-supporting activities e.g. sales promotion, financing and optimization of vehicle for the customers’ needs. After-sales services are e.g. maintenance, repair and recycling. Juheling et al. (2010) emphasise that the after-sale services are very profitable for a vehicle manufacturer.
5.3.2 Integrated Solutions and their Value

More and more companies are starting to change their strategic focus and are offering integrated solutions (IS) rather than individual products or services (Brady et al., 2005). IS, also called product service system (PSS) is defined by Goedkoop et al. (1999) as “…a marketable set of products and services capable of jointly fulfilling a user’s needs.”

Some of the world’s leading companies have started to refocus their business strategy and are working with enhancing their value proposition by providing full solutions rather than individual products or services (Windahl & Lakemond, 2006; Brady et al. 2005). Matthyssens & Vandenbempt (2008) also mention IS as a way to create a new non-price based customer value. Davies (2003) argues that this means a shift from focusing on the products’ functionality to a focus on the outcomes and what the customer can achieve from the products and services. Windahl & Lakemond (2006) and Gebauer & Friedli (2005) stress the importance of not seeing the services as add-ons and after-sales offerings, but as an integrated part of the total solution. This means that services, products and the business have to be developed simultaneously and integrated (Windahl & Lakemond, 2006; Juheling et al., 2010).

Tukker (2004) stresses that IS businesses can create value and increase their competitiveness by:

- Offering customized and integrated solutions that fulfil the customers’ needs. This also enables the customers to focus on their core activity.
- Increase customer loyalty and gain deeper relationships.
- Facilitate innovation since they follow the clients’ needs better than a non-IS business.

Another value brought by IS is the possibility to create sustainable and resource efficient solutions (Stahel, 1982). Instead of focusing on the product, companies would start focusing on the solutions and would become much easier to design need-fulfilment systems with lower impacts (Tukker, 2013).

5.3.3 The Importance of Relationships within the Integrated Solution Business

Challenges connected to the IS development are not only based in the internal organization but also in the interaction with actors in the network (Windahl & Lakemond, 2006). Industrial service providers need to build relationships to create customer value (Barry & Terry, 2008; Uлага & Eggert, 2008; Wilson & Jantrania, 1994). Anderson (1995) and Meuris et al. (2014) emphasise that both buyers and suppliers could benefit from working together. According to Gronroos (1998) and Barry & Terry (2008) customers buying services are more likely to enter a long-term relationship than those buying physical products.

Windahl & Lakemond (2006) mean that the provider cannot just focus on the end customer when developing the offering. Relationships with other actors like partners, government and research institutes also have to be concerned. Windahl & Lakemond (2006) have identified six factors affecting the relationships within the business network:

1. The strength of the relationships between the different actors involved in the project
2. The firm’s position in the network
3. The firm’s network horizon
4. The solution’s impact on existing internal activities
5. Its impact on the customers’ core processes
6. External determinants
5.4 Big Data

Decisions that before were based on guesses or handmade calculations and models can now easily be done by data-driven mathematical tools (Jagadish et al., 2014). Further they stress that today enormous amounts of data are collected and the analysis of it is used more and more in every part of society.

According to Nationalencyklopedin (2015A) big data consists of different types of digital information in the size terabyte to petabyte. This big size needs specific methods to be handled and the challenge is to gather, store, share, transfer, analyse and present (Nationalencyklopedin, 2015A). Working with big data demands large databases, data warehouses and data mining (Nationalencyklopedin, 2015A). Big data is defined by Foreman (2014) as “…turning transactional business data into decisions and insight using cutting-edge analytics (regardless of where that data is stored)...”.

5.4.1 Different Sources of Big Data

Big data can come from different sources and George et al. (2014) list five of them:

- Public data: Data from government and local communities concerning e.g. health care, energy use and transportation.
- Private data: Data from individuals and private organizations and could e.g. include transactions, website browsing and mobile phone usage.
- Data exhaust: Data that are passively collected and have low value for the initial data-collector. These data can be combined with other types of data and by this create value. Examples of data exhaust are mobile phones that create data as a by-product and internet searches that could be used to map an individual’s needs.
- Community data: Data usually consisting of text, used to identify social trends. Examples are rating sites, voting on web pages and Twitter feeds.
- Self-quantification data: Data from people that quantify behaviour and actions. An example is the data that comes from activity tracking wristbands that collect a person’s activity and upload it to an app in the mobile phone.

George et al. (2014) emphasise the difference between different types of big data. Big data can be information in micro lever detail in short duration time but it could also be enormous volumes of data over multiple periods (George et al., 2014). Usually when analysing information focus lays on finding the average, but in the width of big data it is also possible to identify outliers (George et al., 2014). According to George et al. (2014), this means that it is in this data that innovations, trends and revolutions can be found.

5.4.2 Big Data Lifecycle

Jagadish et al. (2014) discuss five steps of the big data lifecycle, and stress the importance of focusing on all of them and not just on the analysis and modelling stage. The first step, identified by the authors, is the data acquisition. Jagadish et al. (2014) stress that because of the huge amount of data, there has to be some kind of filtering to be able to handle all information, but it has to be the right kind of filter to not risk that useful data will be discarded. The second step identified by Jagadish et al. (2014), is information extraction and cleaning. In this stage the data have to be transformed into a format that is suitable for analysis. The authors stress that data can be full of errors and therefore a cleaning technique has to be developed. The third step, mentioned by Jagadish et al. (2014), is data integration,
aggregation and representation where it is important to gain heterogeneous data from multiple sources. Jagadish et al. (2014) identified the fourth stage as the modelling and analysis step, followed by the interpretation which includes examination of the assumptions and possible sources of errors.

Jagadish et al. (2014) mention some challenges within the big data lifecycle. Heterogeneity, which is important to get a nuance and width, is hard for a machine analysis algorithm to handle (Jagadish et al., 2014). Another problem identified by Jagadish et al. (2014) is inconsistency and incompleteness which means that big data includes information provided by different sources of varying reliability and there might be missing values and errors. A challenge is the size of big data since the volume of the data increases faster than the technique for data processing (Jagadish et al., 2014; Schmarzo, 2013). This problem is connected to another problem mentioned by Jagadish et al. (2014), the challenge with handling the need for a real-time technique that can sort out which data need to be stored. Jagadish et al. (2014) emphasise the concern with privacy and data ownership, which is both a sociological and technical problem and has to be handled from both perspectives. The last challenge mentioned by Jagadish et al. (2014) is to make sure that humans can absorb and understand the results of the big data analyses. For big data to reach its full potential, there has to be a good way to handle the visualization of the outcome (Jagadish et al., 2014).

5.4.3 Big Data Business Opportunities

Sensors and machine-generated data makes it possible for companies to change its value creation process (Schmarzo, 2013). This data is given in real-time and enables the service and/or product provider with information that can be used for providing the customer with services as maintenance, product performance and optimization recommendations (Schmarzo, 2013). Schmarzo (2013) stress that big data can be used as a business transformation where the company can change its perspective from looking back into the history to a more forward-looking perspective.

Schmarzo (2013) suggests five steps to be able to define where and how big data and advanced analytics can be used to transform the business.

1. Interviews and research to be able to map the targeted business initiative or process.
2. Develop data preparation and client-specific analytics.
3. Brainstorm new ideas.
4. Prioritize big data use cases, opportunities and barriers.
5. Document identified and prioritized opportunities, implementation risks, business value drivers and recommended next steps.

Schmarzo (2013) stress the importance of prioritizing, step four in the list above. Many of the identified big data business use cases might have the potential to increase business value, but it often happens that the outcomes are not as expected. Reasons behind this could, according to Schmarzo (2013), e.g. be inaccessibility of exact data, lack of experience regarding data sources and technology, limitations regarding architecture and technology and poor communication between business and IT teams.

To ease the prioritization Schmarzo, (2013) has developed a prioritization matrix, see Figure 10. The identified use cases are placed in the matrix by weighting business value and implementation feasibility. The zone in the matrix that is desirable to be in is the upper right quadrant. By using the matrix the risk of poor communication between business and IT teams, mentioned earlier in the text, can be reduced (Schmarzo, 2013).
5.4.4 Ethics in Big Data

On the other side of the enormous possibilities that big data brings to companies there is also an ethical view that has to be discussed. Topics that are discussed by Nunan & Di Domenico (2013) are privacy, the ownership of data and data storage. Finn & Wadhwa (2014) identified other ethical issues like the identifiability, the objectification and manipulation of consumers.

The problem lies in the stipulation of the contract between company and user; users can accept the collection of data but it is often not stated what the data will be used for (Finn & Wadhwa, 2014). Especially no one knows the contextual significance of the data if stored and accessed after some time, it might lead to privacy issues in the future (Nunan & Di Domenico, 2013). To tackle these problems Nunan & Di Domenico (2013) suggest three ethical practices that would permit users to maintain control over their privacy, and still give companies the possibility to provide their services. First the individual’s right to get personal data deleted, second the right to have an expiry date for data and last to own information about oneself that is created by a third party, e.g. a tagged photo on social networks.

5.5 Telematics

According to Nationalencyclopedin (2015B), the word telematics is a neologism derived from the fusion of two words: telecommunications and information technology. Telematics deals with the use of computer technology in telecommunications; according to Richards (2014), it is the science of processing data for storage and retrieval. The growing synergy between computing and telecommunication technology, is becoming more and more important and reorganizing the telecommunications industry (Adamopoulos et al., 2002). Telematics is used in various solutions and often combined with services e.g. ATMs, usage based insurance and fleet management (Albright, 2014).

Diving into the automotive industry, especially OEMs and insurance companies are expanding their use of telematics and offering a large amount of service solutions (Albright, 2014). According to the author, Toyota e.g. offers a social network of customers, dealers and OEMs to provide service alerts. Other companies such as Hyundai offers service of roadside assistance, and insurance companies offer “usage based insurance” (UBI) where good drivers are rewarded by lower premiums (Albright, 2014).
Telematics is a tool that has facilitated the creation of new services and improved their efficiency drastically (Richards, 2014). According to Albright (2014), in order for telematics to become really efficient and powerful, there is a need to create an ecosystem of telematics users, services and infrastructure. Neu & Brown (2005) sustain that the ability to use telematics is a valuable resource in order to successfully compete in markets that are increasingly complex. On the other hand Kowalkowski et al. (2013) stress that telematics is not the key factor for the creation of new offerings, but it is rather a company’s ability to link the technological possibilities with the customers’ needs. Richards (2014) mentions that one of the problems that telematics service providing companies have to deal with is the big, and growing, amount of data. The real challenge for these companies is to understand which data is important for creating a service that the customer needs (Richards, 2014).

Kilcarr (2013) sustains that through telematics the trucks will be able to communicate with drivers, fleet managers, and repair shops. The strength will lay in combining public data and private data into useful and understandable data and services for a more efficient and safer supply chain (Kilcarr, 2013). Examples of possible functions mentioned by the author are engine calibration algorithm, remote diagnostics, fuel management and road safety functions. Kilcarr (2013) emphasis especially the demand on prognostic capabilities is something that is becoming feasible with the development of telematics, using predictive modelling will make the trucks “smarter”. Putting together known data such as driver, vehicle, route and variable data such as traffic, parking and weather conditions an optimized operational map will be created (Kilcarr, 2013). This will make it easier for businesses to see and manage their fleet and offer advanced service offerings (Kilcarr, 2013).

5.6 Intelligent Vehicles

Broggi et al. (2008) sustain that the main reason for developing intelligent vehicles lies in the improvement of safety, convenience and efficiency in the transportation. Broggi et al. (2008) and Seeing machines (2015) mention different intelligent vehicle solutions that increase the safety on the roads, which is important since over 92% of motor vehicle crashes are caused by the driver’s error according to Treat et al. (2010). There are plenty of these systems, and they are becoming more and more standard features in our vehicles, these systems also go under the name of advanced driver assistance systems, ADAS (Riches, 2015). Intelligent vehicles could be a solution for offering mobility with a higher standard to a larger part of the population; however there is still a long way to go in order to achieve a full application (Broggi et al. 2008).

Broggi et al. (2008) sustain that the technologies (sensors and actuators) needed to create intelligent already exist today. These sensors and actuators have to be integrated and controlled in order to fulfil the desired functions that an intelligent vehicle requires (Broggi et al., 2008). The basic requirements, emphasized by Broggi et al. (2008), are the ability to measure:

- The position, the kinematic and dynamic state of the vehicle.
- The state of the environment surrounding the vehicle.
- The state of the driver and occupants.
- The communication with the roadside infrastructure or other vehicles.
- The access to digital maps and satellite data.

Based on Broggi et al. (2008), this section describes how these technologies and functions are connected, combined and organized in order to make the vehicle understand the road scenes, understand the driver, assist and monitor. An intelligent vehicle has to sense the environment around
itself, in order to understand it. This task of understanding involves the use of sensors combined with automatic reasoning, in this way a synthetic representation of the environment is created. The environment that has to be sensed is extremely complicated and includes lanes, traffic lights, traffic signs, other vehicles, bikes and pedestrians. In addition to these objects there are other factors that can influence the vehicle like weather conditions and road conditions, these are harder to sense and can provoke negative effects on the vehicle’s perception of the environment. In some cases the use of interactive infrastructure could drastically facilitate the drive.

5.7 Hypothesis Testing

Diez et al. (2010) argue that in order to execute a hypothesis test a null and alternative hypothesis have to be constructed, and in this section a summary from the literature by the authors are presented. The null hypothesis ($H_0$) expresses the idea to be tested, usually the sceptic’s position or a position of no difference. The alternative hypothesis ($H_A$) stands for an alternative claim. $H_0$ can only be rejected if the result from the test strongly favours $H_A$. P-value could be used when testing a hypothesis. This value is a measure of how strong the evidence favours $H_A$ over $H_0$. $H_0$ could be rejected if the p-value is small.

5.7.1 Decision Errors

The theory behind decision errors described by Diez et al. (2010) is presented in this paragraph. Statistical hypothesis test cannot be made perfectly, and there is a risk that wrong decisions are made during the test. Two different errors can be made: type 1 error is rejecting $H_0$ when $H_0$ is true, and type 2 error is failing to reject $H_0$ when $H_A$ is actually true. Hypothesis test is about evaluate if it is possible to reject $H_0$, but a strong evidence is necessary in order to reject the null hypothesis. A general rule of thumb is that $H_0$ should not be wrongly rejected in more than 5% of the cases, which corresponds to a significance level of $\alpha = 0.05$. In a p-value test this would mean that if the p-value is higher than the significance level $\alpha = 0.05$, $H_0$ cannot be rejected.

5.7.2 Two-Sided Hypothesis Test Based on Difference in Means

In this section the procedures in order to conduct a two-sided hypothesis test based on difference in means described by Diez et al. (2010) is presented. When investigating whether two means are different from each other, a two-sided hypothesis test can be conducted. If the sample means are nearly normal sampling distributions and the observations in the two samples are independent, the difference in sample means has a sampling distribution that is nearly normal. Further if the samples are random and come from less than 10% of the population, the observations are independent. If the sample size is large ($n \geq 30$), the data are not strongly skewed and the sample observations are independent from each other, then the difference in means can be modelled using a normal distribution. Additionally, the larger the sample size, the more the sample’s skew can be tolerated.

The point estimate is calculated according to Diez et al. (2010) as the difference in mean:

$$point \ estimate = \bar{x}_1 - \bar{x}_2 \quad (1)$$

where $\bar{x}_1$ = mean value first sample and $\bar{x}_2$ = mean value of the second sample.

The sample standard deviation is calculated according to Laerd Statistics (2013) with the formula:
\[ s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}} \quad (2) \]

where \( s \) = sample standard deviation, \( x \) = individual values from the sample, \( \bar{x} \) = mean value and \( n \) = sample size.

The standard error for the difference in sample means when each sample mean is nearly normal and all observations are independent can be calculated according to Diez et al. (2010) with the formula:

\[ SE_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \quad (3) \]

where \( SE_{\bar{x}_1 - \bar{x}_2} \) = standard error, \( s_1 \) = first sample standard deviation, \( s_2 \) = second sample standard deviation sample, \( n_1 \) = first sample size and \( n_2 \) = second sample size.

If \( H_a \) is two-sided, both lower and upper tail have to be counted for the p-value (Diez et al., 2010). In Figure 11 the shaded areas represent the p-value, which is the probability of getting the observed value of the test statistics, or a value with even greater evidence against \( H_0 \), if \( H_0 \) is actually true.

![Figure 11](image)

Figure 11 In a two-sided test, evidence in both directions is favourable to \( H_a \) and therefore two tails are shaded (Frost, 2015A).

According to Diez et al. (2010) Z score, or test statistic, is calculated with the formula:

\[ Z = \frac{\text{point estimate} - \text{null value}}{SE_{\bar{x}_1 - \bar{x}_2}} \quad (4) \]

where \( Z = Z \) score, \( \text{point estimate} = \bar{x}_1 - \bar{x}_2 \) according to formula (1), \( \text{null value} \) = the parameter value under the null hypothesis and \( SE_{\bar{x}_1 - \bar{x}_2} \) = standard error for the difference in sample means.

Diez et al. (2010) suggest to use the normal probability table, see Figure 12 and Figure 13, and the Z score, in order to find the upper and lower tail. Further, since it is a two-sided test, both the tails’ areas are needed and therefore the p-value is given by adding the upper and lower tail value. The p-value is compared with the significance level \( \alpha = 0.005 \), if it is smaller \( H_0 \) can be rejected and if the p-value is larger \( H_0 \) cannot be rejected (Diez et al, 2010).
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</tr>
</tbody>
</table>

*For $Z \leq -3.50$, the probability is less than or equal to 0.0002.

Figure 12 Normal probability table for negative $Z$, in Diez et al. (2010).
5.8 Confidence Intervals

P-values can indicate a significant difference, but not give an idea about how large the difference is (Frost, 2015B). According to Frost (2015B) it is also important to look at the magnitude and precision, which is done by calculating the confidence interval. Either p-values or confidence intervals can be used to determine if the results have a statistical significance, and when both methods are used their results will agree (Frost, 2015B). The results from a test are statistically significant if the confidence interval does not include the null hypothesis (Diez et al., 2010; Frost, 2015B).

<table>
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<th>Z</th>
<th>0.00</th>
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<td>0.8315</td>
<td>0.8340</td>
<td>0.8365</td>
<td>0.8389</td>
</tr>
</tbody>
</table>

*For Z ≥ 3.50, the probability is greater than or equal to 0.9998.
According to Diez et al. (2010) confidence interval is a plausible range of values for the parameter, and can be interpreted as follows. The confidence interval is built around the point estimate, and the width is decided based on the standard error. For the accuracy of the confidence interval, the sampling distribution has to be normal. If a 95% confidence interval was calculated for 100 different samples, then 95 of them would contain the true mean value (μ).

An approximate 95% confidence interval is according to Diez et al. (2010) calculated with the formula:

\[ CI = \text{point estimate} \pm 1.96 \times SE \]  

where \( CI \) = confidence interval, \( \text{point estimate} = \bar{x}_1 - \bar{x}_2 \) according to formula (1) and \( SE \) = standard error from formula (3).

If a confidence interval with a higher confidence level is desirable, e.g. 99% confidence level, this is according to Diez et al. (2010) calculated with the formula:

\[ CI = \text{point estimate} \pm 2.58 \times SE \]  

(6)
6 Observations of Truck Drivers

In this chapter the findings from the observation of truck drivers are presented. This is followed by discussion and conclusions regarding the result of the observation study.

6.1 Findings from the Observation of Truck Drivers

Two observations were done by following test drivers driving on the test track. The result from the observations was a description of activities done before, during and after the drive.

The following things were noted to be done before driving were: the driver inserts the driver card into the tachograph and adjusts the seat by choosing the amount of support for the back and suspension. Further, if the weather requires it, the heaters in the side mirrors are turned on. If it is the first time the truck is driven, the driver also changes the settings in the display in order to customize what to be displayed.

Cruise control is a system that can be used to ease the driving as well as the warning system that detects if the white road lines are crossed. These are just two examples of all the equipment there is to facilitate the driving. If there are any problems occurring during the ride or if something breaks, there is a warning system in the display showing yellow if it is a small problem and red if it is a significant problem. During driving the chauffeur can adjust the suspension in the vehicle and also the weight distribution. This can be used e.g. when driving on bumpy roads and uphill. When driving long-haulage the chair comfort and climate control system are important.

When finishing the ride the chauffeur stops the engine, might turn on the parking brake and then take out the driver card from the tachograph. Depending on the routines at the transport company, the driver fills up the vehicle with fuel and does a daily control of the truck, noting eventual problems.

6.2 Discussion and Conclusions of Observations of Truck Drivers

The authors of this thesis argue that the result in this chapter is affected by the choice of method. As described by McDonald (2005), the observations were executed partially natural and partially participatory. Using the natural approach, did not give so much information since it was hard to understand what the driver was doing. Therefore, the main results came from the participatory part when the observer was more active. An even better picture of the vehicle and the driver’s tasks, would probably be created if the observer would have been allowed to drive the vehicle. “Think aloud”, described by Haak et al. (2004), did not work so good in one of the observations because of the driver feeling uncomfortable with this method. Therefore the result does not include any emotions, feelings or needs expressed by the drivers, as mentioned by Osvalder et al. (2010) as a downside with the method. Since the aim was not to collect such information, it was not a problem.

The result from the observation was not really as expected. Since the authors never had visited a truck before, there was an idea about the truck having a large amount of technical equipment in the driver environment. Also, the authors of the thesis thought that during the ride a lot of settings had to be tuned. It turned out not to be like that, and the level of technical equipment could be considered to be relatively low. It was understood that the following interview studies should not focus on technical functions and settings since the information collected from the observation was enough.
In conclusion, even if the result from the observations could be seen as relatively small, it was enough to give a general idea about how the truck driver works and how the vehicle functions. Since this was the aim with this method, the authors of this thesis thought that the result was useful for the further study.
7 First Mapping of Characteristics of the Lifecycle Phases

The first mapping of characteristics of the lifecycle phases was done by doing an interview study. The findings from this study is presented in this section as a black box and schematic view over the trucks lifecycle. Further, the findings are discussed and conclusions are presented.

7.1 First Interview Study

Interviews were held with seven people, followed by an analysis and then a black box was created to visualize the problem and to summarize the findings from the interviews. In Table 3 below the respondents participating in the first interview study are presented. In two cases, respondent C and E in Table 3, the interview was done with two people at the same time and this was because of time constraints. A summary of each interview can be found in Appendix G, H and I.

Table 3 The respondents participating in the first interview study.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Professional work title</th>
<th>Type of interview and duration</th>
<th>Interview date</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Transport business owner (Sweden)</td>
<td>Meeting, 60 min</td>
<td>2015-02-04</td>
</tr>
<tr>
<td>B</td>
<td>Product responsible FMS and tachograph at a distributor (Sweden)</td>
<td>Meeting, 90 min</td>
<td>2015-02-11</td>
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<td>C</td>
<td>(1) Transport business owner, (2) vehicle manager (Sweden)</td>
<td>Meeting, 60 min</td>
<td>2015-02-11</td>
</tr>
<tr>
<td>D</td>
<td>Salesperson service market (Sweden)</td>
<td>Meeting, 60 min</td>
<td>2015-02-12</td>
</tr>
<tr>
<td>E</td>
<td>(1) Salesperson new and used vehicles, (2) salesperson service market (Sweden)</td>
<td>Meeting, 60 min</td>
<td>2015-02-12</td>
</tr>
<tr>
<td>F</td>
<td>Transport business owner (Sweden)</td>
<td>Meeting, 60 min</td>
<td>2015-02-13</td>
</tr>
<tr>
<td>G</td>
<td>Long-haulage driver and logistic planner (Sweden)</td>
<td>Telephone interview, 20 min</td>
<td>2015-02-13</td>
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</tbody>
</table>

7.2 Findings from the First Mapping

In Figure 14 the black box is visualized. This method showed that driver behaviour, vehicle condition and location were of big interest. Looking at the collected interview data and the black box, information regarding the period of the phase transition was lacking. The gathered data concerned the different phases and not the actual transition. To ensure that enough data was collected for the analysis, the interview questions to the resellers were modified and some new questions were added. These new questions focused on getting deeper knowledge about driver behaviour, vehicle condition an location during the phase transition and were used during the second mapping of characteristics of the lifecycle phases, described in Chapter 8.

Figure 14 Black box for transition alert service showing some of the information regarded to create the service.
Further, the first interview study gave insights about the utilization of a long-haulage truck during its entire life. In Figure 15 a schematic view over a truck’s lifecycle is shown. In the figure it can be seen that the first owner orders a truck suitable for the business area, and then the vehicle is used until it is considered to be too old or worn out. The vehicle is then sold, and gets a new owner. This might include a change in geographical location and/or rebuilding in order to fit a new application area. The vehicle is used, and finally either sold and goes through the previously mentioned actions, or disassembled.

It was realized that the delimitation regarding vehicle type, that says that the studied trucks are long-haulage trucks, does not mean that just long-haulage businesses are studied. Since the first owner always buys a truck adapted to the business, the first owner will surely run a long-haulage business. When it comes to the second owner, it cannot be sure that it is still a long-haulage company. This is because the second owner buys what is available on the second-hand market at the moment, and sometimes this means that a long-haulage truck will end up as e.g. a distribution or construction truck. Therefore the second owners included in this study are not just long-haulage businesses.

Figure 15 A schematic view over the truck’s lifecycle.

7.3 Discussion and Conclusions of First Mapping

The first interview study mainly aimed at testing the interview questions and give a general idea about the transportation business, in accordance with Briggs’ (1986) recommendations. Briggs (1986) suggests to try interview questions and then analyse them in order to see if some have to be changed and new respondents have to be found. As seen in Figure 15, the interviews gave a good knowledge about the truck’s lifecycle and what main actions it includes. Further, according to the analysis and the black box, that was inspired by Adamopoulos et al. (2002) and Mital et al. (2008), the areas of interest could be summarized to: driver behaviour, vehicle and location. These findings were vital in order to decide upon what to focus on in the further study. Also the finding that information was lacking regarding the transition phase was crucial for the second interview study. If this was not found in an early stage, probably the whole interview study had to be redone which would be very time consuming.
An important finding was that the delimitation regarding only looking at long-haulage businesses, was not good. As it could be seen from the interviews, even if the truck was built for long-haulage it does not mean that the vehicle will be used for this purpose during its entire life. This discovery was crucial in order to be able to adapt the questions and change the participants in the study.

In conclusion, even though this first interview study was done on a small number of respondents, the results were still important for the rest of the study. The reason why it was possible to get a result from that small number of participants was due to the homogeneity, something described as important by McCracken (1988). The fact that the respondents all had a connection to Scania and were in some way working with trucks, made it possible to draw conclusions even if it was a low number of interviewees. It was valuable to use the first interview study as a test to ensure that the study was constructed in a good way and thereby ensure that all information regarded would be collected. Finally, the authors of this thesis thought that the first interview study made it easier to execute the second one since the first study gave a good basic knowledge about the topic.
8 Second Mapping of Characteristics of the Lifecycle Phases

The second mapping of characteristics of the lifecycle phases was done by an interview study. In this chapter the general findings regarding the transition phase are presented; finally they are discussed and conclusions are drawn.

8.1 Second Interview Study

In Table 4 below the respondents participating in the second interview study are presented. The second interview study was analysed with a broader and deeper perspective with the aim to find information regarding the lifecycle phases and the transition between them that later could be used as indicators of a transition phase. The findings are presented as general findings regarding the transition phase. All the interviews are summarized and can be found in Appendix G, H and I.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Professional work title</th>
<th>Type of interview and duration</th>
<th>Interview date</th>
</tr>
</thead>
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<td>H</td>
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<td>Telephone interview, 20 min</td>
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<td>Telephone interview, 20 min</td>
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<td>J</td>
<td>Transport business owner (Sweden)</td>
<td>Telephone interview, 20 min</td>
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<td>Telephone interview, 20 min</td>
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<td>N</td>
<td>Area sales manager used vehicles (Spain &amp; Portugal)</td>
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<td>O</td>
<td>Mechanic used vehicles (Spain)</td>
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</table>

8.2 General Findings Regarding the Transition Phase

The general findings of the interviews are divided into information regarding owners, the sales process, export and services.

8.2.1 Owners

According to respondent D, E and Y, who are resellers, the customers that buy new trucks are old customers that come back and want to buy a new and better vehicle. Respondent D, who is a service market salesperson, argued that the ones that buy second-hand trucks are foreign customers and customers that cannot afford a new truck, e.g. one-man businesses. The fact that used vehicles are exported was confirmed by resellers W and X, and mechanic O. Further, D stated that first-hand owners usually are bigger transport businesses and that second-hand owners are smaller companies or big transport businesses that need an extra vehicle, which was also mentioned by resellers E and L. Reseller Q and X also stated that companies using second-hand trucks usually are small companies.
Reseller M and Z argued that everybody that can afford a new truck buys one, and it is not a matter of the business size but a matter of the business’ economic situation. This was confirmed by reseller W who stated that old trucks are sold to beginners with less capital. Reseller P and S argued that there is no difference in size of the company when it comes to which type of customer buys a new respectively a second-hand truck. Today’s economic situation in e.g. Italy and Spain leads to that the second-hand market of trucks has increased, according to reseller K, N and Q. This indicates that where the business is located affects if the business owner buys a new or a second-hand truck.

When talking to the hauliers, the answers differed from the answers given from the resellers. Respondent U has mainly second-hand trucks and runs a medium sized long-haulage business and respondent AA has 50% second-hand trucks in his fleet of in total 52 trucks. Respondent U said that buying a new truck is not economically justifiable and that new trucks are way too expensive. Respondent V, who runs a small long-haulage business, has one new and one second-hand truck. V mentioned that, if it was possible, he would only buy new because then the history of the truck is known. A and F, who also manages medium sized transport businesses, mentioned that second-hand trucks are just bought when there is a sudden demand of an extra truck. Respondent I, who is a co-owner of a smaller transport-business, said that a second-hand truck was bought once but never again because it caused her a lot of troubles and expenses. C, G-J, and T are just buying new trucks. To summarize, according to the interviews all kinds of customers buy trucks second-hand. If possible, all customers would like to buy a new truck but some of them cannot afford it.

### 8.2.2 Sales Process

A change of phase can be caused by the change of ownership of a truck, there are two main ways of doing that. The most common way for companies to sell a truck is to trade it in as it is the case for all the interviewed used trucks dealers [K-N, P, S, X-Z]. The other way is to deal between privates which is not as common.

The sales process of a second-hand truck through a dealer was studied in depth in order to find patterns in the performed activities. The results show that the process is similar for most of the used trucks resellers in Europe with some regional variations. The typical sales process consists of taking the truck to the dealer’s yard and a visual inspection is done [L-N, P, X]. Here the trucks are sorted according to mileage and age, if they are too old, too worn out (older than 5-8 years and more than 1 000 000 km) and have a very low market value, they are directly sold to traders [L, M, O, Q, X, Y]. Trader companies usually buy old trucks and export them, or sell spare parts. The trucks that are in an acceptable condition are then tested and undergo a technical inspection where problems and faults are mapped [M-Q, S, X-Z]. The truck is then cleaned, pictures are taken and the vehicle is put for sale through the internet or press according to L, P, S, W-Y. In some cases the dealers already know some possible customers that they contact directly in order to skip the process of public advertisement. A customer that is interested visits the truck personally and reparations and services to be done are discussed. A price is set and when the deal is signed the truck is prepared and delivered to the customer.

The average period of time for how long the sales process takes has a slight difference depending on the country. In Sweden the process usually takes longer time then in the rest of Europe. The average time for a truck to be in a transition phase when sold at a dealer is in Sweden, roughly, 200 days and in the rest of Europe (Italy, Spain, Portugal, Poland and Czech Republic and Denmark) the average is
100 days. The reason behind this difference in unknown, an idea that could describe this phenomenon is the difference in the economic situation that affects the demand of second-hand trucks [K, N, P, Q, S].

When it comes to the geographical position during this phase the changes of position are very few. The trucks stand usually still in the dealers yard waiting for a customer. In some cases these trucks are moved to a dealer in another city in the same country where the demand is higher, according to O, Q and S. X and Z mentioned that a few trucks are used as rental trucks and according to K and N some are test driven by the customers before purchase. Interviewees L, N, P, S and Y stated that the installation of new technology on used trucks is rare and happens only on customer demand. Most of the new installations are mechanical parts, alternators, hydraulic systems and in case of newer trucks software updates [O, P, X].

8.2.3 Export

A result of this study shows the movement of trucks inside and outside Europe and it is summarized in Figure 16. In most of the European countries are young used trucks sold inside the country. First when they become older, six to seven years, they start being exported between countries in Europe and older than ten years the exportation is mainly outside Europe to the Africa, Middle East, Russia and South America. The results are based on interviews with used trucks managers and salesmen from Czech Republic, Denmark, Italy, Poland, Spain and Sweden.

Figure 16 Movement of the truck when it starts being exported.
8.2.4 Services

The study tried to find out how the used trucks on the market are used and if they use the FMS. The empirical studies showed that today very few (Scania) trucks sold on the second-hand market are equipped with the communicator C200. Since it became a standard feature in 2011 a few more years have to pass before there will be a significant amount of connected trucks on the used vehicles market. Therefore it is hard to say how these services will be used by second-hand owners in the future. Interviewees W and X, salespersons in the northern countries, sustained that there is an increasing demand of FMS on the second-hand market. Respondent L, Italian dealer, observed that there is not enough knowledge on FMS today among hauliers that buy used trucks.

8.3 Discussion and Conclusions of General Findings

Few second-hand vehicle owners participated in the study. This was due to the fact that they were harder to get in touch with and to convince to take part in the study. Because of the low number of participating second-hand owners, it became harder to draw conclusions from their answers. It can also be said that the current situation is very specific. The majority of the second-hand trucks on the market do not have C200. This will change in just a few years, since C200 became a standard component year 2011 and the average life time of a first-hand truck is four to five years. This situation observed from the perspective of Levitt (1965), could be described as the truck with C200 and the services connected to it are still in a stage of growth which means that the knowledge about the product is still growing. Today, the C200-related products have not reached Levitt’s (1965) stage of maturity yet, if this study was made in the stage of maturity it would have led to different results.

As it can be seen in the general findings regarding owners the answers differ from hauliers and resellers. This means that both big and small companies buy second-hand vehicles, and it is more about the economic situation rather than the size of the company. This is supported by Guiot & Roux (2010) and MarketLine Industry Profile (2014), who sustain that the reason behind companies buying second-hand trucks could be a way to handle poor financial times. Further, MarketLine Industry Profile (2014) mentions that second-hand medium and heavy trucks become common in both big and small transport businesses. Therefore it is hard to find a specific type of owner of a new/second-hand vehicle and it might not be suited for using as an indicator of a phase transition.

The sales process, according to the interviews, was similar in whole Europe. This can be due to the fact that the resellers have a connection to Scania. It was mentioned by respondent N that the captive resellers are easier to control than the non-captive. A factor that affects the sales process of used vehicles a lot is the economic situation in the country, according to respondent K, N, P, Q and S. This means that the average period an used vehicle is standing at the resellers yard differs in different countries depending on the economic situation and the demand of cheaper trucks, which is supported by the theories by Guiot & Roux (2010) and MarketLine Industry Profile (2014). The difference in how long the sales process of an used vehicle takes, could be interesting to further investigate and translate into measurable data for later translation of characteristics into data.

The findings regarding export are very useful for the later study. This shows that used vehicles sometimes change location during sales, especially the older vehicles. The fact that the location changes might be an interesting indicator when searching for a transition phase. The result saying that the demand for services are low as mentioned by L, was not expected. The fact that not many vehicles on the second-hand market today have the equipment for using FMS, was not something that the
authors of this thesis had thought about. Therefore this was a very important finding. As mentioned during the interviews, the C200 that is necessary for FMS became a standard feature in 2011 and therefore not so many second-hand vehicles are sold are equipped with this. If this interview study would be remade in four years the result regarding services would be different. Then most of the vehicles on the second-hand market would be using C200 and have the possibility to connect to FMS.

In conclusion, there is no typical second-hand vehicle owner and the economic situation in the country affects both type of client, how long the sales process takes and in which country the vehicle ends up in.
9 Validation of Previous Work on Lifecycle Characteristics

In this chapter the interview questions were used to be able to better understand the use characteristics found by Vigmo & Sundkvist (2014). Interview data regarding each characteristic is discussed below and finally a summary regarding the validity is presented.

9.1 Delivery Precision

The further away in the truck’s lifecycle, the lower the focus on delivery precision.

The hauliers that participated in the study, had different types of businesses e.g. long-haulage, timber transport, food transportation and distribution; they were of different sizes and with both Swedish and foreign clients. When asking about the driving schedule and time margins, no trends connected to the use of new or old trucks could be found. How the schedule and margins were set, was according to the job assignment and not connected to the age of the truck. According to all hauliers, regardless if they buy new or second-hand trucks, the time the vehicles are supposed to drive during a day is pre-scheduled and followed up [A, C, F-J, R, T-V, AA]. Respondents A, C, R, J, who only have new trucks, talked about strict time margins given from the customers. Respondent A even mentioned delay fines. Haulier F, who has new trucks and one second-hand vehicle also mentioned strict time margins and fines. Hauliers U and V, both using second-hand trucks, have time margins given from the customer and respondent V also has delay fines. Respondent AA, running a big transportation business (over 50 vehicles) and having a fleet with 50 % second-hand trucks, mentioned high delay fines if the delivery is not in time. By this said, just looking at the age and lifecycle stage of the truck cannot give an exact answer about the business’ focus on delivery precision since both new and second-hand trucks are used by companies having customers with high demand on delivery precision.

9.2 Use Frequency of the Used Trucks

The further away in the truck’s lifecycle, the lower the needs of the businesses to have a high use frequency of the used trucks.

According to the interviews with the hauliers, it can be seen that the use frequency is connected to the job assignment and not to the age of the truck. Both businesses having second-hand trucks, e.g. respondent U and AA, and businesses with only new trucks, e.g. respondent J and T, are using two or more shifts to maximize the use of the vehicle. Since more businesses using only new trucks than businesses with second-hand trucks were participating in the study, it cannot be said whether Vigmo & Sundkvist (2014) are correct or not. The authors of this thesis think that the use frequency might be higher among new trucks, and this could be connected to the fact that new trucks are expensive and need a high use frequency to cover the investment. Since this cannot be confirmed by the interviews, this is a characteristic that should not be used as an indicator of a transition phase.

9.3 Technically Advanced Functions and Use Technical Devices in the Driver Environment

The further away in the truck’s lifecycle, the lower the demand for technically advanced functions &

The further away in the truck’s lifecycle and from the starting point Europe, the lower the incentive to use technical devices in the driver environment.
There are two characteristics, mentioned by Vigmo & Sundkvist (2014), regarding the use of technically advanced functions. One is concerning the technical demand in the vehicle and one is about the drivers’ incentive to use advanced technical functions. This study focuses on the first lifecycle phases and according to respondent X, in five years most of the trucks in these phases will be equipped with a C200 which gives the possibility to use technical functions connected to this device. Also, the drivers will be more and more comfortable with using technology, and drivers that are not used to handle computers will soon be phased out. This means that the drivers incentive to use technical devices in the driver environment cannot really be connected to the lifecycle phase of the vehicle, especially not when just looking at the transition phases studied in this thesis. The hypotheses by Vigmo & Sundkvist (2014) can be considered valid if the later lifecycle phases are studied, when the customers want trucks that they easily can fix themselves. This is confirmed by respondent O that mentioned that really old trucks go to Africa and the Middle East and become spare parts. Reseller P said that the trucks that are exported to Africa and the Middle East are mainly standard trucks with low technology level and with the age of ten years and older. Looking at the interview studies, no conclusion about the technology use connected to the age of the vehicle could be drawn regarding the trucks in the lifecycle phases studied in this thesis.

The authors of this thesis argue instead that the difference that can be found between new trucks and a second-hand trucks is the usage of Scania’s services. Scania Repair and Maintenance Contract, is according to service market salesperson B and salesperson X and Y, just signed for trucks in their first lifecycle phase since it will be too expensive to sign it for an older truck or a truck that is used for another purpose than it was intended. When it comes to the services connected to FMS, it can also be seen that the interest of using all the services’ features decreases as the truck goes further away in its lifecycle. Reseller E, L-N, Q, S and Z emphasized that it is more difficult to sell services to second-hand owners. Reseller E, M and S argued that the reason behind this is that second-hand trucks do not always have the technical device that supports the FMS services. Service market salesperson B, E and D mentioned that the services sold to new truck owners are usually Control or Monitoring and tachograph download. All hauliers that buy new trucks, respondent A, C, F-J, R and T, answered that they at least have Monitoring and tachograph download. Haulier U, that have 80% second-hand trucks, said that Monitoring and tachograph download was bought for one truck and because of the high price this service contract will be ended. Haulier V had one new and one second-hand truck and tachograph download and Monitoring was used for both of them. Haulier AA had just FMS and service contract for the new trucks and not the second-hand ones.

Since not so many second-hand vehicle owners were participating in the study, it is hard to tell from just looking at their responds whether the demand of offered services decrease with the increasing age of the truck. The answers from the resellers though, are all showing that the interest decreases. According to this finding, the authors of this thesis argue that the demand of Scania offered services decreases, rather than the demand of technology, the further away the vehicle is in its lifecycle.

9.4 Need for Vehicle Reliability

The further away in the truck’s lifecycle, the lower the need for vehicle reliability.

Vigmo & Sundkvist (2014) argued that the further away in the truck’s lifecycle the lower the need for vehicle reliability, which does not coincide with the interview studies. Business owners that own a truck in the second lifecycle phase need to use the truck as much as a business that owns a truck in its
first lifecycle phase. When analysing the hauliers’ answers, there is nothing that shows that the need for reliability should be any different; from respondents A, C, F-J, R and T that use new trucks, and respondents U, V and AA who uses second-hand trucks. They have the same responsibility to fulfil their customers’ requirements in order to run a profitable business. This can be connected to the fact that the demand on delivery precision does not change during the truck’s initial lifecycle phases, which was discussed earlier in this section. Based on this, the authors of this thesis argue that the need for vehicle reliability does not change drastically during the transition phases studied in this thesis.

9.5 Repair and Maintenance

The further away in the truck’s lifecycle, the lower the tendency to turn to OEM for repair and maintenance.

The tendency to turn to OEM for repair and maintenance can be seen as decreasing as the truck goes further away in its lifecycle. This is connected to the fact that hauliers that buy new trucks often buy the Repair and Maintenance contract, according to service market salesperson B and reseller X and Y. With this contract the customer can resolve all the problems, from the smallest lamp to big engine problems. Haulier A, C, F, I, J, R and T all buy new trucks and answered that they turn to OEM for all kinds of repair and maintenance. Respondent A and F even mentioned that they have the Repair and Maintenance contract. According to service market seller B, D and E owners of a new truck comes with every little problem, and B mentioned that the tendency to turn to OEM for repair and maintenance decreases with the depreciation of the vehicle. Respondent D described the second-hand owner as a person with “do-it-yourself-skills”. Respondent U, who mainly buys used trucks, said that everything that can be solved at the business’ own workshop is done there, and just important problems e.g. concerning computers and software, are handled by the OEM workshop. The reason behind this is, according to respondent U, that a business owner that buys a second-hand truck buys it because of the fact that he or she cannot afford a new one and turning to the OEM workshop for every problem is too expensive.

9.6 Loyalty Towards the Owner and the Business

The further away in the truck’s lifecycle and from the starting point Europe, the lower the level of loyalty towards the owner and the business.

The level of loyalty towards the business, that according to Vigmo & Sundkvist (2014) should decrease as the truck goes further away in its lifecycle, could be questioned. The authors of this thesis argue that the better the communication between owner and driver and the closer their relationship is, the higher the loyalty towards the owner and the business. Another factor, analysed when looking at the loyalty, is the tendency to inform the business owner about eventual problems with the vehicle.

As mentioned in chapter 8.2.1, all types of customers can buy an old truck, small companies as well as big companies. In small businesses the communication between drivers and owner is easier to manage and are usually on a daily basis, according to haulier U and V who both buy second-hand trucks. Haulier G-J, T, who all buy new trucks and have small sized companies, also mentioned that the communication is handled directly with the driver and that it occurs at least once a day and usually more. U and V also mentioned that it is not just business related talk, but also a lot of communication just for keeping the drivers company. Both respondents said that they have a close relationship with their drivers and that they also drive trucks themselves. In big companies there is a risk that the individual driver becomes
“invisible” and this might lead to a tendency to be less loyal. Hauliers of bigger sizes, respondent A, C, F, R and AA all mentioned that the communication was just business related and not as frequent as mentioned by respondents G-J and T-V. Also, the communication in big companies is usually between the traffic manager and the driver and not the business owner and the driver [A, C, AA].

According to J, G, T-V who runs small companies, the drivers always inform the business owner if there is a problem with the vehicle. Respondent F, owner of a small company, said that if the goods is damaged, the owner is not always informed. Respondent C, who has a big company, answered that the drivers are really good at reporting problems concerning the vehicle. Respondent R, business owner, and AA, personnel manager, at big companies said that it differs from individual to individual.

In conclusion, most of the small companies argued that the drivers were eager to communicate problems, but there are exceptions like the one small company that mentioned the opposite. Also one big company answered that the drivers do communicate every problem.

The characteristic regarding the level of loyalty cannot be validated. Also, it difficult to use business loyalty for translation into measurable data, since it is factor depending on the personality of the driver rather than the condition of the vehicle.

9.7 Driver’s Working Situation and Comfort

The further away in the truck’s lifecycle and from the starting point Europe, the lower the focus on the driver’s working situation and comfort.

The last characteristic mentioned by Vigmo & Sundkvist (2014) is that the further away in the truck’s lifecycle the lower the focus on the drivers’ working situation and comfort. Since this study is focusing mainly on the lifecycle phases where the truck is still used for professional transportation businesses, this characteristic is hard to use since all the hauliers, respondent A, C, F-I, J, R, T-V and AA answered that driver comfort is important. This shows that regardless of whether it is a new or a second-hand truck, the drivers’ working environment is essential.

Reseller Y and Z said that when buying a second-hand truck the interior is as it is. The business owner seldom changes the seats or other part of the interior and this means that the driver has to take the truck for what it is. When buying a new truck the vehicle is custom made for the specific business and might therefore be more comfortable to work with. According to reseller X the interior in a Scania has been pretty much the same during the last ten years, and therefore a new truck and a second-hand truck should have the same equipment. What might affect the comfort is that a second-hand truck could be worn out and therefore not be as comfortable. On the other hand respondent E answered that some business owner can get a better second-hand truck than a new one since they can get a vehicle with better seats and interior than they could afford when buying a new truck. Since there are different opinions regarding this characteristic, it is a factor that has to be carefully handled and should not be used as a strong indicator when identifying a transition phase.

9.8 Summary of Validation of Previous Work

Based on the result of the analysis of the interviews, some of the characteristics defined by Vigmo & Sundkvist (2014) were verified and some were questioned and further discussed. The main reason why some of the characteristics were questioned is that this thesis focuses on the early transition phases, when the truck still is considered to be interesting for Scania, and not on the late ones. Therefore some
of the findings in Vigmo & Sundkvist (2014) are not relevant. By analysing the interviews it could be seen whether the characteristics were suited for the translation into measurable data or not.

The characteristic that can further be used in this study is the characteristic regarding the tendency to turn to OEM for repair and maintenance. The two characteristics regarding use of technology, were translated into the demand of Scania offered services. The reason why the other characteristics could not further be used in this study, was because they did not apply in this case. This is due to the fact that the characteristics presented in previous work are developed from a perspective looking at the whole lifecycle described by Cao et al. (2009) and Levitt (1965), and the lifecycle phases studied in this thesis are those described as middle of life by Cao et al. (2009). The fact that some of the characteristics by Vigmo & Sundkvist (2014) have been falsified by the authors of this thesis does not mean that they are not valid at all, it just means that they are not valid when taking into account the delimitations for this thesis. Since it is not enough to have two characteristics to base the transition alert service on, further analyses follow to find new characteristics better suited for this thesis.
10 Defining Transition Phase

In this chapter the authors of this thesis define transition phase. This is followed by discussions and conclusions where the definition is being analysed.

10.1 The Definition of Transition Phase

Transition phase is defined as the period between one lifecycle phase and the following one. Further, the authors of this thesis have chosen to define transition phase as the period when the vehicle changes owner or utilization or both at the same time. This means that transition phase is the time when the ownership of the vehicle changes from the first owner to the second owner, the second owner to the third, and so on. It could also be the time when the truck changes from its intended original use to a new application e.g. from driving long-haulage to driving distribution. Change in utilization can, according to the interview studies, happen in the same business and is then still regarded as a transition phase and this is the reason why just looking at changes in ownership is not enough.

The lifecycle phases are divided into two categories: type A and B, see Figure 17. Type A are lifecycle phases where the truck still could benefit from services offered by the OEM and when the vehicle is used in a professional transportation business. Type B are lifecycle phases near to end of life where the truck no longer would benefit from the OEM’s service offerings and the vehicle is no longer used in a professional transportation business. This means that a truck in phase B still can be used in a professional business, but the vehicle is not the primary source of income. Transition phases can occur between two type A phases, a type A and B phase and two type B phases.

![Figure 17 Description of a truck's lifecycle including type A and B phase.](image)

10.2 Discussion and Conclusions of Definition of Transition Phase

The study of the work done by Vigmo & Sundkvist (2014) gave an idea about how transition phase could be defined. They emphasized that the core purpose of use and the technical condition of the truck and the importance of advanced technology were parameters of importance when defining the truck’s lifecycle. Further, lifecycle theory from Cao et al. (2009) shows that the cycle can be divided into three stages: beginning of life (BOL), middle of life (MOL) and end of life (EOL). In this thesis the transition phase is limited to MOL. The reason behind this is because of the delimitations of this thesis; owners in the later phases are hard to get in touch with and the interest of service offerings can be considered low. By defining that the transition phase only is in MOL the authors of this thesis might miss interesting events in the later phases of the truck’s lifecycle. It occurs that in some trucks the engine is removed and used for producing electricity, or the truck is rebuilt into a bus. These situations
are on the border of what Cao et al. (2009) call EOL, the truck is still used, but not for what it was intended to. These cases could retrieve interesting information for the future, where services will extend to a larger part of the lifecycle.

The reason behind dividing lifecycle phases into two types, A and B, is that different vehicles can just have one owner change or change in utilization before it is considered to be in the EOL. Other trucks can have three or four changes in both owners and utilizations and still be interesting for Scania. By looking at the lifecycle phases of a truck and label them with A and B, it will be clear when the truck is no longer interesting. If it is shown that the truck is in a transition phase between a type A to type B, there is no longer a need to contact the owner and offer services. Defining the exact limits for the transition between type A and type B is difficult. Scania expressed that the identification of these limits is not highly prioritized and this thesis’ main focus is to detect a transition in phase A. Since both parts consider this as low priority, the limits were not defined. Even though it was not possible to define the limits exactly, the interview study showed that trucks that have an average age of ten years or more, and operate outside of Europe are not interesting for Scania anymore. Also it showed that this type of vehicles very seldom turn to OEM for maintenance and repair. This is a rough estimation that needs to be investigated by further studies.

What can be discussed is the definition of type A and B which is slightly different from MOL and EOL. As described earlier type A includes the vehicles that still are interesting for Scania in a service perspective. It can be discussed whether the area of interest in the future will change, with the increasing amount of data and information coming from all lifecycle phases and new services developed for the whole lifecycle. Looking at the current pace of development and the increasing importance of the use of big data, mentioned by Schmarzo (2008), and connected devices, mentioned by Broggi et al. (2008), it is possible that this described future is close. Is then the definition of transition phase and type A and B in this thesis still relevant? It is relevant now for improving the current services and in a close future it will serve as a starting point for updating the definition.

Creating a definition of transition phase was dependent on the structured analysis from previous steps, and without this it would have been a really hard mission. The main method used was discussions and drawing conclusions from the literature study and the analyses of the interviews. It started with one definition that later was rewritten and redefined when new information was gathered. This was done during the whole study as more knowledge in the area was gathered. Letting this process be iterative, was necessary and would not be possible in the same way if just a linear research process would have been used.

In conclusion, the definition of phase transition was crucial in order to continue with the following phases in the study. Without a clear definition of what is actually investigated, it would be impossible to get a reliable final result. Therefore the authors of this thesis let this phase take time and be iterative, in order to get the definition as correct as possible. Further, as it can be seen the limit between type A and B is not clear and has to be further examined.
11 Parameters Describing the Lifecycle Phases

The validation of previous work on lifecycle characteristics led to the conclusion that a new way of describing the lifecycle of a truck had to be developed. This chapter includes the description of this method, named phase-DNA, and ends with discussion and conclusions.

11.1 Phase-DNA

By combining the identified themes from the analysis of the interview studies and discussing them, it was concluded that every lifecycle phase of a truck is different and can be described using certain parameters. The final combination of themes resulted in six main parameters and this combination was named phase-DNA and is composed by: Geography, Route, Driver, Traffic Condition, Assignments and Services. The content in these parameters is unique for each truck in each lifecycle phase. Looking at changes in the value of these parameters, it will be possible to detect a transition phase. The six parameters included in the phase-DNA are presented in Figure 18.

![Figure 18 Phase-DNA with the six parameters described.](image)

11.1.1 Geography

In most cases new trucks are sold by a dealer located in the same country as the first owner, therefore a change in geographic position might be an indicator of a transition phase. This is connected to the
findings presented in chapter 8.2.3 and the interview answers from respondent N-Q, S, X and Y. Other factors that also are interesting are the topography and the climate which also might change in a transition phase. A drastic change in one of these parameters could be explained by a change of ownership, the change of customer or simply the change of routes.

11.1.2 Route
Change in utilization will affect the routes driven. Going from short to long distances and vice versa and changes in amount of average stops during a day, could be an indicator that the truck has changed its usage area. According to all the hauliers participating in the interview studies, respondent A, C, F-J, R, T-V, the routes are scheduled in advance and time margins are important. This means that the business owner usually uses the same routes for the same type of assignments, in order to handle the strict driving schedules. If the route is drastically changed regarding amount of stops, runtime and distance driven, this could be an indicator of a new owner and/or new utilization.

11.1.3 Driver
If the vehicle changes owner it will probably be driven by new chauffeurs, which means that the driver ID changes. According to respondent A, C, F, G, I, J, and U the same driver or group of driver drives a specific vehicle all the time. A change in driver ID could be seen in e.g. inserted driver cards, settings, the way the driver breaks and shift gears. A change in driving style could be an indicator of a new owner and consequently a transition phase. A change of drivers, does not always have to mean that there is a new owner, but it could indicate a change in utilization and therefore a transition phase.

11.1.4 Traffic Condition
Change in utilization could be seen in a change of the traffic condition. According to the analysis of the answers from respondent A, C, F-J, R, T-V, a business usually has the same type of work assignments and therefore drives in similar traffic most of the time. If the type of utilization changes, the roads that the vehicle drives on and the amount of traffic on these roads might change. This will probably also affect the average speed and amount of stops of the vehicle.

11.1.5 Assignments
If there is a change in usage of the truck it will be seen in new transport assignments, which is confirmed by respondent A and C. Changing business or just changing utilization of the truck will lead to different goods handled by the vehicle and also a change in vehicle weight and maybe body work. This parameter is close connected to parameter Route and Traffic Condition, since these will probably also change if the assignment changes.

11.1.6 Services
As seen in the interviews, depending on the type of business there is a different need of services. Especially the interest of repair and maintenance services offered by the OEM differs, a conclusion that can be drawn from the answers from respondent A-D, F, I, J, R, T, U, X, Y and the argumentation in chapter 9.5.

From the findings presented in chapter 8.2.4 it is seen that the interest in FMS services are big among owners of new vehicles, respondent A, C, F-J, R and T answered that they at least have Monitoring and tachograph download. When it comes to the services connected to FMS, it can also be seen that the
interest of using all the services’ features decreases as the truck goes further away in its lifecycle. Reseller E, L-N, Q, S and Z emphasized that it is more difficult to sell services to second-hand owners. This means that changes in the services supplied by Scania could be an indicator of a transition phase. As discussed in chapter 8.2.4 we are in a shift where vehicles on the second-hand market soon will be equipped with the unit that enables the vehicle owner to sign service contracts such as e.g. FMS.

11.2 Discussion and Conclusions Phase-DNA

The creation of the phase-DNA was dependent on a well performed analysis of the interview studies. Using the seven stages suggested by Kvale (1996) and then coding themes as suggested by Miles & Huberman (1994), made it possible to find the six parameters described above. Especially the colour coding was important in order find different themes and merge similar ones.

The idea with the phase-DNA is that it will help identify transition phases. By finding different data connected to each parameter in the DNA and then investigate if these data change during a certain period of time, this could be an indicator of a transition phase. A change in one of these parameters does not mean that a transition phase has occurred, but a change in a few of them at the same time could be an indicator of a transition phase.

The choice of these six parameters is based on the finding from the analysis of the interview studies. The parameter Geography can be connected to the general findings in chapter 8.2 regarding export and sales process. According to the findings in chapter 8.2.3, it could be seen that trucks go to export after a certain time on the second-hand market but also that it happens that vehicles change location during the sales process, see chapter 8.2.2. By this said, a vehicle can change its geographical location many times during its life.

Route and Driver are both connected to the fact that all types of customers buy used-vehicles, mentioned in chapter 8.2.1. Since both the company’s size and business can differ among the customers of used vehicles, no typical driver or route can be connected to a second-hand vehicle. This means that during the whole life, the vehicle changes drivers and routes many times and this could be used to identify transition phases.

The parameters Traffic Condition and Assignment both depend on the business the vehicle is used in. The business is connected to the owner of the vehicle, and as mentioned before all types of businesses can use a second-hand vehicle. This means that the assignment will probably change when ownership changes and with this comes a potential change in traffic condition.

The parameter Service is connected to the findings regarding services in chapter 8.2.4. Even though the demand for services are considered to be low among the second-hand vehicles, it could be used as an indicator for the first lifecycle phase to the second.

In the definition of transition phase, see chapter 10.1, change of ownership is a factor that clearly indicates a transition. This parameter is not included in the phase-DNA because a change of ownership can be hard to identify. In Sweden the vehicle register from The Swedish Transport Agency can be used, but in the rest of the world it is hard to gather information concerning ownership. When doing research in the Swedish vehicle register, it appears that resellers of used vehicles are seen as owners. This implies that some of the owners shown in the register are resellers and not owners that can make
use of Scania’s services. A second downside with using the register is that the possibility to detect a transition then would be dependent on information produced by another actor.

In conclusion, the six parameters seem to be quite broad and can therefore together be considered to cover the whole vehicle’s lifecycle.
12 Translating Parameters into Data

The translation of parameters into data was done by a group brainstorming. This chapter includes a presentation of the result of this method, a discussion and conclusions regarding the findings.

12.1 Group Brainstorming

The group brainstorming was conducted together with three specialists from different departments at Scania. It resulted in a large number of ideas regarding what could be measured in each of the six parameters: Geography, Route, Driver, Traffic Condition, Assignments and Services that are described earlier in chapter 11.1. 15 to 30 ideas were created for each field and organized under different categories by using affinity diagrams. In Appendix J the result of the brainstorming is presented. In a second phase the authors of this thesis reorganized the sticky notes with the ideas. The first time all the parameters were mixed together, but this did not show any interesting results. The second time, each parameter was analysed individually. The third time similar ideas were put together, impossible or irrelevant ideas were changed or taken away and finally ideas that could work in the future were put in an own category. The final result consisted of possible ways to measure changes in the seven parameters presented below. As can be seen when comparing the result from the group brainstorming presented in Appendix J and the figures shown in this chapter, not so many ideas were eliminated due to the fact that not so many ideas were out of topic. The ideas eliminated were those mentioned for many parameters and those who were too futuristic or unrealistic, and these are discussed in chapter 12.2.1.

12.1.1 Geography

The category Geography was the richest in number of ideas. Geography was described by four factors: topography of the landscape, geographical position, climate and road related factors. The topography could indicate a change of landscape and thereof a change in usage. Not only altitude and satellites can be used to describe the topography, but also the driving style could give significant data, e.g. many curves could indicate mountain driving. The most straightforward way that shows a change in location is looking at the GPS data. Another way would be to look at the mobile phone operator, both cases will show the movement of the truck to a different country. Both the road factors and the climate could indicate the change of location. Climate parameters recorded by the truck and compared with data coming from weather forecasts could report information about geography. The data concerning Geography are displayed in Figure 19.
12.1.2 Route

The driving style of a driver is able to describe the route of a vehicle. By looking at how the driver uses the vehicle it could be possible to see that a truck changed route. Though the most interesting idea was to look at the GPS data and draw the shape of the route, and then compare the shape over time. Another idea based on GPS data, was to find the “home” location of a truck and see when it changes. The “home” location is the place where the truck goes back regularly. Finally, a way to describe a route is the analysis of stops. Different businesses make different amount of stops, and this could be used to describe the route. The data concerning Route are displayed in Figure 20.
12.1.3 Driver

During the brainstorming it was mentioned that the most efficient way to identify a change of driver would be to check the driver card and check whether the driver IDs differ during a period of time. Another way to identify a change of driver is to compare the driving style, since all drivers drive differently. The data concerning the Driver are displayed in Figure 21.
12.1.4 Traffic Condition

Traffic condition was during the brainstorming divided into the traffic’s character, driving style and road condition. Driving style data that could be used is amount of vehicles on the road, which can be read by radar. Another important data for finding changes in traffic condition is time spent in traffic jam. Data connected to driving style that can indicate a change in traffic condition is how much the warning lights are used, the average speed and how much the driver brakes. If the vehicle e.g. suddenly has a much higher frequency of use in all these factors, the vehicle has probably changed from a “calm” traffic to a more intensive. The roads can tell a lot about the traffic condition, which was mentioned during the brainstorming. Therefore the road quality is described as road friction, use of ABS, road temperature, road smoothness and road width. The data concerning Traffic Condition are displayed in Figure 22.
12.1.5 Assignment

According to the brainstorming result, the most important data to look at for finding changes in assignment is connected to the freight’s characteristics: freight temperature, vibrations, density, sound and air in the freight. If there is a change in the average level of these data, there might be a change in assignment. How well-loaded the trailer is, was found as too hard to measure and also might be answered by the freight density. An important factor is vehicle-related data, described as braking force, tire pressure, weight and fuel consumption. These data can give an idea about what type of goods that are transported and if there is a drastic change, the nature of transportation probably has changed. Different assignments require different body work and therefore this is also an indicator of a transition phase. Type of body work could be seen in change of power outlet and type of trailer or other body works, which can be seen in the data files created during workshop visits. New assignments also lead to new routes driven, which is mentioned earlier in this section. The data concerning Assignment are displayed in Figure 23.

Figure 22 Different data describing the parameter Traffic Condition.

Figure 23 Different data describing the parameter Assignment.
12.1.6 Service

The services that emerged during the brainstorming were of all different kinds: FMS, R&M contracts, driver coaching and communication. Interesting was the frequency of a truck going to an OEM workshop and the location of the workshop, these two factors could indicate a transition and have a connection to eventual R&M services. Also what other systems for order management or temperature control that are installed on the truck, could be a factor that shows a transition phase. The data concerning Service are displayed in Figure 24.

![Diagram of Service categories]

Figure 24 Different data describing the parameter Service.

12.1.7 Future

There were some identified data during the brainstorming that the authors thought were really good but a bit too futuristic to be used as an indicator of a phase transition today. Therefore a new category was created, called Future. This category includes data like platooning, speeding cameras, customs cameras, mobile phone, personal driver settings, radio channels listened to, face recognition, language spoken, ADAS, communication between vehicle and infrastructure and driver characteristics like sweat, pulse and weight. The data concerning Future that are displayed in Figure 25.
12.2 Discussion and Conclusions of Translating Characteristics into Data

In this section the ideas from the brainstorming are discussed. This is followed by a discussion regarding the potential of using big data when translating the characteristics.

12.2.1 The Ideas from the Group Brainstorming

The result from the group brainstorming was useful since a lot of different ideas were created. The width in the result could be connected to the fact that the participants came from different backgrounds. When comparing the initial ideas seen in Appendix J and the final result presented in chapter 12.1, it can be seen that not so many ideas were eliminated. This is due to the fact that not so many ideas were out of topic, which should be seen as a consequence of a well performed group brainstorming session.

During the group brainstorming some of the data mentioned were not considered to be useful for the translation of the parameters. In the category Driver the conclusion was made that the most efficient way to identify a change of driver would be to check the driver card and driving style. All other ideas of methods were too vague or could have shown ambiguous results. Mapping which gadgets are used in the cabin was not considered because there is no study that shows that the change of driver implies a change of gadgets, and compared to the accuracy that a driver card gives, it is a farfetched solution.

Ideas on data from the group brainstorming concerning traffic condition that was taken away was communication with infrastructure, weather related data and positioning with GPS. The reason behind why communicating with infrastructure was eliminated from this category, was because it was
considered to be too futuristic and therefore placed in the new category called future. Positioning with GPS was already brought up as data that could describe route, and weather data was considered to belong to the theme concerning geography.

The authors of this thesis decided to create a new category called Future. This was a way to handle the data that were considered too hard to use at the moment. Many of these data could today be considered as invasion of privacy, but the authors argue that in some years most people will not be uncomfortable with the fact that these data are collected.

In conclusion, most of the ideas that came from the group brainstorming have potential and could be used for indicating a transition phase. Some of them could be seen as more indicative than others. In order to investigate how good the ideas are, a discussion is not enough, they have to be tested. Therefore the following chapter 13, aims at investigating which data types that could be seen as indicators of a transition phase.

12.2.2 The Potential with Using Big Data when Translating the Parameters

Using big data to find a set of data that can be used to indicate a transition phase, means that finding a transition phase can be done automatically instead of manually. This is in line with Jagadish et al. (2014) that mention that big data decreases the need for handmade calculations and estimations and replaces it with data driven mathematical tools. The risk of using human made assumptions including errors will be minimized.

The data that are used are the types by George et al. (2014) called private data and data exhaust. The private data used are e.g. information from the driver card used in the truck and data exhaust are data that are collected from different parts from the truck during the drive e.g. amounts of stops. As mentioned by Jagadish et al. (2014) more and more data are collected in our society and the authors of this thesis argue that people will be more comfortable with this. This means that other kinds of data could in the future be used to make the indication of a transition phase even more exact. Public data, e.g. data from local communities and data from road tolls could be used to keep track of the vehicles. Private data, like how the driver uses the radio and mobile phone are other examples that could be used. Self-quantification data is also a future possible data resource if the Scania mobile phone application and FMS will expand and enable the driver to upload more vehicle related and personal data than it is done today.

Kilcarr (2013) discusses the future trucks and the systems around them, and mentions that by using telematics the trucks will be able to communicate with the drivers, fleet managers and repair shops. If the vehicles in the future will be equipped with such expanded telematics, other types of data will be accessible for Scania to be used when investigating the vehicle’s usage pattern.

If Scania will be able to find new sources of data, more heterogenic information should be collected. What has to be kept in mind is that the reliability might vary among the collected data. Data collected from the vehicle parts can be seen as more reliable than data gathered from an self-quantification application in a mobile phone. If the heterogeneity and the different data sources can be handled, it is according to Jagadish et al. (2014) important for getting a nuance and width. The authors of this thesis think that in the future when better solutions for real-time data handling and the problem with privacy and data ownership, which is mentioned by Jagadish et al. (2014), is solved there are big opportunities for creating an even better set of data that indicate a transition phase.
George et al. (2014) mention the possibility to find outliers when analysing big data. The data used for indicating a transition phase is mainly average values which can be assumed to work fine at the moment. But as the time goes and technology develops, the usage patterns of a truck might change. The usage patterns translated into data presented in this chapter might not be valid in ten years. Therefore the authors of this thesis argue that it is important to look at the outliers in order to predict future trends and patterns to be able to always keep the set of data up to date.

To sum up, using big data gives great opportunities and enables an automate detection of transition phases instead of manual work. Since big data and telematics are growing fields, the authors of this thesis think that there will be even more possibilities to detect changes in usage patterns in the future than those described in this chapter.
13 Hypothesis on Detecting a Transition Phase

The parameters translated into data were used to construct a hypothesis. In this chapter the hypothesis creation is described. This is followed by a validation done in two steps: exploratory and statistical. Finally discussion and conclusions are presented.

13.1 Hypothesis Creation

Based on the translation of parameters into data done during the group brainstorming and the analysis of the results, the authors of this thesis decided upon eight different data types to use for the hypothesis creation. Data from five of the parameters mentioned in the section above: Geography, Route, Driver, Traffic Condition, Assignment and Service were used. In Figure 26 the phase-DNA is shown with data types used for the hypothesis covering the six parameters. The hypothesis concerning change in ownership and/or utilization was decided to be a change in the data for:

- **Route Shape** – the shape created by GPS coordinates
- **Amount of Stops** – the number of stops done during one day
- **Run Time** – the total time in hours the vehicle was driven during one day
- **Idle Time** – the total idle time in hours during one day
- **Distance Driven** – the total distance in kilometres driven during one day
- **Coasting** – the total distance coasted in kilometres during one day
- **Driver ID** – the pattern of driver cards inserted in the vehicle
- **Average Speed** – the average speed in km/h for one day
- **Fuel Consumption** – the total fuel consumption in litres during one day
- **Workshop History Data (WHI)** – the location of the workshop visits

Figure 26 The phase-DNA parameters with belonging data types used in the hypothesis.
13.2 Exploratory Analysis of Hypothesis

The first step of the exploratory analysis consisted of plotting graphs over the whole lifecycle for five trucks regarding the data types: Distance Driven, Coasting, Run Time and Idle Time. In the graphs the change in ownership date was noted. Two distinct types of graphs could be identified. One was vehicles with graphs that had the same gradient before and after the change in ownership, see Figure 27, and the second type was vehicles that had a big gap in the graph around the date of change in ownership, see Figure 28. The gap in collected data could be explained by the vehicle being turned off or by the FMS services being deactivated.

![Graph over a vehicle where there is no change in the gradient before and after change in ownership. Plotted is Distance Driven, Coasting, Run Time and Idle Time and the sales date is marked with a red dashed line.](image)

Figure 27
After discussion with experts at Scania, it was decided that the first type, the one without a gap, was the most interesting. If there is no gap in the graph when looking around the sales date, there is a risk that the FMS service was not cancelled during the sales process. Then the first owner might still get the FMS data even though he or she does not own the vehicle anymore. This also means that Scania has missed a potential customer: the second owner. The second graph type is not as interesting for Scania. As it can be seen in Figure 28, the service was cancelled a time before the sales and then started again after a while when the new owner used the truck. What could be seen in Figure 28 was that the gap due to no collected data is big. This could mean that the second owner used the truck for a while without using any FMS. If FMS would have been offered earlier to the customer, which means that the gap would be smaller, Scania could have earned more money. Therefore it is also important to handle type two, but not as important as type one.

Based on this the second analysis begun, using eight vehicles with an official change of ownership and one reference vehicle without owner change. Since vehicles like the one in Figure 27 was considered to be more important, trucks that had no gaps in the data were selected. Graphs for each vehicle were plotted regarding the data types: Distance Driven, Coasting, Run Time, Idle Time, Amount of Stops and Fuel Consumption. For these data types the trend lines before and after sales date were compared. GPS-positions were plotted on a map to see the route shape, and were analysed by searching for differences before and after sales date. Analysis of the drivers was done by plotting all driver IDs that drove the vehicle two weeks before and two weeks after sales date, and then see if they appeared both before and after. In all these eight visualizations the date for change in ownership was noted. All the graphs, maps and tables for each vehicle that was conducted during the exploratory analysis are shown in Appendix K.
13.3 Result of the Exploratory Analysis of Hypothesis

The final results are displayed in Table 5. A “1” means that there was a visible difference in gradient, route shape or driver pattern, when data from before and after the sales date were compared. A “0” means that no visible difference was found.

Table 5 Final results of the exploratory analysis, where zero indicates that no change could be seen in the data before and after sales data and one indicates that a change could be seen.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Distance Driven</th>
<th>Coasting</th>
<th>Run Time</th>
<th>Idle Time</th>
<th>Driver ID</th>
<th>Route Shape</th>
<th>Amount of Stops</th>
<th>Fuel Consumption</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1215</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5124</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1949</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2931</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1967</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2053</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8230</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>6680</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
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<td>Ref</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

It was observed that the reference vehicle showed no change in any of the data types and only two vehicles, 6680 and 8230, showed a change in all data types. These three cases are consistent with the hypothesis. In the other six cases the number of factors that show a change are less. By counting the positive results for each category it can be seen that the data types that have a high result have a higher relevance. According to Table 5, the most relevant categories are Amount of Stops and Driver ID, after that equally relevant come Distance Driven, Run Time, Idle Time and Route Shape. The less relevant data types are Coasting and Fuel Consumption.

By doing the exploratory analysis more than just a change in slope was observed. When it comes to Route Shape, vehicle 1215 showed that the shapes were very similar and therefore it was set that the route shape did not change before and after the date of sale. Looking at vehicle 2931 and 5124 the routes of the whole lifecycle showed a significant difference, but it did not show any difference in the fourteen days period so the result was set to “0”. While comparing the set of drivers before and after the sales period it was seen that in the case of vehicle 5124 and 6680 the whole set of drivers changed one week after the official date of sale. For vehicle 8230 the set of drivers changed five days before the official date of sale. This could be because of delays in the bureaucratic process of changing ownership or other unknown reasons. Anyhow, the result was set to one because the change of drivers occurred even if not exactly on the official date of sale.

In order to better understand the changes regarding the whole lifecycle of the truck, Distance Driven over the whole lifecycle was plotted and is shown in Figure 29. The data type Distance Driven was chosen since it showed, according to previous analysis, clearly the type of usage of the vehicle. The truck that was chosen, was a vehicle that according to The Swedish Transport Agency has had many owners. Doing investigations on the internet, it was found that the first and the second owner were bigger hauliers in Denmark, the third owner a dealer and the fourth owner a big Swedish haulier. Going through the whole lifecycle it can be seen that the first owner bought the truck and after one month
started driving it. The reason for this stop is unknown, but it could be due to reconstruction of the vehicle or just that the job did not start directly. During the first ownership the truck has driven nearly the same distance every day, except for one stop in the beginning. After one month of stop in May 2013, the truck was sold to the second owner. Interesting was that the amount of kilometres driven per day, changed between the first and second owner, but did not change between the second, third and fourth owner, not even when the truck was owned by the dealer. The first change of ownership was relatively easy to discover, the other two were harder to discover when looking at the plot of the whole lifecycle. Yet a difference might be found when looking at a shorter time period.

![Distance Driven, Vehicle 3233](image.png)

**Figure 29** Graph showing Distance Driven over the whole lifecycle for vehicle 3233.

### 13.4 Statistical Validation of Hypothesis

In order to further investigate the data type Amount of Stops, i.e. amount of stops per day, a statistical hypothesis test was conducted. The null hypothesis ($H_0$) states that the difference of the means of the samples in Amount of Stops from the last two owners is zero. The alternative hypothesis ($H_A$) is that the difference of the means is different from zero.

$$H_0: \mu_1 - \mu_2 = 0$$

$$H_A: \mu_1 - \mu_2 \neq 0$$

In order to test the hypothesis the p-value and the confidence interval had to be calculated and data concerning amount of stops was collected for the last two owners of the vehicles. Firstly mean value, standard deviation and sample size were calculated for both owners, according to Formula 2 in chapter 0. The results from the calculations are displayed in Table 6.
The sample is a group of data points (observations) containing the amount of stops per day in a period of time where the vehicle is owned by one owner. The samples are assumed to be random since the vehicles were chosen randomly. Every sample contains a certain number of observation varying from 127 to 488.

Table 6 Calculations of mean, standard deviation and sample size for the two last owners.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Sample Owner 1</th>
<th>Sample Owner 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean value, $\bar{x}_1$</td>
<td>Standard deviation, $s_1$</td>
</tr>
<tr>
<td>1215</td>
<td>8,60</td>
<td>4,89</td>
</tr>
<tr>
<td>5124</td>
<td>10,96</td>
<td>5,03</td>
</tr>
<tr>
<td>1949</td>
<td>4,02</td>
<td>2,90</td>
</tr>
<tr>
<td>2931</td>
<td>5,04</td>
<td>3,33</td>
</tr>
<tr>
<td>1967</td>
<td>15,93</td>
<td>8,69</td>
</tr>
<tr>
<td>2053</td>
<td>8,67</td>
<td>4,30</td>
</tr>
<tr>
<td>8230</td>
<td>16,83</td>
<td>10,31</td>
</tr>
<tr>
<td>6680</td>
<td>7,01</td>
<td>3,99</td>
</tr>
</tbody>
</table>

After this the point estimate was calculated using Formula 1 in chapter 0., standard error (SE) was calculated using Formula 3 in chapter 0 and Z score ($Z$) was calculated by using Formula 4 in chapter 0. The result from these calculations are shown in Table 7. By looking in the normal probability table for positive or negative $Z$, see Figure 12 and Figure 13, one side of the tail could be found and by doubling this value the p-value could be found (p-value in Table 8). For calculating the confidence interval (CI in Table 8) Formula 5 and 6 in chapter 0 were used for 95% respective 99%.

Table 7 Calculations of point estimate, standard error, $Z$ score and tail.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>point estimate</th>
<th>SE</th>
<th>Z</th>
<th>tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1215</td>
<td>1,31</td>
<td>0,32</td>
<td>-4,15</td>
<td>0,0002</td>
</tr>
<tr>
<td>5124</td>
<td>-3,72</td>
<td>0,57</td>
<td>-6,50</td>
<td>0,0002</td>
</tr>
<tr>
<td>1949</td>
<td>0,75</td>
<td>0,25</td>
<td>-3,00</td>
<td>0,0013</td>
</tr>
<tr>
<td>2931</td>
<td>-1,67</td>
<td>0,30</td>
<td>-5,65</td>
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</tr>
<tr>
<td>1967</td>
<td>0,28</td>
<td>0,57</td>
<td>0,50</td>
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</tr>
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<td>0,15</td>
<td>0,41</td>
<td>0,35</td>
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<td>8230</td>
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<tr>
<td>6680</td>
<td>0,10</td>
<td>0,29</td>
<td>0,36</td>
<td>0,3594</td>
</tr>
</tbody>
</table>

13.5 Result of the Statistical Validation of Hypothesis

The p-value, in Table 8, clearly shows that in five out of eight cases the difference is highly significant, $p$-value $< \alpha$ ($\alpha=0,01$) which means that the difference is significant. In all these five cases the null hypothesis can be rejected. In the remaining three cases the $p$-value $> 0,05$, and therefore the null hypothesis cannot be rejected.

For all the vehicles the 95% confidence interval was calculated and for the vehicles where the difference is significant the 99% confidence interval was calculated, see Table 8. It can be observed that, in the vehicles where the null hypothesis cannot be rejected, the confidence interval includes 0 which is the null hypothesis and for the other vehicles the confidence interval does not include 0.
Table 8 Results from calculating p-value and confidence interval. The vehicle marked with red colour are the ones where $H_0$ cannot be rejected.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>p-value</th>
<th>95% CI</th>
<th>99% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1215</td>
<td>0.0004</td>
<td>(0.69, 1.93)</td>
<td>(0.50, 2.12)</td>
</tr>
<tr>
<td>5124</td>
<td>0.0004</td>
<td>(-4.84, -2.60)</td>
<td>(-5.19, -2.24)</td>
</tr>
<tr>
<td>1949</td>
<td>0.0026</td>
<td>(0.26, 1.25)</td>
<td>(0.11, 1.40)</td>
</tr>
<tr>
<td>2931</td>
<td>0.0004</td>
<td>(-2.25, -1.09)</td>
<td>(-2.43, -0.91)</td>
</tr>
<tr>
<td>1967</td>
<td>0.6170</td>
<td>(-0.83, 1.39)</td>
<td></td>
</tr>
<tr>
<td>2053</td>
<td>0.7264</td>
<td>(-0.66, 0.95)</td>
<td></td>
</tr>
<tr>
<td>8230</td>
<td>0.0004</td>
<td>(8.40, 11.06)</td>
<td>(7.98, 11.48)</td>
</tr>
<tr>
<td>6680</td>
<td>0.7188</td>
<td>(-0.46, 0.67)</td>
<td></td>
</tr>
</tbody>
</table>

The observations are independent (simple random sample, <10% of the entire vehicle population), the sample size is at least 30 ($127 \leq n \leq 488$); the normal approximation and estimate of $SE$ should be reasonable. The p-values is interpreted as follows. If the null hypothesis is true, then the probability of obtaining the observed difference (or more extreme) in average amount of stops for vehicles 1215, 5124, 2931 and 8230 due to random sampling errors is less than 0.04%, and for vehicle 1949 less than 0.26%. The p-value for vehicle 1967, 2053 and 6680 is relatively large, which means that if $H_0$ is true it would be possible to find differences in mean different from 0.

The authors of this thesis are 99% confident that the difference in mean value of amount of stops is between 0.5 and 2.12 for vehicle 1215, between -5.19 and -2.24 for vehicle 5124, between 0.11 and 1.40 for vehicle 1949, between -2.43 and -0.91 for vehicle 2931, and between 7.98 and 11.48 for vehicle 8230. For vehicle 1967, 2053, and 6680 there is not sufficient evidence to conclude that the difference in mean value of amount of stops is different from 0.

### 13.6 Visualisation of Driver ID

The visualisation of Driver ID for each vehicle is shown in Figure 30. On the horizontal axis the date is displayed and on the vertical axis the different Driver IDs. The black vertical lines mark the sales date for the vehicle and the coloured dots and level on the horizontal axis show every time a Driver ID was used, different colours and level show different drivers. In Figure 30 the whole period of ownership before and after the sales date is displayed. Compared to the exploratory analysis this visualisation show a longer time span and therefore different patterns were seen. A clear change in Driver IDs can be seen in vehicle 1949, 2931, 5124 and 8230, less clear are the patterns of vehicles 1215, 1967, 2053 and 6680, where some of the drivers continue driving even after the sales date.
In order to better understand why some drivers appear both with the first and the second owner, further investigations were made by using The Swedish Transport Agency’s vehicle register and talking to distributor, reseller and vehicle owners. The main reason behind this phenomenon was that the second owner bought the whole order, together with truck and drivers. In some cases, the first owner’s company stopped existing and trucks and drivers moved to another company. According to a dealer that was contacted, these changes are very common.

### 13.7 Summary of the Results

The result of the validation can be connected to the phase-DNA. In Figure 31, the parameters that after the validation still can be considered to be useful are presented. For each parameter, the belonging data type is shown. According to the results, Fuel Consumption and Coasting were not data types that indicated on a transition phase in many of the cases, and therefore they are written in grey in the figure. Amount of Stops and Driver ID were the two data types that appeared to be most indicative, and they are written in italic in the figure. What can also be seen is that the parameter Traffic Condition and Service is taken away from the phase-DNA, due to the fact that the data type connected to these parameters appeared to be non-indicative on a transition phase during the tests.
13.8 Discussion and Conclusions of Hypothesis on Detecting a Transition Phase

This section starts with a discussion of the assumption that the graphs were considered linear. This is followed by a discussion of the choice of data used in the hypothesis, the importance of data types and the degree of transition phase. Finally, the results from the statistical hypothesis test and the visualisation of Driver ID are discussed.

13.8.1 The Assumption of the Graphs being Linear

An assumption made for enabling the comparison of the graphs’ slopes before and after sales date, was that the gradient was linear. The assumption was based on the fact that theoretically most of the data types used in the hypothesis should decrease linearly over time. This could be seen as a rough estimation, due to the fact that reality sometimes is far away from the theory. The reason why the graphs are not being linear could be explained by many factors. One is that the data is not always collected constantly, since it can only be done when the vehicle is turned on and a service is connected. Also the weather condition and the state of the vehicle affects the data that is sent in.

To summarize, the assumption did most likely affect the outcome of the hypothesis validation. Since the hypothesis validation was made both exploratory and statistically, the assumption of the graphs being linear did not affect the result of the hypothesis validation too much.

13.8.2 The Choice of Data in the Hypothesis Creation

The data used for the hypothesis was supposed to cover the six parameters of the phase-DNA. Also it was important that the data were accessible at Scania. The reason behind this was because the authors thought it was important to be able to test and validate the hypothesis. Already today there are a lot of parts in the vehicle that communicate, examples are ADAS mentioned by Riches (2015) and systems that enable the vehicle to understand the driver and the road as mentioned by Broggi et al. (2008). These systems create data that can be used for finding an indicator of a transition phase. Even though trucks already today can be seen as intelligent vehicles according to the definition of Broggi et al.
(2008), in the future the vehicles will probably be even more intelligent. This means that more data will be accessible and the indicator of a transition phase will be more exact.

One idea that came up during the group brainstorming, see Appendix J, was to use the frequency of visits at an OEM’s workshop and which workshop that was visited, in order to see a change in ownership or utilization. A test was conducted where five trucks, that had all went through one transition phase at least, were examined. By using the Workshop History Information (WHI) the vehicles’ workshop visits showed that usually the vehicle goes to the closest workshop for repair and maintenance, but it is not unusual that another workshop that is nearby is visited if the first choice is fully booked. This means that it is hard to see a change in ownership if the truck is sold to a company close to the first company. Also, if something happens to the truck when it is on the road, any workshop can be contacted for repair work. Therefore a change in workshop location is not a good indicator for a transition phase. The frequency of workshop visits should according to the interview study decrease as the vehicle gets older. Since the phases that are interesting for this thesis are those when the truck still is used in a professional transportation business, vehicle faults and problems will be solved. Whether they are solved at an OEM’s workshop or another workshop depends much on the business owner but also on how urgent it is to get the reparation done and which workshop that has time at the moment. Therefore WHI was not chosen to be a part of the hypothesis and the phase-DNA parameter Services was not covered.

Another idea from the group brainstorming that had to be discarded was the idea of identifying a “home” location for the truck. Five trucks that drove long-haulage and performed tip exchanges of the drivers were observed. The routes’ GPS data were analysed and two frequent locations were localized. The trucks stopped in both locations and changed drivers so it was not possible to find one place that could be seen as “home”. Other businesses might exchange drivers in one place but especially with long-haulage the trucks are constantly on the road, which made it clear that this method was not optimal.

The data Average Speed was analysed on a few vehicles but did not give interesting results, thus it was removed from the hypothesis and the phase-DNA theme Traffic Condition was not covered.

### 13.8.3 The Exploratory Analysis

It was observed that the most important data types were Driver ID and Amount of Stops, these data types show a change in 62% of the cases according to this study. What also can be observed is that a transition phase is always shown either by Driver ID, Amount of Stops or by both, hence the combination of these two factors should reveal a transition phase 100% of the times.

In order for the data type Driver ID to indicate a change, all driver IDs should change within four weeks. This could not work when a company changes owner but keeps the same trucks and drivers. When Driver ID indicates a change, in 40% of these cases it is the only data type indicating a transition phase. In 20% of the cases that Driver ID indicates a transition phase, it is supported by Idle Time. In the remaining 40% of the cases when Driver ID indicates a transition phase, it is supported by all the other data types. This means that Idle Time can be seen as a support data type to Driver ID. Idle Time shows a change in usage area or route, e.g. a truck that is used in a metropolitan area will stand still waiting for traffic lights much more than a truck used on the country side.
The data type Amount of Stops presupposes that the number of stops per day varies before and after a transition phase. This is supposed to show a change in usage, e.g. from long-haulage with few stops per day to distribution with many stops per day. Nevertheless this data type is easily affected by other factors that are not connected to a transition phase, e.g. a haulier gets new customers that require more stops. In the study, the data type that support Amount of Stops are in 20% of the cases Route Shape, and 20% the combination of Run Time and Distance Driven. In 40% of the cases that Amount of Stops indicates a transition phase, all other data types also do. In 20% of the cases Amount of Stops is the only data type showing a change. Since it is hard to define what a change in Route Shape is, in order to see a change in Route Shape there has to be a significant geographical change of route. Especially in Sweden there are some routes that are very common and it is therefore hard to see a major change. Also since a truck is built for a certain kind of usage/route it will most probably be used for the same purpose by the new owner as well. Unfortunately this study did not include trucks sold abroad, in those cases this data type could have been a valid indicator. Run Time is connected to the type of business, some companies drive two shifts a day which implies that the truck is running ca. 20 hours a day and some companies drive only ten hours a day. A change in Run Time is supposed to show either a change in ownership, or a change of business type. In a similar way shows Distance Driven a change of route e.g. long-haulage to distribution.

Fuel Consumption and Coasting show a positive result only when all the other data types also indicate a transition phase, and therefore looking only at them is not a trustful indicator. In the case of Fuel Consumption it can be explained by the fact that the analysed trucks are built in order to keep a steady fuel consumption, the only time important changes are shown in the data is when the topography of the route drastically changes. These kind of changes are therefore closely connected to a change in route shape. When it comes to Coasting the reason why it does not show a change more often is unknown. Finally, in order to detect a transition phase the data types that are most indicative are Driver ID and Amount of Stops and they can be supported by Distance Driven, Run Time, Idle Time and Route Shape and further with Coasting and Fuel Consumption.

It is known that the trucks used in the study have gone through a change in ownership, so the fact that all data types do not indicate a transition phase shows that all transition phases are different and comprising in various degrees. According to the definition stated previously in this thesis, a transition phase is a change in usage or a change in ownership or both; according to the results this definition might not have a sufficient degree of detail. As it can be seen by summing for each vehicle the number of categories showing a change, some trucks show a change in all categories and some just in one or two. This shows that some of the phase transitions are more comprising than others, but all go under the definition of transition phase. Vehicle 6680 and 8230 both have all data types showing a transition phase. This can be seen as those vehicles going through a big transition phase. Then there are vehicles with just one data type showing a transition, vehicle 1215, 2053 and 5124. These trucks did probably not go through a transition phase as big as 6680 and 8230. As it can be seen for vehicle 5124 only Driver ID changed. The reason behind this could be that a new owner bought the truck but is driving the same route. Even though it is only one data type, it is a very important one, because the OEM wants to detect any kind of change in ownership.

13.8.4 The Statistical Validation

According to Frost (2015) the p-value shows if the null hypothesis can be rejected and the confidence interval gives a better understanding for the results. The confidence interval shows that vehicle 8230
is very distant from 0 even when the confidence interval is 99%, compared with vehicle 1949 that is very close to 0, see Table 8. In the cases where the null hypothesis could not be rejected the confidence interval confirms the results given by the p-value, which is correct according to Frost (2015).

The decision errors that appear in this kind of tests were handled by choosing a low value of $\alpha (\alpha=0.01)$, which means that $H_0$ should not be wrongly rejected in more than 1% of the cases according to Diez et al. (2010). The difference in means were modelled using a normal distribution. This assumption could be done according to Diez et al. (2010) since the sample size is large ($127 \leq n \geq 488$) and the samples came from eight random trucks which is less than 10% of the whole vehicle population. Because of this, according to Diez et al. (2010), the difference in means is nearly normal.

The result from the statistical hypothesis test can be compared with the previous exploratory analysis, this shows that there are some differences in the results. Only four of the vehicles showed an indication of transition phase in both cases. This difference in results could depend on the different time windows of the data. In the exploratory study only data collected during four weeks were used, and in the statistical test the data came from different time spans depending on how long the owners had the trucks. Another reason behind the differences could be that in the statistical method even extreme deviations were included, unlike the exploratory study where the human eye easily could screen out those samples. The statistical test unlike the exploratory test is consistent and treats all the cases with equal terms, this also influenced the results.

This statistical test can be seen as a complement to the exploratory study, since it was known that all the trucks had changed owner. Looking closer at some vehicles like 2931 and 5124, the exploratory analysis did not indicate a transition phase but the statistical test did. The same reasoning can be done the other way around by looking at vehicle 1967 and 6680. In order to find out the reason behind these discrepancies a closer look to the plots from the exploratory analysis needs to be taken, since the study of the Driver ID data clearly shows that the official date of change in ownership does not coincide with the date when the drivers change. This is also a factor that clearly has affected the results and needs to be further investigated.

In conclusion the statistical test of the hypothesis shows similar results to the exploratory analysis in terms of the number of vehicles that indicate a transition phase, in both studies five out of eight. The differences lay in the discrepancy of which vehicles that show a transition phase.

### 13.8.5 Visualisation of Driver ID

The visualisation of Driver ID showed different patterns than the exploratory analysis done on the same data type. The reason behind this is that these two studies were made with different time perspectives, and gave therefore different results. The visualisation was very useful to understand the behaviour of the trucks. As mentioned by Jagadish et al. (2014) the data have to be transformed into a format that is suitable for analysis, and this was done by creating a visualisation.

The result from the visualisation showed that vehicle 1215, 1967, 2053 and 6680 did not show a sharp change in Driver ID before and after sales date. Because of this, these vehicles were further investigated by using The Swedish Transport Agency’s vehicle register, contacting the distributor, reseller and vehicle owner. It was shown that the reason behind these four vehicles not following the pattern, was because entire assignments with trucks and drivers or even entire companies were bought by other companies. This was also the explanation behind vehicle 1967, 2053 and 6680 not
showing any change in Amount of Stops according to the statistical hypothesis test. The result shows that some ownership changes cannot be detected by only using the data types Driver ID and Amount of Stops. If ownership changes due to companies taking over other companies have to be identified, another combination of data types has to be tested. Also, it has to be investigated how common this occurrence is, and if it is interesting to find a solution to the problem.

In conclusion, comparing the results from the statistical validation and from the visualisation gave an understanding of that the data types might not be enough to discover all changes in ownership. In order to cover all changes in ownership other types of data have to be analysed.
14 The Transition Alert Algorithm

Based on the result from the hypothesis validation, an algorithm to detect a transition phase would be created. In this chapter the algorithm is described on a high-level ignoring full description of implementation details. This is followed by an implementation test of Driver ID into the algorithm. Finally discussion and conclusions are presented.

14.1 Two Types of Transition Phases

The algorithm consists of six data types, the ones that were most indicative during the hypothesis validation. According to the definition of transition phase, done earlier in this thesis, a transition phase can be a change in ownership, utilization or both at the same time. Since it is important to know whether it is a change in ownership or usage, the algorithm has to indicate what type of transition it is. The authors of this thesis have chosen to divide it into two types:

- **T1**: Change in ownership, or change in both ownership and utilization
- **T2**: Change in utilization

If the driver ID indicates a transition phase, this transition is directly categorized as a T1. This indication can be strengthened when any of the data types: Amount of Stops, Route Shape, Run Time, Idle Time and Distance Driven, indicate a transition phase. This means that the supporting data types do not decide upon whether it is a type T1, but make the indication of a transition phase more sure. A T2 transition phase is shown when some of the data types: Amount of Stops, Route Shape, Run Time, Idle Time and Distance Driven indicate a transition phase. This means that Driver ID must be negative if the transition phase has to be classified as a T2. In Table 9 below, the definition of the two types is summarized.

<table>
<thead>
<tr>
<th>Type of transition phase</th>
<th>Data type deciding upon what type of transition phase</th>
<th>Supporting data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Driver ID</td>
<td>Amount of Stops, Route Shape, Run Time, Idle Time, Distance Driven</td>
</tr>
<tr>
<td>T2</td>
<td>Amount of Stops</td>
<td>Route Shape, Run Time, Idle Time, Distance Driven</td>
</tr>
<tr>
<td>T2</td>
<td>Route Shape</td>
<td>Amount of Stops, Run Time, Idle Time, Distance Driven</td>
</tr>
<tr>
<td>T2</td>
<td>Run Time</td>
<td>Amount of Stops, Route Shape, Idle Time, Distance Driven</td>
</tr>
<tr>
<td>T2</td>
<td>Idle Time</td>
<td>Amount of Stops, Route Shape, Run Time, Distance Driven</td>
</tr>
<tr>
<td>T2</td>
<td>Distance Driven</td>
<td>Amount of Stops, Route Shape, Run Time, Idle Time</td>
</tr>
</tbody>
</table>

14.2 How the Algorithm Works

The algorithm’s task is to detect a transition phase by using the six different data types collected through FMS. All vehicles connected to FMS send in data and these are constantly scanned thorough to find transition phases. This is done by creating a reference value, based on data collected in an early period of the lifecycle phase, and then comparing the new collected data with it. In order to handle fluctuations within the business, the reference value is constantly updated by making the data collection for the reference value based on a rolling scheme. This means that the reference value is always updated but still keeps a certain distance in time to the data that it is compared with. If the comparison shows a difference, it is a transition phase and the concerned actors are informed. If no
data type indicates a transition phase, the algorithm continues to compare new collected data with the reference value.

First of all, the algorithm checks driver ID, to be able to say whether it is a type T1 or type T2 transition phase. Since Amount of Stops according to the hypothesis validation was as indicative as driver ID, this is the second data type that is checked. Then the algorithm checks the four remaining data types.

**Driver ID** – The driver ID is checked by identifying a pattern based on drivers using the truck during a set time period. This pattern is set as reference, and is compared with the pattern of driver IDs created during a certain time after the reference was set. This is done in order to see if there is any change in the pattern. If the pattern is broken, i.e. all the driver IDs are replaced, this means that a transition phase type T1 has occurred. The algorithm continues to check the remaining data types to see if it is possible to strengthen the detection of a transition phase by finding more indicative data types. If the Driver ID pattern does not change at all, no transition phase type T1 has occurred but the remaining data types have to be checked in order to see if a type T2 has happened. In chapter 14.3, a further description of driver ID and how it was implemented in the algorithm is presented.

**Amount of Stops** – The algorithm creates a reference value based on the average amount of stops per day done during a month. After one month, a new average is calculated based on stops done during the last 14 days. This is compared to the reference and if there is a change, Amount of Stops indicates a transition phase. If there is not a change, Amount of Stops is not indicative and the algorithm keeps on comparing periods of 14 days with the reference value.

**Route Shape** – The algorithm collects GPS data during one month and then sets this as a reference route. After a month GPS data for the last 14 days are compared with the reference. If they differ, Route Shape indicates a transition phase. If there is no change, the algorithm continues to compare periods of 14 days with the reference route.

**Run Time** – The algorithm creates a reference value based on the average run time per day done during a month. After one month, a new average is calculated based on the run time during the last 14 days. This is compared to the reference and if there is a change, run time indicates a transition phase. If there is not a change, run time is not indicative and the algorithm keeps on comparing periods of 14 days with the reference value.

**Idle Time** – The algorithm creates a reference value based on the idle time per day done during a month. After one month, a new average is calculated based on the idle time during the last 14 days. This is compared to the reference and if there is a change, idle indicates a transition phase. If there is not a change, Idle Time is not indicative and the algorithm keeps on comparing periods of 14 days with the reference value.

**Distance Driven** – The algorithm creates a reference value based on the average distance driven per day done during a month. After one month, a new average is calculated based on the distance driven during the last 14 days. This is compared to the reference and if there is a change, Distance Driven indicates a transition phase. If there is not a change, Distance Driven is not indicative and the algorithm keeps on comparing periods of 14 days with the reference value.
14.3 Implementation of Driver-ID in the Algorithm

Since Driver ID was one of the most indicative parameters, the authors decided to start an implementation of this parameter in the algorithm. A first version of the algorithm that checked the Driver ID was written in SQL and compared data from the Fleet Management database and from the Swedish Transport Agency’s vehicle register. A first try was made by creating an algorithm that would run and detect all trucks that changed owner a specific day. All drivers that had driven less than 1 km were screened out, so that only official drivers would be taken into account. 5 752 trucks were checked and 221 trucks were detected to have gone through a change of ownership, in reality only 21 of them had legally changed owner.

The first result was not satisfying and a second try was made by changing the time periods of comparison. Two different setups were chosen, one used four weeks to create a reference pattern and the other used two weeks. The drivers from the reference patterns were then compared with drivers from a time window three weeks after the reference weeks and drivers who had driven less than 10 km were screened out. The setup that used four weeks detected 261 trucks, where 12 really changed owner according to the Swedish Transport Agency’s vehicle register and the setup with two weeks detected 348, where 16 really changed owner. The implementation of the algorithm was stopped after the above described tests due to time constrains.

14.4 Discussion and Conclusions of Transition Alert Algorithm

The algorithm is based on the outcome from the hypothesis validation. This means that if the validation would have been executed in a different way, the algorithm would probably look different. The authors of this thesis believe that the qualitative hypothesis validation should be complemented with a quantitative one, and then the algorithm should be updated according to the new results. Still, the authors of this thesis emphasise that the algorithm could be considered to be valid since it consists of six different data types, which according to the hypothesis validation did indicate a transition phase.

14.4.1 Two Different Types of Transition Phases

The reason behind dividing the transition phase indications in T1 and T2 was mainly to make it easier to describe what type of transition phase the different data types indicate, since according to the study they are more indicative on either change in utilization or change in ownership. T1 is only composed by one type of data and T2 by five. This is because the authors of this thesis had to choose from the data that are collected today, and among these only Driver ID was showing a distinct change of ownership. If more types of data were included in the description of T1, results might have been more accurate. The reason behind the low number of data types in the algorithm could be connected to the problem with the overwhelming amount of big data mentioned by Jagadish et al. (2014), Richards (2014) and Schmarzo (2013). The authors of this thesis had some problems, even though specialists at Scania were consulted, to find, sort, prioritize and handle the big volume of data and therefore there is a risk that useful data types could have been missed. The access to data was dependent on telematics and intelligent vehicles, and these areas can be considered as pretty new and growing based on the literature by Albright (2014) and Broggi et al. (2008). This means that in the future, it would be possible to look at new data types in order to make the definition of T1 and T2 more accurate and robust.

What also can be discussed is the certainty of the indication on either a T1 or a T2. According to this study, it has shown that if all drivers change this indicates a change in ownership. Since this study is
done on eight vehicles only, it cannot be completely excluded that a change in Driver ID might occur in a change in utilization only. If so, the division into type T1 and T2 is not as valid anymore. The solution to this problem is to do another quantitative study on how the data type Driver ID changes during a vehicle’s life.

14.4.2 How the Algorithm Works

How the different data types are used in the algorithm are described in a general way and have to be tested before it is possible to define exactly how the algorithm works. This is the reason why the algorithm is just on a descriptive level and not presented as a functioning product. Further work has to be done on the algorithm in order to improve it and find a good way to program it. Also, it has to be investigated if all of the data types are suitable for creating the algorithm. One example is Route Shape, that needs a comparison of routes which might require much computer capacity which could make the algorithm slow. When searching for suitable data types, it would be beneficial to further investigate the potential with using big data, telematics and intelligent vehicles mentioned by Jagadish et al. (2014) Neu & Brown (2005) and Broggi et al. (2008).

The choice of basing the creation of the reference value on a rolling scheme, was to reduce the risk that the algorithm would detect a phase transition even though it is just a small and maybe natural change in the collected data. What has to be further investigated, is how this scheme should look like. In the description of how the algorithm works, it was described that the period of time between the reference pattern and the latest pattern was 14 days. Since this has just been a little tested during the hypothesis validation and the implementation of Driver ID in the algorithm, it is not guaranteed that 14 days is the best time window. Also, it is not sure that the same time window suits all of the six data types.

The period of time that was chosen for calculating the average when comparing with the reference value was 14 days. The reason behind this was because this was used during the hypothesis validation and according to the results this worked. This does not mean that it is the optimal amount of days and by doing more tests on the algorithm a more suitable time period might be found. The reason behind using one month when setting the reference was based on the fact that the authors of this thesis thought that it was a good idea to create the reference value based on a longer time period in order to make it more valid. It was assumed, supported by the answers from the interview studies, that a vehicle is not sold as soon as one month after the purchase. This means that the probability to miss one transition phase during the month when data is collected for the first reference value is low. Still, this does not mean that one month is the most suitable period of time and this could be further investigated.

Regarding all six data types supposed to be used in the algorithm, limits have to be set regarding how much change there has to be before each data type can be considered to indicate a transition phase. This can be done by creating an algorithm including all the data types and then try out what limits are suitable. Because of the time constraints for this thesis, this could not be done.

Another question that has to be answered is how many of the data types that have to indicate a transition phase to be able to detect a type T2 transition phase. According to the hypothesis test, Driver ID and Amount of Stops can be seen as much indicative but the remaining data types are not as indicative. The question is if it is enough with just one data type to indicate a transition phase or if it
has to be combined to be able to say that the indication is strong enough. This can just be answered by testing the algorithm, and once again the time limit for this thesis did not allow this.

The algorithm cannot predict a transition phase, but it gives an indication when a transition phase might have occurred. If it would be possible to make the algorithm predictive, it would be even more useful. Therefore further studies should be done in this direction.

To conclude, the algorithm is not a complete product yet. More tests have to be done in order to be able to include all six data types and improve the algorithm. Therefore the description in this chapter is on a conceptual level and far from an implementation plan.

14.4.3 Implementation of Driver ID in the Algorithm

Since the authors of this thesis have a limited knowledge in programming, it was not possible to create the algorithm for all of the six data types. According to the hypothesis validation Driver ID was most indicative, and therefore an algorithm including only this data type was created with help from an person with experience from SQL coding at Scania. The creation of the algorithm was dependent on access and knowledge about how to handle big data, which is stressed as a challenge by Nationalencyklopedin (2015A). Therefore the implementation was dependent on big data knowledge gained from the literature study and programmers at Scania.

The implementation was following the five steps mentioned by Schmarzo (2013), where the prioritizing step is described as the most important one. Schmarzo (2013) mentions that many big data business use cases might have potential, but it often happens that the outcomes are not as expected because of e.g. inaccessibility of exact data, lack of experience regarding data sources and technology, limitations regarding architecture and technology and poor communication between business and IT teams. The problems mentioned, came up during the implementation and did of course affect the result. Examples are the challenge to communicate to the programmer, the limitations with coding in SQL and the sometimes low quality of the collected data. When it comes to the tests made regarding the implementation of the Driver ID in the algorithm, the results are interesting, but need further investigation. In the second and third version of the implementation algorithm, two reference time frames were compared, and they showed that the four weeks’ time frame gave less total detections but also less correct detections. This could mean that the time frame of the reference is not the main factor that affects the amount of correct detections over the total amount of detections.

In the description of how Driver ID is used, it was decided that when all the IDs are exchanged, a transition phase has occurred. This limit has also been used in the implementation algorithm and judging from the results of the tests it might not be the optimal limit. The algorithm, as it is today, is not accurate enough, too many vehicles change all its drivers even though they do not change owner. This could be due to the formulation of the algorithm, but it could also indicate that the changing of drivers under the same owner is very common and therefore it is not possible to detect a change in ownership by only looking at the complete change of drivers. In that case, more advanced patterns need to be identified and used to develop a new implementation algorithm for Driver ID.

A conclusion is that even if the implementation of Driver ID in the algorithm did not work as thought from the very beginning, it still gave ideas and hopes about the possibility to create a functioning algorithm. It is not necessarily the algorithm that is in-correct, but that the result from it is hard to understand. Maybe the algorithm detects a new type of transition, not included in this study. Further
investigations have to be done, and complemented with statistical analysis. Another conclusion is that the reality is far from the theory, and an algorithm that in theory should work does not always work in practice without modifications.
15 Mapping the System of the Transportation Business

In this chapter a system map is presented describing the flows of value, products, services, money and information that goes between the actors. Also a picture of how a transition phase today is detected is shown. The chapter ends with discussion and conclusions.

15.1 System Map of the Transportation Business

A system map including actors involved in the transportation business was created and can be seen in Figure 32. The choice of which actors to include in the map was based on the participants in the empirical studies and the findings from the interview studies described in chapter 8.2. The map shows how the flow of value, products, services, money and information goes between the actors involved in the transportation business. The term information in this case includes both machine generated data and communication between people.

![System Map](image)

Figure 32 A system map with actors involved in the transportation business.

In the picture it can be seen that many actors are involved in the transportation business. The long-haulage OEM is far away from the end customer. There are connections between Scania R&D and the haulier, but all of them go through the distributor and the dealer. Another observation from Figure 32 is that the dealer and the haulier have most connections, which indicates that this relationship is important. In Figure 32 two future connections can be seen: between infrastructure and Scania, and infrastructure and the truck. These connections are thought to be possible as the telematics solutions get more developed and the infrastructure can communicate with the surrounding, e.g. sending information about traffic condition and weather.
15.2 Detecting a Transition Phase Today

Figure 33 shows what it looks like today when a transition phase is detected. This information was collected during the second interview study. The only type of transition phase that is detected currently is due to a change in ownership. Usually the haulier contacts the dealer for three main reasons when it comes to informing about a change in vehicle ownership. One reason can be because the haulier still gets invoices regarding services connected to a vehicle not owned anymore. Another reason can be that the haulier informs the dealer that a vehicle is sold and the last one is that the vehicle is sold directly to the dealer. The dealer in turn has to contact the distributor, since it is the distributor who owns the service deal and the one that can cancel a contract. It is also the distributor that checks if there are customers with C200 and no service offerings. If such a customer is found, the dealer is contacted and asked to sell services to the client. The distributor uses the Swedish Transport Agency’s vehicle register to investigate if there is a new owner of a vehicle and if this is a potential service offering customer. Scania, as a manufacturer, is just providing the service and is not involved in the direct contact with the customer when it comes to administration and sale of the service offerings.

Figure 33 A picture of how it looks today when a transition phase is detected.
15.3 Discussion and Conclusions of Mapping the System of the Transportation Business

In this section the system map and the picture of how a transition phase is detected today are discussed and conclusions are drawn. The system maps had to be simplified in order to be easy to read. To make sure that important actors or connections were not left out, the map was checked by experts at Scania. The method is, according to Morelli & Tollestrup (2007) and Lindahl et al. (2014), suited for developing product service systems due to the fact that these type of offerings are complex and immaterial. This means that the method was well suited for the aim with this stage and gave a result that was easy to read and understand. The choice of method affected the outcome of the mapping. The recommendations from Morelli & Tollestrup (2007) regarding the connections between actors were followed and therefore focus was on value, product, service, money and information. This means that if another method was used, the outcome would be slightly different.

15.3.1 System Map of the Transportation Business

While mapping the flow of information it was observed that the truck is an important actor and information carrier, when it comes to data from vehicle parts; through telematics this information goes directly to Scania. The other channel of information goes a long way and passes through haulier, dealer and distributor or workshop before arriving to Scania. This type of information includes, workshop information and feedback from the end customers which is valuable for Scania. Why is this information not being sent through the truck as well? This is an area of research and improvement that could give Scania a faster feedback on products and services. It can also be seen that the haulier is the actor that has most connections to other actors. Hauliers have many entering information arrows and only one out to the dealer. This means that if the haulier possesses information that can be useful for Scania it has to go through the distributor, which is one extra step where information can get lost or distorted.

The flow of money shows most of the times an exchange of a product or a service, what is seldom paired up with money is the exchange of information. One reason is the fact that the cost of the information is paired up with other costs, e.g. products. Also most of the information has a double arrow, which means that useful information is exchanged by both parts.

The flows of information with a question mark that go between truck, infrastructure and Scania, were plotted as a result of the group brainstorming, described in chapter 12.1. These are examples of potential future connected systems. One example of a future connection is that the infrastructure sends information about weather and traffic condition, and the system could combine it with the route information of the truck and suggest a faster route, something that is a possibility with intelligent vehicles mentioned by Broggi et al. (2008), Seeing machines (2015) and Riches (2015).

Value creation and building a strong relationship with the clients is crucial for a OEM (Barry & Terry, 2008; Ulaga & Eggert, 2008; Gronroos, 1998; Wilson & Jantrania, 1994), and therefore the value arrows in the map can be seen as very important. The value arrows are mostly paired up with information exchange. Value is seen as something personal that is exchanged between actors. In the relationship between the dealer and the haulier there is a value exchange in terms of the dealer helping the haulier to find the right truck and give advice. Another example is between the truck driver and the end customer, the driver gives a value to the customer by e.g. helping to load off or arriving in time. There is one more arrow that is described as value, and it is between Scania and the truck drivers. This is an
interesting relationship, because from the second interview study the knowledge about a “Scania culture” emerged; drivers are proud of driving Scania. One plausible explanation to this value is the feeling the drivers have of being listened to, and that Scania develops the trucks putting the drivers in focus. It might also be the fact that Scania is a premium brand. However a direct feedback channel or connection from the drivers to the company was not found.

To conclude, the system is complex and many actors are involved. The map shows the current situation and if the transportation business will change in the future, probably a lot of actors and connections shown in the map will be replaced.

**15.3.2 Detecting a Transition Phase Today**

The map over how a transition phase is detected today was important for the further work in this thesis. It showed the complexity of finding a transition phase and that there is a need for a simplified method. The map shows that the distributor is an important actor that controls the FMS contracts and that there is a dependency on external actors like the Swedish Transport Agency. The distributor both searches for contracts that should be terminated and potential customers for new service contracts. The distributor seldom contacts the haulier directly, the communication goes through the dealer. This implies a risk for misunderstandings since the communication is not direct but goes through another actor.

Since it is a service and not a physical product that is handled, the question is raised: do there have to be so many middlemen? The authors of this thesis believe that in a desirable future the service contracts are handled between the producer and the end customer directly. This idea is against the current structure at Scania and can therefore be seen as an idea that cannot be implemented in the near future. Still, it should be discussed in order to prepare the transformation to become a total solution provider which is something that is a growing trend among OEMs (Windahl & Lakemond, 2006; Brady et al. 2005). The authors of this thesis argue that by reducing the amount of middlemen, the offering of services will be faster and the provider will be closer to the end-customer. An integrated solution and a closer cooperation with the customers will according to Tukker (2004) facilitate innovation since it will be easier to follow the clients’ needs.

From Figure 33 it can be concluded that finding a transition phase today is complex and involves many actors. It might not be possible to simplify the system by cutting out actors in the close future, but there is room for improvements that would ease the distributor’s task and reduce the need of “detective” work.
16 Possible Stakeholders for the Transition Alert Service

In this chapter the possible stakeholders for the transition alert service are presented. This is done by first doing additional interviews and then map all possible stakeholders. The result is presented by four personas. The chapter ends with discussions and conclusions.

16.1 Finding Stakeholders

When investigating possible stakeholders interview data from the first and second interview study was used. Additionally, four more interviews were executed, where respondent 1 and 2 were interviewed together. In the Table 10 below the respondents are presented.

Table 10 Respondents participating in the interviews for creating personas.

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Professional work title</th>
<th>Type of interview and duration</th>
<th>Interview date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Head of Product and Portfolio Management, Connected Services</td>
<td>Meeting, 60 min</td>
<td>2015-03-27</td>
</tr>
<tr>
<td>2</td>
<td>Customer Experience Manager Fleet and Driver Services</td>
<td>Meeting, 60 min</td>
<td>2015-03-27</td>
</tr>
<tr>
<td>3</td>
<td>Head of cross-functional coordination</td>
<td>Meeting, 30 min</td>
<td>2015-03-27</td>
</tr>
<tr>
<td>4</td>
<td>System owner Performance Evaluation and Tools</td>
<td>Meeting, 30 min</td>
<td>2015-03-30</td>
</tr>
</tbody>
</table>

The answers from all interviews were analysed in order to find possible stakeholders for TAS. In Figure 34 below the stakeholders that could benefit from the transition alert service are presented. Figure 34 shows that Scania as a truck producer has interest in the knowledge produced by TAS, mostly for improving their products but also for the development of future products and services. Competitors have the same interests as Scania for their own vehicles. As seen in the system map in Figure 32, dealer, distributor and haulier have a strong relationship and TAS would ease some parts of it. Workshops and spare parts dealers would benefit of finding new customers in the second hand segment. Companies offering financial services, tolls and transportation agencies would benefit from TAS for finding breaches of contracts and problems connected to the export and ownership of trucks.

A short description of the stakeholders’ needs, i.e. their wishes of what TAS should fulfil, can be read below each stakeholder in Figure 34. Stakeholders that expressed the same interests, are grouped in the figure.
Figure 34 Possible stakeholders for the transition alert service and their needs expressed during the interviews.
16.2 Personas

Out of the 16 stakeholders presented in previous chapter, the four stakeholders that expressed most needs and could be seen as having the closest relation to the OEM were translated into personas. The personas reflect the main needs that came up in Figure 34, and put them into a context to make them easier to understand. Below Adrian the workshop manager, Benny the salesman, Carol the distributor and Doris from R&D are presented.

Adrian, Workshop Manager

Adrian is a manager at a workshop connected to a Scania owned dealer. He is really dedicated to his work and has a close relationship to his customers, which is why his clients are really loyal and always turn to Adrian’s workshop if possible. During all his years he has noted that the hauliers visit the workshop for repair and maintenance less frequent as the vehicle gets older. Adrian believes that the reason behind this is that the customers think that it is too expensive and therefore they solve as many vehicle faults as possible by themselves. Most frequent visits are made by the first owners of a vehicle because they almost always have a service contract.

Since Adrian is a committed person that always searches for new customers he has thought about this problem a lot. He thinks that the second, third and fourth owner of a vehicle potentially should be bigger customers because older vehicles demand more maintenance and repair. One problem, as Adrian sees it, is that if a vehicle is sold and changes region, the new owner might not have any relationship with the local workshop. The relationship between workshop and haulier is really important for having a profitable workshop business. If a truck owner does not find Adrian, he believes he has to find the truck owner instead. Therefore Adrian would like to have some kind of system helping him to find second-hand vehicle owners in his region.

Benny, Salesman

Benny has been working for a family owned Scania dealer for ten years. Earlier he was a vehicle salesperson but since the last four years he has been working as a service market salesman. Benny loves his job, but is not so comfortable with computers, so he often contacts Carol at the distributor for all types of questions regarding FMS and tachograph services. Carol is really helpful and Benny thinks that they have a good relationship, which is crucial since Benny cannot start or cancel a service contract by himself because the deal is owned by the distributor.
Benny finds it really embarrassing when customers contact him about invoices regarding services connected to a vehicle that they do not own anymore. Usually he is very careful checking that the service contract is cancelled when a customer trades in a truck, but it is hard to manage when the vehicle is sold privately.

Sometimes Benny feels a little too supervised by the distributor. It happens that Carol contacts him and informs him about vehicles that run without any connected services in his sales region. Benny knows that he can find these potential customers by himself, but he does not have any time for that. Benny suspects that he misses a lot of potential customers because there is no good system for catching them up. Even if Carol is doing a good job finding them, he believes there are more hauliers driving Scania trucks without any connected services.

Sometimes Benny feels that it is a bit hard to sell connected services to the hauliers. Some hauliers have their own systems, and there is also a couple of customers that are concerned about the fact that Scania collects so much data from the vehicles. They express that they feel controlled and they are afraid that the information will end up in the wrong hands. It is difficult to convince these customers to buy FMS, because it does happen sometimes that the data from the new owner of a second-hand vehicle are sent to the previous owner because the contract was not transferred correctly.

Since the business also sells second-hand vehicles, Benny believes he has pretty good knowledge about these customers. Sometimes he manages to sell services to these clients, but it is hard because not so many second-hand trucks today are equipped with the unit that is necessary to be able to use the services.

**Carol, Distributor**

Carol is product responsible for FMS and tachograph services working at the Swedish Scania distributor. She is responsible for the services that the dealer in turn sells to the end customers. Since it is the distributor that owns the deal and the service contract, Carol is the one with the power to start up and cancel a service. This means that the dealer contacts Carol when a new contract has to be signed, cancelled or when there is some kind of problem concerning the service offerings. It is not unusual that the dealer contacts Carol asking for help with the service contracts. One example is how to handle customers that have got an invoice concerning services connected to a truck that they no longer own.

The goal that Carol is working for is to secure that at least 90% of all new trucks have the service called Monitoring. To ensure this, Carol is using the Swedish Transport Agency’s vehicle register, searching for Scania trucks with no connected services. When such a truck is found, the dealer in that district is informed so that service offerings to the vehicle owner can be sold.

When it comes to second-hand trucks, there are no guidelines regarding the amount of services that should be sold. Carol thinks this is a problem, since she believes that the second-hand owners also
could be potential customers. The problem is that she does not have enough knowledge about the second-hand customers to be able to sell services to them.

Carol is a bit tired of playing detective in her search for new potential FMS and tachograph service clients. This search takes a lot of her time, time that she could have spent on educating the dealers in the service offerings to increase the sales. Sometimes she thinks about her distributor colleagues in the rest of Europe, where there are no such registers as the one provided by the Swedish Transport Agency. She wonders how they manage her work.

**Doris, R&D**

Doris works with the development of connected services at Scania R&D. She is also participating in a project group working with integrated solutions at Scania. The focus in today’s development is on the first owner, both products and services are custom made for this client. Doris thinks that this has to change. She sees a lot of potential in the second and third owner, especially when it comes to the service offerings. The problem is that she and her colleagues do not have enough knowledge about these customers. Doris is therefore planning to do field trips and visit hauliers that buy second-hand trucks. Based on the information she can gather from this study, she is hoping to be able to create new solutions better suited for second-hand owners’ demands.

While developing services and handling big amounts of data, Doris reflected over the risk of data ending up in the wrong hands. She is also concerned over the high telecom costs that come with vehicles running in certain countries. She feels that today’s control over the service contracts is not enough and she sees the potential risk with service contracts not being cancelled or transferred in the correct way when a vehicle changes ownership. When handling as much data as she and her colleagues are, the data security is of high priority. It concerns her that she does not have any knowledge about a change in ownership.

Another problem that Doris has noted is that it is sometimes hard to handle the big amount of data. When searching data for a specific vehicle she would like to be able to gather data connected to a certain owner. Today she has to manually look up in the vehicle register during the period the vehicle was owned by a certain haulier and then in her data search enter this time period. If the data automatically could be displayed per owner, it would facilitate her job.

**16.3 Discussion and Conclusions of Personas**

As mentioned earlier the 16 identified stakeholders became four personas, and as recommended by Martin & Hanington (2012) this is a suitable amount of personas for one project. Summarizing many actors into four could be done because, as seen in Figure 34, some stakeholders shared the same needs and interests, and therefore some of them were combined to create one persona. The authors of this thesis chose to focus on stakeholders that had a close connection to Scania, since the goal was to design an internal service. This does not mean that some stakeholders were forgotten, their interest...
were still kept in mind when continuing to the idea generation phase. The advantage with just creating four personas, was that the personas were easy to remember. The downside was that there was a risk that important stakeholders and their needs were forgotten. The authors of this thesis solved this problem by trying to include as many stakeholders’ requirements in the personas as possible, and therefore the personas can be seen as a summary of all stakeholders. This solution was done based on the recommendation from Gou et al. (2011) arguing that personas could be used to summarize the information of all users. The need expressed by the spare part dealer is represented by the workshop manager persona. The needs expressed by hauliers, logistic company, customer of logistic company, spare part dealers, insurance company, finance, assistance, tolls, the Swedish Transport Agency and competitors could all be connected to the information requirements that is mentioned by the personas: dealer, workshop manager, distributor and R&D. This means that if the four personas’ needs are fulfilled, all the 16 stakeholders’ needs are being fulfilled.

Creating personas gave a better understanding for the need of the different stakeholders and ensured a user-centred approach (Martin & Hanington, 2012; Stickdorn & Schneider, 2011), since it put the requirements in a context and made it easier to relate to. The aim was to enable the further work, when the stakeholders were to be taken into account when developing the transition alert service. When creating the personas, the authors of this thesis tried to keep the description short and concise, but at the same time communicate real problems identified during the empirical studies in a way that the reader of this report can assimilate, as recommended by Guo et al. (2011) and Stickdorn & Schneider (2011). The personas were named and complemented with pictures in order to even more ease the understanding and remembering of the stakeholders.

In conclusion, it can be seen from the personas that they share similar problems: the knowledge about second-hand vehicle owner is limited and the control over the service contracts are based on manual work. This means that these two requirements could be seen as much important and should be taken into account when developing the transition alert service.
17 Capture of Needs

In this chapter the identified stakeholders’ needs are presented in a list and the result is discussed together with conclusions.

17.1 List of Needs

Based on the stakeholders’ needs, see Figure 34, and the personas, see chapter 16.2, five main needs that the transition alert service should fulfil were identified. Below the needs are presented with no internal ranking.

N1: Ease start and cancellation of services – According to the distributor finding out that a service contract should be cancelled involves some “detective” work and the distributor is dependent on the vehicle register supported by the Swedish Transport Agency. This means that if a vehicle is sold private and the service is not terminated, there is a risk that the distributor never gets to know about this. The information about when a service should be terminated and offered to a new customer has to be easier to access and not being dependent on an external actor as the Swedish Transport Agency.

N2: Avoid unnecessary telecom expenses – The R&D person mentioned that if a vehicle is connected to services and runs in certain countries this leads to high telecom expenses. Therefore it is important to ensure that the connected services actually are used and if not, being cancelled at the right time. This need is connected to the one mentioned above, that the termination of a service has to be simplified. If the distributor automatically is informed that there is a vehicle with connected services that are not used anymore, the problem with high telecom expenses will be reduced.

N3: Avoid that information goes to wrong customer – If a service contract is not cancelled when a vehicle is sold, the vehicle information from FMS will continue to be sent to the first owner. The fact that customer data might end up in wrong hands is harmful for Scania’s brand and reputation and is also a question about data integrity and information security. This risk could be delimited by detecting all service contracts signed on the wrong vehicle owner.

N4: Find new customers – If a vehicle is sold privately and the service is cancelled there is a risk that the new owner never gets new service offers because there is no dealer involved in the sales process of the truck. The salesman mentioned that potential customers are missed just because the dealer does not have so much knowledge about the second-hand owner of the vehicle. Therefore there is a need for a system to catch up all potential customers, even if they did not buy their vehicle at a captive dealer. This need is connected to the need of simplify the start of a service contract, since it has to be easier to find new potential customers in order to be able to sign new service contracts.

N5: Customize services – All personas: distributor, salesman, workshop manager and R&D person, mentioned that there is a limited knowledge about the second-hand vehicle owner. This means that services today are mainly adapted to the first owner, even if the second-hand owner could be seen as a potential customer. There is a need to get more information about the second-hand owner and to easier get in touch with them.

17.2 Discussion and Conclusions of List of Needs

Need N1, ease start and cancellation of a service, can be seen as the main need since the other needs derive from it. As mentioned in the description of N1, it is interesting to create a solution that is not
dependent on external actors as e.g., the Swedish Transport Agency. In Sweden, the Swedish Transport Agency is frequently used when managing service contracts at Scania. In other countries such a vehicle register is not as easy to access, which is confirmed by Scania employees in Brazil, Hong Kong and China. The importance of avoiding unnecessary telecom expenses, need N2, was mentioned during the small interview study described in chapter 16.1. This problem is an example of a need that indirectly will be fulfilled as need N1 is handled.

Avoid that information goes to the wrong customer, need N3, is very important for all businesses working with services based on user data. Even if this problem might not occur as often, it could be harmful for the brand and damage the clients trust for the company. N3 can be connected to the ethical problems when handling big data, mentioned by Nunan & Di Domenico (2013) and Finn & Wadhwa (2014). It is important to solve the data privacy, ownership and storage in a trustful way Nunan & Di Domenico (2013), and that the customer is informed about how the collected data will be used (Finn & Wadhwa, 2014). By fulfilling N1, N3 will be easier to fulfil since as the control over the contracts increase, the risk of vehicle information ending up in the wrong hands decreases.

N4, finding new customers, is important for all types of businesses and is therefore not specific for the case used in this thesis. If there would be an automatic way to find potential customers, the dealers’ work would be eased. In Scania’s case, there is potential to find new customers in the second-hand segment, since the knowledge in this field is limited. According to Guiot & Roux (2010), MarketLine Industry Profile (2014) and Kwak et al (2014), the second-hand market is important to take count of and it is also a growing segment. This is a big reason why Scania, and other OEMs, should start focusing on this market as well.

N4 is in a way connected to N5. When new customers are found, there is also the potential to find new customer needs. This in turn, could contribute with knowledge to be used when customizing services. Custom made services could be seen as a part of going towards becoming a total solution provider, which according to Antioco et al. (2008) and Kindström et al. (2012) is a growing trend among manufacturing firms. Customized solutions create value, and value creation is important for building up a customer loyalty (Tukker, 2004).

The list of five needs could seem short, the reason behind this is that these are the most important needs and the interviewed stakeholders did not mention any other needs. The drawback with having five needs to relate to in the following service development phase, is that it can be hard to use the needs for evaluating concept ideas. Since the needs are not measurable, it might be hard to verify that they are actually fulfilled. Still, the authors of this thesis empathise that the needs will be helpful during the idea generation because they can be used as desirable effects that each concept idea should fulfil.

To sum up, the five identified needs all seem relevant both according to the interview findings and the theory presented in the theoretical framework in this thesis. It can also be seen that there are connections between the needs, which means that if one is fulfilled the rest of them will be easier fulfilled.
18 Transition Alert Service Development

The chapter describes the service development process of Transition Alert Service (TAS). The development consisted of an idea generation and resulted in a description of the transition alert service and service blueprints. The aim was to create a service that fulfils the five identified needs from the previous chapter.

18.1 Idea Generation

The idea generation was done by sketching ideas on how each of the five needs described in chapter 17.1 could be fulfilled. Then the authors tried to see how TAS could ease the fulfilment. A selection of the ideas that came up during the idea generation is shown by photographs in Appendix L.

18.2 Description of Transition Alert Service

All the ideas that were created during the idea generation covered the five needs. The authors of this thesis discussed the different alternatives and decided to merge all of them together to create a solution that fulfils all the needs. This resulted in the concept visualized in Figure 35.

First of all a transition phase is detected by TAS. This is done by the algorithm checking the six vehicle data types: Driver ID, Amount of Stops, Route Shape, Run Time, Idle Time and Distance Driven. For a further description of the different data see chapter 14.2. Depending on if the TAS indicates a change in ownership or only a change in vehicle utilization, the following steps differ.

Figure 35 A visualisation of how TAS works and how it fulfils the five identified needs.
In the case of a change in ownership, the FMS contract date is compared with the date for the transition phase detected by TAS. If the FMS contract is older than the TAS date, it means that the contract maybe still is signed by the previous owner. Then there is a risk that vehicle information is sent to the wrong customer, the “Danger” box in Figure 35. The distributor has to check whether this alert is correct and then take a decision about an eventual cancellation of the service contract. When the contract is terminated, the distributor also has to contact the dealer informing that the vehicle has a new owner who might need services. In this way it is avoided that vehicle information goes to the wrong customer. Also, the distributor’s decision about starting and cancelling a service contract is eased. The solution also leads to avoiding unnecessary telecom expenses, since contracts can be cancelled before they start to cost Scania more than they give.

If TAS indicates a change in ownership, but the comparison of TAS date and FMS contract date show that there are no FMS contracts anymore, it means that there is a service sales opportunity for the dealer, the “New sales opportunity” box in Figure 35. This is a solution to find new customers and ease the start of new contracts. Also, it makes it easier for the dealer to customize the service offerings, since already before contacting the customer it is known that it is a second-hand vehicle that needs other services than a new vehicle.

The last scenario is that TAS indicates a change in utilization only, the “Additional sales” box in Figure 35. Then the TAS date will be the same as the FMS contract date, since there is no new owner. Still there is a business opportunity for the dealer since if the vehicle owner has changed business area e.g. from long-haulage to distribution, the owner might be in need of new services. This is a way to find new customers and customize the services. It can also be seen as fulfilling the need of ease start and cancellation of services, since it makes it easier to find opportunities to create new service contracts.

18.2.1 Service Blueprint

The transition alert service development resulted in three service blueprints describing how the TAS should be used and what activities are made in order to fulfil the needs. The reason why it became three blueprints even though five needs were identified, was because some needs were fulfilled by the same activities. By being able to control the start and cancel of a service contract as seen in Figure 36, it will also be possible to avoid that vehicle information goes to the wrong customer. The need expressing importance of finding new customers is also part of cancelling and starting a service, since if a service contract is cancelled for the previous owner the new owner is a potential customer. Therefore the service blueprint in Figure 36 includes all these three needs. Figure 37 shows how TAS can be used in order to customize the services and Figure 38 describes how TAS can be used to avoid unnecessary telecom expenses.
Figure 36 Service blueprint describing how TAS is used when starting and cancelling a service contract. The red lines describe the cancellation and the green dashed lines describe the start of a service contract.
Figure 37 Service blueprint describing how TAS is used in order to customize services.
Figure 38 Service blueprint describing how TAS is used to avoid unnecessary telecom expenses.
18.3 Discussion and Conclusions of Transition Alert Service Development

In this section it is discussed how TAS fulfils the identified needs. This is followed by discussions connected to servicification, telematics, intelligent vehicles, big data and ethics, and the second-hand market.

18.3.1 How the Transition Alert Service Fulfil the Identified Needs

Since the aim was to develop a service that fulfils the five identified needs, it is also important to investigate whether TAS does that or not. Taking the customers’ needs into account when creating a new service offering is something that Kowalkowski et al. (2013) stress as very important. As can be seen in Figure 35, all the five needs are covered. The actions that follow the “danger”-indication, all lead to fulfilment of the most important needs; N1: Ease start and cancellation of services, N2: Avoid unnecessary telecom expenses and N3: Avoid that information goes to wrong customer. There is also a “bonus” advantage when N3 is solved. If FMS contracts are cancelled in time, there will not be any invoices sent to the previous owner regarding FMS contracts, and this will lead to less complaints from clients getting invoices regarding services are not used anymore. Need N1 is fulfilled by all actions in Figure 35. This is because this can be seen as the initial need that the rest of the needs are based on. If the contracts are better controlled, this means that the other needs indirectly are fulfilled as well. The possibility to customize services more, need N5, is important for OEMs trying to become solution providers. This is mentioned by Antioco et al. (2008) and Kindström et al. (2012) as a trend in the manufacturing industry, which makes the fulfilment of need N5 important. In conclusion, TAS fulfils all identified needs and therefore it has great potential.

18.3.2 The Servicification Perspective

TAS by itself is not possible to classify into Antioco et al.’s (2008) SSC or SSP, but it can be seen as a service that supports or triggers other services. Start or cancellation of services is enabled by TAS, and this service can be categorized as SSP, since it supports the product. The other application of TAS that enables the possibility to sell customized services can be categorized as SSC, since some of the customized services are supporting the client’s action. In short, TAS can be classified as both SSC and SSP depending on what kind of service it supports. Since Antioco et al. (2008) sustains that SSC focused businesses lead to deeper customer relations and more loyal buyers, TAS can be seen as an enabler for services that will increase the relative product sales. TAS can be used to support pre-sales, sales and after-sales services. Since Juheling et al. (2010) sustain that the after-sales services are important and profitable in the automotive industry; TAS could be used specifically to support this kind of services.

TAS will enable the possibility to offer more unique and customized services, which according to Vargo & Lusch (2004) will lead to higher and more stable sales, cash flows and profits. What Vargo & Lusch (2004) also sustain, is that creating total solutions will create synergies which can be an advantage against companies that only provide products or services. By this said, TAS can be seen as a tool for making the creation of total solutions easier and contribute to the creation of the above mentioned synergies. According to Matthyssens & Vandenbempt (2008) providing a total solution is a way to create non price based customer value. In order to create value, Gebauer & Friedli (2005) and Windahl & Lakemond (2006) stress that service should not be seen as add-ons or, as mentioned by Juheling et al. (2010), after sales offerings. Services have to be seen as parts of the total solution. In the case of Scania, offering a total solutions appears in the Ecolution offering, see chapter 4.5. TAS in this context
would help to capture customer specific information that would help the development of a more efficient total solution offering.

As seen in the blueprints the relation between Scania R&D, dealers, users and distributor is complex. TAS eases the work of the distributor; consequently the dealer should receive less complaints and the customer a better service. A better service leads to a stronger relationship with the customer which according to Barry & Terry (2008), Ulaga & Eggert (2008) and Wilson & Jantrania (1994) creates customer value.

18.3.3 Using Telematics and Intelligent Vehicles

TAS is based on information gathered from telematics and, as Richards (2014) mentions; telematics is a good tool for improving the efficiency of new services. In order to make TAS even better and accurate it would benefit from more data and this could be solved by expanding the telematics and, as Albright (2014) emphasises, create an ecosystem of telematics users, services and infrastructure. At the same time it is not enough to just develop the telematics in order to improve TAS. Kowalkowski et al. (2013) argue, the company has to have the ability to link the technological possibilities with the customers’ needs to be able to create new offerings. This means that when further work is done on how TAS can be improved and what more sources of data this requires, the customers’ needs have to be in focus.

When looking into the future, as mentioned by Adamopoulos et al. (2002), Albright (2014) and Kilcarr (2013), more data will be possible to collect due to advanced telematics. When the authors of this thesis created TAS, the amount of data was already overwhelming. Richards (2014) stresses that the challenge for companies providing services based on telematics is to handle a big, and growing, amount of data. In order to not make TAS more advanced and data requiring than needed, the improvement plan has to include an idea about how to handle the data.

Finally, TAS could be created because the trucks are, as mentioned by Broggi et al. (2008), intelligent vehicles. According to Broggi et al. (2008), intelligent vehicles have not reached their full application yet and it is not known if TAS will be necessary when the intelligent trucks have reached that level.

18.3.4 Big Data in the Service Creates Business Opportunities

According to Schmarzo (2013), with big data come business opportunities. Creating TAS is one example of using big data to ease decision making in a business. Schmarzo (2013) mentions that using big data enables the business to have a more forward-looking perspective, which is important for decision making. Using big data for decision making is also supported by Foreman et al. (2014), and TAS is a good example of this. Instead of waiting for the customer to contact the company informing that the vehicle has a new owner or utilization, the customer can be contacted by the company instead. This means that the risk of losing a potential client will be smaller.

Schmarzo (2013) mentions that big data have the potential to increase business value, but because of the lack of exact data, limitations regarding technology and knowledge about data sources, the outcomes are often not as expected. Since TAS is just on a conceptual level, it has not been tested if it will increase the business value. To get an idea, the prioritization matrix developed by Schmarzo (2013) could be used where business value is weighted against implementation feasibility. Since the authors of this thesis can be considered as subjective when it comes to validate the value of the developed service, this should not be performed by the authors. The recommendation is that those taking the
decision regarding whether the service should be further developed and later implemented, should use this matrix.

18.3.5 An Ethical View on the Solution

Just as mentioned by Nunan & Di Domenico (2013), there are not just possibilities with big data but also ethical issues that have to be discussed. Privacy, ownership of data and data storage are topics mentioned by Nunan & Di Domenico (2013) that are relevant discussing in this case. Since TAS is used for minimizing the risk with vehicle information sent to the wrong client, the solution can be seen as making the information security higher which will prevent some of the problems mentioned by Nunan & Di Domenico (2013). When it comes to the problem with privacy, it is crucial that TAS is used in a correct way. If TAS is going to be used in order to find new customers, it is important that the dealer’s market strategy is well designed so that no vehicle owner feels supervised or annoyed by dealers offering them new services all the time.

The idea with TAS is that it uses old data to create a pattern that later is compared with new data in order to detect differences. This means that there will be a problem with second ethical practice stated by Nunan & Di Domenico (2013); the individual’s right to get personal data deleted and the right to have an expiry date on the data. This problem could be handled by informing the customer about the usage and storage of the data. The vehicle owner has to be informed that the FMS data will be used for the TAS according to Finn & Wadhwa (2014). If the vehicle owners are informed about the value TAS can create, it would be easier to convince them to “give away” information to Scania.

18.3.6 The Second-Hand Market

According to Guiot & Roux (2010) and Kwak et al. (2012) the second-hand market is growing. Respondents from the interview studies and MarketLine Industry Profile (2014) mention a growing interest in second-hand vehicles both in big and small transport companies, and it can be described as a result of the economic situation in some European countries. TAS can be seen as an important tool for expanding long-haulage OEMs’ control over the second-hand market. Even if TAS will help the manufacturer to handle the second-hand market better, it is not enough. Kwak & Kim (2015) mention that in order to maximize the current and future profit, the vehicle’s lifecycle must be taken into account already when taking design decisions. This means that TAS is a tool for getting better knowledge about the second-hand vehicle owner and how the trucks are used, but the vehicles still have to be designed for working on the second-hand market as well.

Since TAS fulfils the need to customize services and to find new customers, it also means that the second-hand vehicles get more focus than before. How the customer perceives the value of a second-hand truck is important for the manufacturer, according to Kwak et al. (2012). By getting more information about used vehicles and being able to customize the services based on the truck’s current lifecycle phase, the perceived vehicle value will increase. Upgrading the vehicle by enabling connected services suited for second-hand trucks, would increase the second-hand value of the truck since it minimizes the obsolescence. Designing for upgrading is something that Kwak et al. (2012) mention as a recommended design approach.
19 Possible Applications of the Transition Alert Service

When it was sure that TAS fulfilled the five identified needs, possible applications for the service were investigated. This was done in order to see what potential there is for TAS. In this chapter the idea generation, concept selection and a presentation of a total solution can be read. Finally, discussion and conclusions are presented.

19.1 Idea Generation

The idea generation consisted of three steps: a brainstorming where the authors of this thesis generated ideas, a workshop with a distributor and a workshop with experts at Scania.

19.1.1 Brainstorming

The pictures from the brainstorming can be seen in Appendix M. A large amount of ideas were created and after discussion the most relevant concepts were chosen and developed. These are described below.

**Concept 1: Usage-history** – A possible application that would include TAS is putting together information that describes how the truck has been used during its life. TAS would signal a change in ownership or a change in utilization, and this combined with other data that describe how, when and where the truck was driven and what kind of reparations were made, would give a good picture of the usage-history of a truck. Preferably all this information would be visualized in order to make it easy to understand so it could be used as a base for decisions.

**Concept 2: Help logistic company when hiring new haulier** – Scania could sell the information about transition phases to logistic companies when they want to hire new hauliers. By knowing the history of the vehicle the haulier is using, how old it is and how it has been used, the haulier best suited for the assignment can be hired.

**Concept 3: Help insurance company find new customers** – The information regarding change in ownership and/or utilization could be sold to insurance companies. They would benefit from this knowledge when they search for new potential customers. When a haulier buys a second-hand truck from a private person, he or she could automatically be offered insurance. Therefore it is important for the insurance companies to know about a truck that has changed owner and is without an insurance or a truck that has changed application and therefore need a new type of insurance than the one that is signed today.

**Concept 4: Vehicle technology update** – When a second-hand vehicle is bought it is not sure that the technology in the vehicle is suited for the specific business. This is due to the fact that sometimes the right vehicle is not available on the second-hand market and the haulier has to buy a truck that is good enough. If the workshop could access the TAS and be able to get indications on transition phases, the workshop could contact buyer of second-hand trucks and offer a technology update of the truck suited for the haulier’s specific business area.

**Concept 5: Plan R&M** – Phase transition alerts could be collected and analysed in order to see what types of R&M that usually are done in different lifecycle phases. Based on this knowledge, it would be possible predict what type of R&M a vehicle in a certain lifecycle phase probably needs. When a new TAS for a vehicle occurs, the workshop could contact the vehicle owner and offer R&M suited for the
lifecycle phase that the truck is in. This means that the customer does not have to contact the
workshop, but they contact him or her instead and offers the service to schedule R&M in order to
prevent vehicle faults.

**Concept 6: Keeping the right spare parts in stock** – If the workshop knows about in what lifecycle
phases the vehicles running in the region are, it would be possible to predict what types of spare parts
that will be requested. This means that the workshop could guarantee their customers that the needed
spare parts always are available.

**Concept 7: Finding lost vehicles** – If the vehicle owner can access the TAS, strange vehicle utilization
could be detected and investigated. This means that if the vehicle is running far away from the
scheduled driving route or being active during periods when it should not be driven, the haulier could
get an indication that something might be wrong. This information would help the haulier to find
drivers that use the truck for e.g. private purposes or stolen vehicles.

**Concept 8: Decision support when buying a second-hand vehicle** – With the knowledge gained from
previous TAS alerts connected to a certain vehicle, Scania could sell information regarding a second-
hand vehicle’s previous lifecycle phases to hauliers when they want to buy a used truck privately. This
means that the haulier will have more information to base the purchase on.

**Concept 9: Scania Assistance** – To be able to ensure that the assistance goes to the right vehicle and
that the invoice is sent to right owner, Scania assistance could use TAS to ensure that the latest owner
is signed on the assistance contract.

**Concept 10: Mixed fleet service** – Hauliers buying second-hand trucks cannot be as picky when
choosing what brand the truck should be. This means that the fleet might consist of different brands,
all with their own monitoring system. If the TAS detects a change in ownership, the dealer can contact
the new owner and offer a service making the fleet work better together. This service could e.g. be
FMS for all of the vehicles or R&M suited for different brands.

### 19.1.2 Workshop with Distributor

The idea generation together with the distributor resulted in six ideas describing how the knowledge
of a transition phase could be used. These ideas are described below.

**Concept 11: Adapt a R&M contract in time** – When signing a R&M the price of the contract is
dependent on the intended usage of the truck and how many workshop visits the dealer thinks that
the vehicle will need during the contract period. This means that if the vehicle changes usage area
during the contract period, the estimated workshop costs might not be valid anymore. A higher
workshop visit frequency than planned means that the dealer loses money on the contract. Therefore
the R&M contract has to be up to date and the dealer could benefit from getting an automatic alert
on a transition phase to be able to ensure that the contract is signed for the right vehicle utilization
and that it is not changed during the contract time.

Another area the knowledge about a transition phase could be used for, connected to the R&M
contracts, is to ensure that the contracts are terminated in time. Sometimes it happens that the
contract is not cancelled when the vehicle is sold, and then the previous owner continues to get
invoices. If the dealer could get an alert on a change in ownership so that the termination of the contract will be done, the problem with paying back money to the previous owner will be avoided.

**Concept 12: Help dealers value trade-in trucks** – Dealers could use the information from previous alerts from TAS connected to a certain vehicle as a tool for estimating the value of a trade-in truck. Thereby the prices for used vehicles can be set according to the vehicle’s condition.

**Concept 13: Detect wrong specified vehicles** – A transition alert could be used for finding vehicles that are wrong specified. This means that if the dealer gets an alert saying that a vehicle has changed its utilization, the dealer can check whether the vehicle is suited for that specific task. If not, the owner can be contacted and maybe offered a new more suitable vehicle in order to save money.

**Concept 14: Detect breaches of contract** – In order to detect eventual breaches of contracts, the knowledge about a transition phase is valuable. The contracts like R&M, finance, rental and leasing are signed for specific vehicle use and owner and if any of these change the contract is breached.

**Concept 15: Predict hauliers’ need of changing a truck** – Information gathered from previous alerts from TAS, could be used to predict the best time when a truck should be sold. This knowledge could be used by the dealer in order to contact the owners of a truck close to a transition phase, inform them about the situation and sell a new or a better second-hand truck. Using this method the customers could save money and avoid stress situations because the vehicles are sold at the right time, and dealers get opportunities to sell vehicles.

### 19.1.3 Workshop with Experts at Scania

The workshop with the internal experts resulted in eleven concepts described below.

**Concept 16: Vehicle intro** – Based on the transition phase alert Scania could get in contact with the new owners of a second-hand vehicle and offer them a vehicle introduction. Especially if the truck is made for one segment and it is going to be used in a different one, the intro could include advice on how to use the truck in the best way.

**Concept 17: Mapping the market** – TAS could be used for mapping the movement and the use of the trucks on the second-hand market. This information could be used to see how the trucks move geographically over time and where they finally end up. It could also be used in order to see how hot a specific market is. This could help finding changes on the market and new market needs. Mapping the typical changes in utilization, would help understand the needs of a specific segment.

**Concept 18: Pro-active buying and refurbishing** – Based on TAS it is possible to predict that a truck is going towards the end of a lifecycle phase. This knowledge could be used by Scania to pro-actively buy used trucks, refurbish them and sell them, instead of letting customers make private sales.

**Concept 19: Help rebuilding wrong specified trucks** – With help from TAS the dealer could get in contact with the new owner of a used truck, where the specification of the truck does not fit the new utilization. The dealer could then offer help rebuilding the vehicle so that it perfectly fits the intended usage area.
**Concept 20: Sell financial services** – If TAS indicates that a vehicle has changed owner, there is a chance that the previous owner needs to buy a new truck. This could work as a trigger for contacting the previous owner and offer financial services.

**Concept 21: Trigger for Scania rental** – If a haulier buys a second-hand truck it could be because of a new job assignment appears on short notice. Since it could be hard to find second-hand trucks suited for a specific task, the haulier might be in need of more trucks than available on the second-hand market at the moment. When TAS indicates a change in ownership, this could be a trigger for Scania rental offering more temporary vehicles to fulfil the haulier’s need of vehicles.

**Concept 22: Sales prediction** – TAS could help creating better statistics on how long the usual lifecycle phases for each vehicle segment are. This could predict when a truck is probably going to be sold.

**Concept 23: Second-hand vehicle database** – The knowledge of where in the lifecycle vehicles are could be collected in a database. Based on this, the dealer could offer customers help to find the perfect second-hand truck. By checking in the database for the desired vehicle specifications, the suitable truck could be found. If the vehicle according to this register is in a lifecycle phase close to a transition and probably will be sold in a close future, the dealer could contact the owner of this vehicle and offer a suitable deal. This means that the vehicle owner will be offered help with selling the vehicle and also offered a new truck to keep the fleet updated. Also the client searching for a second-hand truck will be able to get a vehicle suitable to the business area.

**Concept 24: Follow-up salesman** – Based on TAS the distributor could check how many times an indication of change in ownership leads to the new sale of a truck, which means that the amount of missed sales opportunities could be controlled. This would work as an indication of how good or bad salesmen are, and used to motivate the resellers.

**Concept 25: New used truck in a dealer’s zone** – TAS together with GPS data could tell dealers that there is a new used truck in their area that is driving without any services. This could work as a trigger to find new customers.

**Concept 26: Measure quality** – By looking at how often TAS occurs during a vehicle’s lifetime and how long it is between the alerts, a standard for how long a vehicle usually stays in a special lifecycle phase before being sold could be created. If a truck is sold earlier than expected it could be due to problems or dissatisfaction with the truck, and this could be used as a measure of the quality of the trucks.

### 19.2 Concept Selection

After the meetings with a business development manager and a business analyst the 26 different ideas described in the earlier section were delimited to two main areas. Based on what type of conclusions and actions the TAS is followed by, the concepts were categorized as either services connected to change in utilization or ownership. Concepts that did not fit in to these two main areas and that did not have the potential to be further developed were eliminated and are presented in the discussion of this chapter.
19.2.1 Services Connected to Change in Ownership

The action of changing ownership was divided into three parts: before, during and after the change. Also different actors were identified, which helped categorizing and choosing the concepts. Nine concepts were developed and put together into a final solution, see Figure 39.

<table>
<thead>
<tr>
<th>CHANGE IN OWNERSHIP</th>
<th>BEFORE</th>
<th>DURING</th>
<th>AFTER</th>
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<td>VH</td>
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<td>Predict hauliers’ need of changing a truck and pro-actively buying the vehicle</td>
<td>I</td>
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<td>VH</td>
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<tr>
<td>Help customers find the most suitable second-hand truck</td>
<td>II</td>
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<tr>
<td>HAULIER</td>
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<td>VH</td>
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<tr>
<td>Decision support when buying a second-hand truck</td>
<td>III</td>
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<td>WORKSHOP</td>
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<td>Change in Ownership</td>
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<tr>
<td>Keeping the right spareparts in stock</td>
<td>IX</td>
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</table>

Figure 39 Services, change in ownership.

All service concepts are based on TAS, though the type of information required for every concept differs. Below is a description of the four different information types, and this is followed by a presentation of the services.

VH Vehicle History

Vehicle history is data composed by the collection of all TAS over time. Similar to a timeline where all changes in ownership and changes in utilization during the vehicle’s life are displayed.

The vehicle history could be seen as a service based on historical TAS that together with a new transition phase alert could be used when analysing the situation.

Vehicle history based on TAS benefits from being combined with other data in order to get an even better idea about a specific vehicle’s life.
This data is based on GPS coordinates and shows the position of the vehicle over time.

**TAS signal that indicates that a change in ownership has occurred.**

**TAS signal that indicates that a change in utilization has occurred.**

**Before**

Three TAS-based services were developed that could be offered right before change in ownership.

I: **Predict a haulier's need of changing a truck and pro-actively buying the vehicle** – Using the vehicle history the dealers could predict when their customers are about to change truck, and thereby pro-actively contact the owners, offer them a new truck and buy the old one back. (I, in Figure 39)

II: **Help customers find the most suitable second-hand truck** – As it emerged from the interviews, it is hard to find a second-hand truck that perfectly fits the business area. The dealers could help finding a suitable second-hand truck by looking not only to the trucks already for sale, but also at those that are still used. The vehicle history could be used for checking which suitable trucks are driving at the moment, and which are at the end of their lifecycle period. When a truck is found the dealer can contact the owner, buy the truck and offer a new deal. The first customer gets a second-hand truck adapted to the business and the previous owner of the vehicle might buy a new vehicle. Furthermore, from the hauliers perspective, being contacted by the dealer and getting advice about when to sell the truck shows that the dealer values the haulier as a client. (II, in Figure 39)

III: **Decision support when buying a second-hand truck** – A service that was developed to benefit the haulier, is a decision support platform when buying a second-hand truck privately. A haulier that found a used truck for sale, and wants to know more about it could go to the Scania homepage and buy the information included in the vehicle history. (III, in Figure 39)

**During**

Three TAS-based services were developed that could be offered during change in ownership.

IV: **Value trade-in truck** – By having access to the vehicle history, the trade-in trucks could be valued by the dealer in a more consistent way. This would work as a guarantee towards the buyers, ensuring that the vehicles’ prices are decided based on knowledge about the trucks. (IV, in Figure 39)
V: Value truck – In the same way as mentioned in previous service, this service could be used by hauliers that want to know how much their or other’s trucks are worth. This could work as an online service in order to simplify private sales. (V, in Figure 39)

VI: Financial services – This service is based on a change in ownership only and facilitates the offering of financial services. When TAS detects a change in ownership Scania can contact the previous owner of the truck and offer financial services, since he or she is probably going to buy a new truck. (VI, in Figure 39)

After

Three TAS-based services were developed that could be offered after the change in ownership.

VII: New truck in dealers’ zone – This service is based on the fact that a truck has been sold and the new owner changes region. By combining GPS data and the indication of a change in ownership, the dealer closest to the truck gets an alert. In turn, the dealer contacts the owner of this truck and offers services like R&M, FMS, driver coaching, vehicle intro and insurance. This creates value since the haulier does not have to actively contact a dealer or workshop, but gets all the offers served. (VII, in Figure 39)

VIII: Rating system for hauliers based on fleet – The vehicle history could be used in a service that reports the condition of the trucks. Hauliers could use this in order to show that their fleet is updated, and it could be a competitive advantage when big logistics companies hire hauliers. (VIII, in Figure 39)

IX: Keeping the right spare parts in stock – The workshops could use vehicle history information in order to get better knowledge about the trucks running in the workshops’ region. This in turn, gives information about which vehicle faults that probably will occur and which spare parts to keep in stock. This would make workshops more efficient, and customers could get a better and faster service and become more loyal. (IX, in Figure 39)

19.2.2 Services Connected to Change in Utilization

The change in utilization process is not as complex as the change in ownership, therefore it was not divided in before, during and after. Two main services were developed based on T1, T2 and GPS data. These are displayed in Figure 40.

X: Detect wrong specified vehicles – By combining the alert of a change in utilization and the specifications of a truck, vehicles that are specified for a different use than the one that they are actually used for can be identified. If the “incorrect” use of the truck implies exaggerated costs for the haulier, the GPS will be used to find the closest dealer so he or she can be informed about the situation. The dealer contacts the vehicle owner and offers either help with rebuilding and updating the truck or offers another truck that better fits the haulier’s type of business. (X, in Figure 40)

XI: Track lost vehicles – The service helps the haulier to find the truck in case of theft and detect if the truck is used in an inappropriate way by the driver. This is done by looking at alerts on change in utilization and/or change in ownership that should not occur since the vehicle is not supposed to change usage or owner. This service would give hauliers better control over their fleet. (XI, in Figure 40)
The services presented in the previous section do not create a total solution, since the goal was to find possible applications for TAS. They can easily be integrated into a total solution and in this section one example named “No Worries Second-Hand” is presented. A visualization of the service offering is shown in Figure 41.

This total solution offers the customer the perfectly suitable second-hand truck without having to spend time searching for it. It also consists of a contract saying that if the customer signs a R&M contract, the dealer will buy back the vehicle and offer a new second-hand vehicle when the old one gets too old or used. When a customer buys this total solution he or she only needs to specify needs and preferences for the truck. After that, the dealer will try to find a vehicle that fulfils the requirements among the trucks on the second-hand market and vehicles that are about to end a lifecycle phase and probably will be sold in a close future. When a suitable truck is found, it is valued and the owner of this vehicle is contacted and offered to sell the vehicle. If the owner accepts the offer, it is bought, reconstructed or repaired if needed and sold to the new customer. The customer uses the truck and signs an R&M contract, which is a must when signing the “No Worries Second-Hand” deal. When it is time to sell the truck again, meaning that if the truck is kept longer it will cost more than it is worth, the dealer will contact the customer, buy the truck back and provide a new second-hand truck to the customer so that client’s business is always running. During the utilization time the dealer can sell all the standard support services. TAS makes this total solution possible by giving the dealers the possibility to know more about the truck and predict phase transitions.
19.3 Discussion and Conclusions of Possible Applications of the Transition Alert Service

In this section the potential services and the total solution are discussed, and the reason why some of the concepts were eliminated.

19.3.1 The Potential Services

According to Gronroos (1998) and Barry & Terry (2008) customers buying services are more likely to enter long-term relationships than those buying physical products. Therefore, the authors of this thesis argue that the services described in this thesis could be used in order to increase customer loyalty and rise cash flows and profits, which is in line with Vargo & Lusch (2004). The services cover a wide range of possible applications connected to the change in ownership and change in utilization of the truck. The services developed touch three different actors: haulier, dealer and workshop, but the focus still lays on the relationship between the OEMs and the hauliers. According to Windahl & Lakemond (2006) the company offering the services should not only focus on the end customer when developing an offering. The authors of this thesis followed this advice and tried to focus on more actors. The developed services could have focused more on internal actors at OEMs, but most of them e.g. connected to the distributor, R&D and marketing personnel were seen as trigger services or follow-up services and were therefore not included in the final choice of services. The dealer plays a very important role, since it is the main contact between the customers and Scania. Therefore the authors of this thesis think that, if the relationship between dealer and haulier can be enhanced with help from TAS, this will create value and strengthen the brand.

Figure 41 A description of the total solution “No Worries Second-Hand” and how the developed services are used in order to create the offering.
Most of the services developed can be seen as SSC (services in support for the client’s action), as described by Antioco et al. (2008). The reason why the services are classified as SSC is that the authors of this thesis argue that the services are more or less customized and require customer relationships, which is in line with Antioco’s et al. (2008) and Mathieu’s (2001) description of SSC. Antioco et al. (2008) and Fang et al. (2008) emphasise that this kind of services give deeper customer relations and lead to more loyal buyers, which in turn will lead to increased product sales. Another advantage with providing SSC is that, according to Antioco et al. (2008) and Vargo & Lusch (2004), these types of services are harder to imitate and copy for a competitor.

19.3.2 Services Connected to Change in Ownership

The information source called vehicle history was crucial to create most of the services connected to change in ownership. Vehicle history is created by historical TAS, collecting changes in utilization and owner over time. With this information it is possible to get an idea about how the vehicle has been used during its life. The vehicle history in this thesis does not include other additional information, since the aim with this study was to find possible applications for TAS, even though it could be complemented with more information to make the vehicle history more covering. Examples of information are vehicle specification, GPS coordinates, workshop history and eventual accidents and theft. The type and amount of data that could complement TAS in vehicle history is dependent on the OEM’s ability to handle big data, which according to Schmarzo (2013) can be challenging. According to Albright (2014), Broggi et al. (2008) and Riches (2015) OEM’s in the automotive industry are expanding their service solutions by using telematics. There is today a similar service called Carfax, that provides private people with vehicle information (Carfax, 2015). The fact that this type of service already exists, is a sign that vehicle history is needed. There is also a risk that Carfax is good enough and that there is no need for more services like this. Still, the authors of this thesis see a huge potential in further developing the vehicle history service in the future and find even more applications for it.

The selected services were divided into before, during and after which is similar to Juheling et al.’s (2010) categorization into pre-sales, sales and after-sales. Juheling et al. (2010) sustain that the after-sales services are very profitable for vehicle manufacturers, and this was confirmed by a business development manager at Scania. Seen from a profitability perspective the services VII, VIII and IX, see Figure 39, are very important. A business analyst sustained that during a change in ownership a large amount of money is involved, therefore selling extra services could be easier in this stage, since the cost of a service can be considered to be low compared to the price of the vehicle. This is the main reason why services connected to change in ownership are important.

Service I and II come from concept 15 and 18, see chapter 19.1.1. The fact that the dealer works proactively and contacts the haulier in order to help with the change of a truck, makes the vehicle owner feel valued. As mentioned by Tukker (2004), value creation and fulfilling the customers’ needs make it easier for the customers to focus on their core business. Service I and II are examples of services where the dealer and buyer work together. The previous vehicle owner gets a new updated truck and the second client gets a second-hand vehicle suitable for the business. This means that the buyer and the service provider work together, which Anderson (1995) sustains is beneficial for both parts. This creates a closer relationship which in turn creates customer value according to Barry & Terry (2008), Ulaga & Egert (2008) and Wilson & Jantrania (1994).
Another example of taking care of activities that are not part of the client’s core business, is service III. This service comes from concept 8, see chapter 19.1.1. Everything that makes the change of ownership easier and smoother, creates according to the authors of this thesis value. This is due to the fact that the transition in ownership is not part of the haulier’s main business and therefore by making the transition easier, creates value according to Tukker (2004). Service III can be seen as less of a whole solution compared to I and II, since this service only provides information and does not take care of the whole purchasing process as service I and II do. Service I, II and III all fit into the description of pre-sales services by Juheling et al. (2010), supporting the sales activities e.g. optimization of the vehicles for the customers’ needs. The three services are also examples of how to handle the second-hand market, mentioned by Guit & Roux (2010), Kwak et al. (2012) and MarketLine Industry Profile (2014) as a growing and interesting market.

Service IV and V come from concept 12, see chapter 19.1.2. The difference is that IV is directed towards the dealer and V is supposed to be used by the vehicle owner. Both these services are tools for the long-haulage OEMs to better control the sales of vehicles on the second-hand market, since the prices of the used vehicles are based on information from the vehicle history. Getting better control and knowledge about the second-hand market is crucial for a business that wants to enter the second-hand market, in line with Kwak et al. (2012). Service IV makes it easier for the dealer to decide the price for a trade-in truck, since it makes it easier to take the vehicle condition into account. It also works as a guarantee for the customer that the trade-in price was based on real information and knowledge and not just the dealer’s instinct. Service V works in the same way, but for private sales. These services are, as Juheling et al. (2010) mention, sales services that support the sales activities and financing.

Service VI, previously called concept 20 in chapter 19.1.3, describes a method for selling more financial services based on the knowledge about a change in ownership. This means that when the dealer gets information about that a vehicle has changed owner, the previous owner of the vehicle is probably in need of a new truck. While helping the new owner getting started with the vehicle, the dealer can simultaneously contact the previous owner and offer financial services for buying a new truck. This is an example of sales service, described by Juheling et al. (2010).

Service VII, previously called concept 25 in chapter 19.1.3, is a service directed to the dealer and that triggers sales of customer service like R&M, FMS, driver coaching, vehicle intro and insurance. This service creates great customer value, since the haulier does not have to worry about contacting the right dealer because the dealer contacts him or her. This enables the customer to focus on its core activities, as mentioned by Tukker (2004), and not worry about looking for which dealer in the region to contact. This service is also valuable for the OEM, since if the dealer is automatically informed about new potential customers in their zone, the risk of missed sales opportunities will be reduced.

Service VIII was inspired by concept 2 from chapter 19.1.1, but it was changed so that the service is more directed towards the haulier than to the logistic company hiring the haulier. The reason behind the changed focus, was because the service sounds more positive if it is a tool for the haulier to guarantee that his or her fleet are of good quality, rather than the logistic company evaluating fleets. This service is an after-sale service, as described by Juheling et al. (2010).

Keeping the right spare parts in stock named service IX and previously called concept 6 in chapter 19.1.1, works as a guarantee for the workshop customers that the spare parts needed are always
available. If the workshop can secure that the most needed spare parts are always in stock, the potential that the client will go to an OEM workshop instead of another workshop will increase. This is a typical after-sales service, as mentioned by Juhelings et al. (2010), where the OEM can earn a lot of money by selling original spare parts instead of the customers buying substitute parts.

19.3.3 Services Connected to Change in Utilization

The reason why service X and XI were put under the category change in utilization, was because they need a TAS type T2 and because the services do not facilitate the transition of ownership. Service X was previously called concept 7 in chapter 19.1.1. The detection of a wrong specified vehicle could be followed by three different actions: technology update of the vehicle, rebuild wrong specified vehicles and offer second-hand/new trucks that better fit to the customers’ needs. The first two actions mentioned were before called concept 4, see chapter 19.1.1, and concept 19, see chapter 19.1.3. Service X helps the vehicle owner to adapt the vehicle to the specific business, even if the vehicle was not sold at the dealer’s place. This creates value for the vehicle owner, because it gives the feeling that the dealer cares about the customers. It also creates value for the dealer, because new workshop customers could be found. Rachaniotis (2008) and Kwak et al. (2012) mention that technological obsolescence cannot be avoided. A solution to this is to enable product upgrading (Kwak et al., 2012). Making it easier to detect wrong specified trucks and offer upgrading, as service X includes, is a way to handle the obsolescence. Service X could be classified as an after-sales service, and is the type of service that is very profitable for the manufacturer according to Juhelings et al. (2010).

Service XI was previously called concept 7 in chapter 19.1.1. Tracking lost vehicles can be classified as Juhelings et al.’s (2010) after-sales service. This service is slightly different from the rest of the services, since it does not enable the change in ownership or the change in utilization. This service is based on undesirable changes in utilization or ownership and secures that the vehicle stays with its rightful owner. This in combination with other services mentioned, e.g. taking care of the upgrading of the vehicle (service X), is a tool for handling the fact that only product innovation no longer is enough to stay competitive, mentioned by Antioco et al. (2008), Matthyssens & Vandenbempt (2008) and Ulaga & Eggert (2008).

19.3.4 Example of Total Solution – “No Worries Second-Hand”

The total solution presented is just one example of how the TAS-generated services can be used in a context. In this case TAS simplifies steps like the process of finding a suitable truck, and contributes to lowering the risks involved when setting a trade-in price of a truck. Basing the valuation of a truck on knowledge about its history, would make the price more accurate and reduce the risk of the dealer putting a too high trade-in value on the vehicle.

According to the findings from the interview studies, see chapter 8.2.1, second-hand trucks are often bought because a new truck is too expensive, though it is hard to find a suitable second-hand vehicle, and it takes time. This is one aspect that is improved by this configuration of services. By using TAS-related services it is easier for dealers to find a suitable second-hand truck for the customer. Another reason for buying a used truck is the quickness of the deal. Ordering a new truck takes a long time, therefore hauliers with sudden assignments tend to buy second-hand trucks instead of new ones according to the interview studies. This total solution would offer, in theory, a faster deal than ordering a new vehicle. Of course in practice it always depends on the situation, it could happen that the right
truck cannot be found in a short time, and the customer has to buy another truck and rebuild it. Since these processes rely on new and untested algorithms, the offering would need improvements in order to work properly.

According to the business development manager at Scania that participated in the concept selection, see chapter 2.14.2, selling R&M contracts and spare parts is very important, especially when it comes to the used vehicle market. Therefore it is included in the offering that the customer signs an R&M contract when buying the truck. Knowing that the truck has been serviced regularly and original spare parts have been used, is a safety for the dealer when buying it back and is a way to extend the vehicles’ life. According to the interview studies it is today uncommon that second-hand vehicles sign R&M contracts because the contracts are seen as too expensive. “No Worries Second-Hand” will therefore need R&M contracts that are suited for second-hand trucks. This total solution gives control over the vehicle’s lifecycle for a longer time, which means that the MOL described by Cao et al. (2009) is extended. Extending MOL implies that services can be sold for a longer period and also more information regarding the vehicle can be sent back to the BOL, which in turn will help to improve the product and the value chain mentioned by Cao et al. (2009).

With “No Worries Second-Hand” the customer does not have to care about searching for a suitable truck, he or she just gets an offer to accept. This saves the customer a lot of time and work, and since the dealer can use a broad network and has access to detailed data about each truck, the dealer can find a suitable truck faster than the client would do when searching by itself. This would also give the customers a kind of security when it comes to the state of the used truck. Offering a total solution is a way to create new non-price based customer value sustain Matthyssens & Vandenbempt (2008), which is what happens in this case when customers do not have to actively search for a truck, value it and take decisions.

Furthermore the offering would create a form of loop. When customer 2 in Figure 41 uses the truck, the dealer receives continuously updates about the vehicle’s status, and knows when it is the best time for the customer to sell it. At this point the dealer will buy the truck back, and re-sell it if there is an interested customer or trader (customer 1 in Figure 41). By always buying the truck back, the dealer has better control over what is going to happen with the truck and choose the most sustainable and resource efficient way to handle the vehicle. A total offer gives the possibility to create sustainable solutions (Stahel, 1982), since as Tukker (2013) argues the focus lays on the solution and not only on the product.

In conclusion, the benefits that come with total solutions will create more stable sales and are hard to copy sustain Vargo & Lusch (2004). This means that offering total solutions like the one described in this section would give the OEM a competitive advantage.

19.3.5 Eliminated Concepts

Since the study had to be delimited, it was necessary to eliminate some of the concepts in order to have time to further develop the most promising ones. It was important that TAS was included in the solutions, and this also delimited the amount of ideas. The concept elimination was based on feedback from the two meetings and discussions regarding the services potential to create a cohesive solution. Also, economic aspects were taken into account when deciding what to focus on and what to eliminate.
The authors of this thesis, in accordance with Windahl & Lakemond (2006) and Brady et al. (2005), thought it was important to create a total solution with concepts that work together, find which concepts that create synergies and could create a total solution, rather than developing individual services. Consequently, some ideas were eliminated even though they might have been good and had a relevant application area. The eliminated concepts are discussed in this section in order to not be forgotten, and the authors of this thesis hope that some of them might find a suitable application in the future.

**Concepts Classified as Follow-Up services** – Concept 5, 11, 14, 17, 22, 24 and 26 were all classified as follow-up services. Concept 5 and 11 are about controlling the R&M contracts and concept 14 describes a way to detect breaches of contracts, which are interesting for the distributor and dealer. Concept 17, 22, 24 and 26 are more interesting for the distributor and the marketing side of Scania.

When talking to the business development manager, he stated that knowing the market and especially gain a deeper understanding for the second-hand market is important. He also mentioned that the follow-up services were interesting. The reason behind the elimination of these ideas was the limited potential they had to work together with other services. Further, the concepts describe different ways to gain knowledge and evaluate situations, which means that they do not include any actions. Therefore they did not fit together with the potential services.

Even if the ideas were eliminated in this thesis, the authors argue, based on the meeting with the business development manager, that the follow-up services have potential and should be further investigated.

**Concepts Classified as Trigger Services** – Concept 3, 9 and 21 were classified as trigger services, which means that TAS will trigger other services. The reason behind eliminating these concepts, was the lack of potential for further development and the ideas did not contribute to a holistic total solution. The concepts did not include any actions, but did just consist of getting the indication from TAS and draw conclusions. If these concepts had to be further developed, Scania Assistance, Scania Rental and external insurance companies that are included in the three concepts, should participate in a workshop and contribute with feedback on the concepts’ relevance and further ideas on how the concepts could be implemented.

**Other Concepts** – Concept 10: Mixed fleet service, was eliminated because it is an entire new service that does not exist at Scania today and thereby requires further development to be able to see whether it is a good idea or not. Also, the use of TAS in the concept was a bit vague. Since it is already included in the total solution that TAS should trigger sales of different services, the Mixed fleet service could in the future be offered at the same time. Concept 23: Second-hand vehicle database was eliminated because the idea was already included in other ideas: concept 1, 15 and 18.
20 Methodology Discussion

The chosen research plan and the methods used during this thesis are discussed in this chapter.

20.1 Research Plan

Doing a case study, as suggested by Yin (1994), was useful because it helped set the delimitations of the thesis and also made it easier to have something to relate to during the development of TAS. The choice of Scania as case has influenced the study and has affected the outcome, but the authors of this thesis have tried to keep the results general and applicable to all truck OEMs.

In this thesis an established product development process was combined with a process adapted for service development, as described in chapter 2.1. The linear process was familiar to the authors of this thesis, but the agile method was less known. Using a well-known linear method, as described by Ulrich & Eppinger (2008), when creating the main phases for the study, was valuable for the structure of the work. The agile method, described by Adamopoulos et al. (2002), helped when iterating the phases and made the outcome of this thesis more reliable. The reason behind the need of many iterations was because the thesis’ topic was not familiar to the authors of this thesis, and thereby it became necessary to go back to previous phases and redo some activities as more knowledge in the area was gained.

The combination of the two different approaches did fit this study well. Still, as it can be seen in chapter 2.1, the methods had to be modified in order to suit the aim and delimitations with this thesis. By doing so, the work went smoothly and it could be ensured that no activities were forgotten. The downside with combining methods is that the structure of the process is not always clear and easy to follow. When starting to combine different approaches, it sometimes became a bit unclear what the next step would be. The authors of this thesis handled this by spending a lot of time with thinking through the research plan and trying to ensure that it was easy to follow and that suitable theory regarding product and service development processes had been studied. If more time would have been spent on this, more literature about different methods could have been analysed.

20.2 Literature Study

The literature study covered needed topics, and worked as a good basis for the study and for the analysis. Following the five stages suggested by Hart (1998) and the cyclical process suggested by Jesson et al. (2011) was helpful in order to execute a good literature study. By using this methodological way, not so much of the reading had to be redone and thereby time could be saved.

The information search was mostly done by using LiU search, the main reason behind this was because it was hard to get physical books. The search could have been broaden by looking for information from other resources. Even if only LiU search was used, different data bases were accessed and thereby information came from different sources.

Finally if there would have been more time for the literature study, the authors of this thesis could have found more information supporting the theories brought up in this thesis’ theoretical framework. Still, the authors of this thesis emphasise that the theoretical framework was wide enough relative to the topic of this thesis.
20.3 Observation of Truck Drivers

Doing observations gave a good idea of the extreme situations a truck and a driver can experience, though it gave less input regarding the routines and the driving situation in a real haulage contractor. Performing an observation on a real long-haulage driver, and not a truck on a test track, might have given more insight on the actual routines. The result of the observation gave a general picture of the functions and technical parts in the cabin rather than a picture of the usage patterns. The choice to use a partly natural and partly participatory method helped to understand the driver environment and the control panels in the cabin. Asking the driver to “think aloud”, as recommended by Haak et al. (2004), gave an understanding of the procedures. The drivers had never used this method before so they did not go into deep regarding all their actions and thoughts. The reason why just two drivers were observed was that enough information was collected during these two rides.

Using an observation protocol was a good alternative since photographs were not allowed to be taken. Of course it would have been better if the observations were filmed or photographed, but the protocol did work good enough since observations were supposed to give a general idea about how a truck works.

20.4 First Mapping of Characteristics of the Lifecycle Phases

When conducting the interviews the seven stages described by Kvale (1996) helped structure the work and ensure that nothing was forgotten. The seven first interviews could be seen as a test round. Since the authors of this thesis were not completely sure about what information to look for, doing some interviews followed by an analysis was a good way to ensure that the questions and the focus were correct as recommended by Briggs (1986). By doing a black box during the interview phase, as recommended by Adamopoulos et al. (2002) and Mital et al. (2008), the interview questions’ relevance could be evaluated. When doing so, it showed that questions had to be added. By making this in an early stage, interviews did not have to be redone and time could be saved. Without the first seven interviews and the black box method, finding the missing questions would have been hard.

Using a cross table ensured that the interview questions were covering the whole area of the chosen topic. Even though the questions had to be changed after the first analysis of interviews, without using the cross table even more reconstructions of the questions probably would have been necessary. The choice of using the identified characteristics by Vigmo & Sundkvist (2014) in the cross table instead of the research questions, did work well. Since all the interview questions were supposed to help answering to all research questions, more or less directly, a cross table with research questions would have been full of crosses and not so useful. Therefore the solution chosen was better because then the interview result could also be used to validate the findings done by Vigmo & Sundkvist (2014).

20.5 Second Mapping of Characteristics of the Lifecycle Phases

The second interview study was based on the remodelled questions, and became the main basis for the rest of the study. By remodelling the questions a lot of new information was collected, which turned out to be crucial for the findings of the study. The interviews were carried out during a longer period than planned. Most of them were done a few weeks in advance, which gave the authors longer time for analysis.
A difference in approach was noticed after all the interviews were done. The three categories of people interviewed were hauliers, service market salesmen and resellers. Even if the respondents had different backgrounds they still shared the connection to Scania. This homogeneity was important in order to get a good result, also supported by McCracken (1988). The choice of having different questions for different categories was good because they possessed different kind of information. When interviewing the sales managers from other countries the questions were broader and the interview was less structured, this gave the interviewer a better picture of the context. Interesting to notice is also the cultural difference that exist when making appointments with people for the interviews. During interviews with hauliers, the interviewer noted that some of them were trying to answer in the way they thought they were expected to answer. The reason behind this could be that the respondents knew about the questioners’ connection to Scania and therefore tried to answer in favour of Scania. This affected the outcome of the interview and had to be taken into account while analysing the data. It was hard to come around this problem when planning the interviews, since it was important to describe the background of the study when talking to the respondents. One solution could have been to not highlight the connection to Scania and use a more general approach.

If the interview study had to be done again, more international respondents should participate. Conclusions regarding the rest of Europe were based on representatives from Czech Republic, Denmark, Italy, Spain and Poland. To get an even better idea about the business in countries outside Sweden, additional respondents from other countries should have participated in the study. The conclusions regarding countries outside Europe were based on information given from resellers from Europe. The reason behind this was the delimitation of the study saying that the first owner of the vehicle is running a business in Europe. Still, to gain a broader perspective interviewees from countries outside Europe could have been included.

The choice of semi-structures interviews turned out to be an appropriate method and gave the expected results. It was however noticed that in those interviews where the available time was shorter the interviewer did not follow the questions and tried to make broader questions. This resulted in a less structured interview and the level of detail became naturally deeper.

When analysing the interviews, instead of using numbers or letters as suggested by Miles & Huberman (1994), colours were used. This made it easier to see the different themes. Combining a structured method with discussions, that can be considered as unstructured, was a good choice. Just using discussions should have been hard to manage since a great amount of data had to be taken into account. At the same time just using a structured method, would not have left any space for insights and ideas that might have come up during the analysis.

20.6 Parameters Describing the Lifecycle Phase

The method used for creating a phase-DNA was discussion between the two authors of this thesis. The discussion was based on the analysis of the interviews. The description of the phase-DNA could be seen as valid, since the interview studies included a varied population of interviewees and the questions were broad. Of course more data could have been collected to ensure that no information was missed, and also interviews regarding the accuracy of the phase-DNA with experts at Scania could be executed. If the interview process was iterated and adapted to the current description of phase-DNA, the result might have been even more valid. A further discussion regarding the phase-DNA can be seen in chapter 0.
20.7 Translating Parameters into Data

Using group brainstorming generated more ideas than if the authors had a brainstorming by themselves, which is in line with the advantage with the method stressed by Wilson (2013). Especially since the authors did not have so much knowledge about available vehicle data, experts in this area were valuable and generated a big amount of ideas. This can be explained by the fact that the participants were feeling comfortable in the group, and it showed how important it was to have an introduction and ensuring that the group members were relaxed with each other. The plan was to have two more participants so that it in total were seven people with the authors included, which also would contribute to a diversity that is important according to Wilson (2013). The invitation to the group brainstorming was sent three weeks in advance, but it was hard to find a time that suited everybody. Even if the experts were only three, the authors think that a lot of valuable information was gathered. The low number of participant might even have led to people feeling more comfortable in the group and felt that they could share all their ideas without feeling embarrassed.

Using the provocation method, as recommended by De Bono (1995), was valuable when the idea generation started to fade. This encouraged the participants to think outside the box and come up with ideas that were not predictable. Because of the fact that people were feeling comfortable, provocation did not have to be used as much as expected. Affinity diagrams were both useful during the session when the group together organized the ideas into different themes, and afterwards when the authors did it to enable the analysis. By testing different ways to sort the ideas, the most suitable way was found, this gave a good quality to the results.

Since the group brainstorming was scheduled during a certain time, there was not time for having a group discussion and analysis after the brainstorming. To be time efficient just some of the bigger ideas and the identified themes were discussed. This means that the main discussion and analysis was done by the authors themselves, this might have led to the misunderstanding of some ideas. Therefore, if the group brainstorming should be redone, the session should be scheduled for a longer time so that more discussions in the group could take place.

Using affinity diagrams, as recommended by Cheng & Leu (2011), in order to organize and analyse the ideas facilitated the discussion and kept the group brainstorming going. Also it forced the participants to describe their ideas, which minimized the risk of ideas being misunderstood.

20.8 Hypothesis Creation

Creating a hypothesis and test ensured that the translation from characteristics into measurable data was correct. By creating a hypothesis formulated in a simple way, as recommended by Khan (2008), it was easier to conduct the tests. The choice of the eight data types: Distance Driven, Coasting, Run Time, Idle Time, Driver ID, Route Shape, Amount of Stops and Fuel Consumption, was based on the analysis of the group brainstorming and the current data collection at Scania. The fact that the creation of the hypothesis was dependent on what data that was available at Scania was a downside because it limited the possibility to be innovative and come up with a hypothesis with new data.

During the hypothesis creation the idea about using the most frequently visited workshop’s location and finding a “home” location for the truck was directly tested before the real validation. The reason behind testing these two ideas was because the authors already in this early stage had a feeling that these data could be hard to use in the hypothesis. This was a good idea because it ensured that ideas
that were unrealistic did not continue to the real hypothesis validation. This first test could have been done on the rest of the data as well, but it was decided that it was too time consuming.

20.9 Exploratory Analysis of Hypothesis

The first step of the hypothesis validation, which is important according to Khan (2008), was an exploratory analysis. For the validation of the hypothesis vehicles had to be found. This was done by using the register at Scania Used Vehicles. Since a date for the transition phase had to be used, the only possibility was to use the sales date. This means that the validation could just be done on vehicles with change in ownership and vehicles with change in both ownership and utilization. Trucks with just change in utilization could not be studied. If the study was supposed to be redone in the future, a method for finding vehicles with just a change in utilization, and not in ownership, has to be found. One way is to interview different hauliers and try to search for ones that have changed usage area for some of their trucks. This would be a time consuming method, and this is the reason why it was not done in this study.

Since C200 is standard from 2011 and not so many used vehicles on today’s market are equipped with this unit, it was a bit problematic to find appropriate vehicles for the hypothesis validation. The problem was that only vehicles with C200 and with an activated service offering send data to Scania. This lead to the fact that many vehicles had to be taken away during the test when it was shown that data were lacking.

During the first test, it was seen that looking at the whole lifecycle for each vehicle was not a method that was fast enough. Therefore it was decided that it was better to just look at two weeks before and after the sales date. The problem with this was that the amount of collected data was lower than for the whole lifecycle and finding major trends became harder. The authors of this thesis still thought that it was a good decision since it reduced the amount of data, and the time it would have taken to discover a transition phase became shorter.

In the exploratory analysis, visually judging the route shape by looking at maps with the vehicles’ GPS-positions plotted was a rather easy method to use, but the accuracy that all cases were judged on equal conditions was low. The definition of route shape was vague, so differences in result might depend on this. If the hypothesis validation will be conducted on a bigger scale, this method has to be made scalable and route shape has to be precisely defined. It would also be recommended to use a computer program to decide about an eventual change in route shape since this would be time saving and objective.

The decision regarding whether a change in the data type had occurred or not was collected in a table. If it was considered to be a change in a data type for a specific vehicle it was noted with “1” and if no change could be seen it was noted with “0”. As mentioned earlier this was based on a visual judgement, which means that the decision regarding if a data type in a specific case was “0” or “1” might vary a little from case to case. This is due to the fact that the number of participating vehicles in the study was low and it was not possible to find a method for finding exact limits for when a data type was “0” or “1”. To make the validation of the hypothesis more accurate, criteria for the determination have to be determined.
Since the hypothesis validation was done manually, it was time consuming and made it impossible to study a larger number of vehicles. Due to the low number, the hypothesis validation cannot be seen as quantitative but rather qualitative.

**20.10 Statistical Validation of Hypothesis**

The statistical hypothesis testing was a good complement to the exploratory analysis, because it gave a more objective result. This method was meant to be used for validating the results from the exploratory analysis, rather than for getting new results. Calculating the p-value and the confidence interval made it possible to see quantitatively whether the rejection of the null hypothesis was a close decision or not, as suggested by Frost (2015). Following the five steps mentioned by Diez et al. (2010) was helpful since it made it easier to know what to calculate.

The reason why the hypothesis test was just done on the data type Amount of Stops, was because of time constraints and the authors of this thesis wanted to focus on the data type that was most indicative during the exploratory analysis. According to the exploratory analysis, Driver ID was as indicative as Amount of Stops. The hypothesis test used in this thesis was just possible to execute on numerical values, which means that it was not possible to do it on Driver ID since it was a categorical variable.

If the statistical hypothesis testing had to be redone, it would be suitable to check all data types and validate all the results from the exploratory analysis. Then it is important to take into account that the hypothesis test done on Amount of Stops, does not fit all data types. Other data types, like Route Shape and Driver ID, are not numerical and also the normal distribution, described by Diez et al. (2010), cannot be assumed as easily as for Amount of Stops. This means that the hypothesis test has to be adapted to the specific case in order to get a reliable result. Another improvement that could be done on the test is to test a bigger population.

**20.11 Visualisation of Hypothesis**

The choice of using a visualisation method when examining the data type Driver ID was due to the fact that it was a categorical variable that could not be investigated using a statistical hypothesis test. The type of visualisation was chosen based on consultation with a specialist at Scania. No other types of visualisations were considered due to time constraints, this could have been done and the results might have been different.

The visualisation of Driver ID could be compared with the second step in handling big data mentioned by Jagadish et al. (2014). In this stage the data have to be transformed into a format that is suitable for analysis (Jagadish et al., 2014), which is exactly what this visualisation aimed at. The visualisation made it easier to see patterns and for further investigating on some vehicles. If this visualisation had to be done again more trucks should be involved and more time should be spent on the analysis of the results.

**20.12 Implementation of Transition Alert Algorithm**

Using the five steps mentioned by Schmarzo (2013) helped structure the implementation and later the documentation for the patent proposal. Even if it only was a first implementation step, it was possible to follow all five steps and without using them, the communication with the programmer helping with SQL would have been hard. The speed of the development of the implementation was affected by the
fact that the author of this thesis could not develop the code by themselves and had to involve an employee at Scania with knowledge in SQL. Meetings had to be organized and even the smallest changes had to be discussed. Iterating the process worked well, and being three people with different backgrounds helped develop innovative ideas, though the authors of this thesis had less control over the code. Using a different programming language would have been time consuming since SQL is working directly in the database.

If more time was spent on this phase, and the authors of this thesis had learned how to use SQL, it would have been possible to further develop the algorithm and make it more accurate. This would also facilitate more iterations of the process, which might have given more exact results.

20.13 Mapping the System of the Transportation Business

Since the logistics business could be seen as complex, a system map was useful to get an oversight, which was mentioned by Morelli & Tollestrup (2007) and Lindahl et al. (2014) as an advantage with the method. The system map was used when starting the service development, to ensure that all actors and connections were taken into account. Creating the map in an early stage of the development process, was good because it started the idea generation. When deciding which connection to put between which actors, ideas about how connections could be improved and eased came up. When creating the map it showed that it was harder than first thought to find out which actors to involve in the system. Since the truck is an important part, the authors decided to involve the vehicle as an actor. The reason behind this was that information was both sent to and collected from the truck. Because the authors of the thesis thought that there were some more connections that could be created in the future, two of them were added to the system map.

A problem that had to be handled when creating the map, was the level of depth that it should have. The authors decided to just show Scania as producer and developer, but another alternative would have been to show all departments at Scania that have some connection to the flow of information, money, products, service and value. The risk with this, and the reason why it was not done, was that the map should have been too hard to understand.

The second map created when investigating the current system, was the map that describes how a transition phase is detected today. The method used for creating this map was inspired by the theory about system maps described by Morelli & Tollestrup (2007), but it was simplified and only information, service and product flows were shown. The reason behind not showing all flows used in the previous system map, was because value and money was not interesting as the aim was to give an idea about the complexity of today’s work with detecting a transition phase.

20.14 Possible Stakeholders for the Transition Alert System

The search for stakeholders and the making of personas was done by summarizing the problems found during the first and second interview study and during the creation of the system map. Additional interviews were held, but unlike the two previously interview studies, these were unstructured and consisted of four meetings. Having extra interviews, just focusing on stakeholders’ requirements, gave deeper knowledge and eased the development of the transition alert service. The reason why a lot of new information could be gathered by these four interviews was, according to the authors of this thesis, because the meetings were unstructured and gave the respondents space for being spontaneous in their answers. This finding is also supported by Kvale (1996).
The list of stakeholders focused primarily on Scania connected actors, having a more general approach could have given different results. Summarizing the users’ needs in order to create insights about the user and define the product specification was the main purpose of personas, and are mentioned as the advantages with the method described by Goodwin (2009). This could also have been done with different methods e.g. just listing the needs in a table, but by using personas it became easier both for the authors of this thesis and for the readers of this work, to remember and relate to needs. Since the personas in this case had to represent the needs of big and complex organizations e.g. distributors, R&D department and dealers, including a fictional name and a picture in the description of personas as suggested by Guo et al. (2011) and Stickdorn & Schneider (2011) helped creating a character and simplified the work.

20.15 Capture of Needs

Creating a list of requirements was a hard task since it was not a physical product that was supposed to be developed, but a service on a conceptual level. Since the people participating in both first, second and the additional interview study mentioned different kinds of needs, it was decided that the list should consist of five needs that the transition alert service should fulfil. This means that the list became rather short and quite different from the one that both Ulrich & Eppinger (2008) and Adamopoulos et al. (2002) describe.

The reason why the list consisted of needs and not measurable requirements as suggested by Ulrich & Eppinger (2008) and Adamopoulos et al. (2002), was because the service that had to be developed was totally new and the interviewed stakeholders could not express a precise framework or exact requirements that the service should fulfil. The requirements that the authors of this thesis therefore had to relate to were thereby more vague.

20.16 Transition Alert Service Development

The two steps of the development of the transition alert service: idea generation and description of transition alert service are discussed below.

20.16.1 Idea Generation

The idea generation started with the authors of this thesis sketching ideas on how each of the identified needs could be fulfilled. Then the authors tried to see how TAS could ease the fulfilling of the needs. Sketching was useful because it eased the discussion of each idea since it made it easier to explain the idea. Sketching is a method which allows creativity as mentioned by Wilson (2013). Using PMI while sketching, as recommended by De Bono (1982), facilitated remembering the pros and cons with each idea.

After a while of sketching the amount of new ideas started to decrease and then Lego was a good tool to trigger the idea generation again. When being able to build the ideas, and not just sketch them, it was possible to create even more new concepts. The downside with the Lego method was the limited amount of bricks.

A natural step in a product development process is a concept selection, as suggested by Ulrich & Eppinger (2008), Pugh (1990) and Haik & Roy (2005). Since the service development was on a conceptual level and no requirements, but needs from potential stakeholders were used, the
development phase did not have any concept selection as recommended by the literature. Instead by discussing the ideas and finding similarities it was possible to merge them into one final concept.

20.16.2 Description of Transition Alert Service

Getting feedback from the Swedish Scania distributor ensured that the chosen idea was good. Inputs from another person was crucial in order to gain a new perspective and find other solutions. To ensure that the final concept was the best one, more feedback could have been collected e.g. through a focus group with different stakeholders. Still, the authors of this thesis were sure that the design of TAS fulfilled all stakeholders’ needs since they were taken into account from the beginning of the development of TAS.

The creation of the blueprints followed the recommendations from Bullinger et al. (2003), Fließ & Kleinaltenkamp (2004) and Shostack (1984). This eased the work since the authors of this thesis had something to compare the created blueprints with and it ensured that nothing was forgotten. During the creation of the blueprint it was hard to define which user to focus on. First the distributor was put as the user, but this made the other categories less logic and the flow was hard to follow. Finally the haulier was set as the user, dealer as front stage and distributor in the back stage, which made the blueprint easier to read. All these procedures helped to organize actors and the actions between them, as Bullinger et al. (2003) mention helps modelling the service. What also became very clear by doing the service blueprint were the areas of improvement. Another method that could have been used to display the service is e.g. customer journey, but this method would not have shown all the activities that are happening in the background.

20.17 Possible Applications of Transition Alert Service

In this section the three different activities done during the generation of possible applications of TAS are discussed. Using more than one method and involving different people, gave a width on the ideas that would not have been possible to create in another way. Finally the method for concept selection is analysed.

20.17.1 Brainstorming

Just as mentioned in chapter 20.16.1, using sketching, PMI and Lego was really helpful for the creativity. Compared to the previous idea generation, when the transition alert service was developed, this phase enabled more creativity and “thinking outside the box” and therefore the methods were even more valuable in this step.

Other methods for the brainstorming could have been used, but since ideas on applications came up during the brainstorming regarding the development of TAS the two idea generations could be seen as done partly at the same time. Therefore the methods used were the same during the both brainstorming sessions.

20.17.2 Workshop with Distributor

Having a workshop session with the distributor was valuable for the result of this phase. Since the distributor has a good knowledge about the dealers and the problems that occur with service contracts, the meeting gave a good input to the work. Many of the ideas that came up during the brainstorming done by the authors of this thesis involved the distributor and therefore is was good to get an opinion on the concepts already created. During the workshop totally new ideas came up, which
was a sign of the importance of the involvement of the distributor. The reason behind that many new ideas came up, could be that the workshop followed the recommendations on lateral thinking by De Bono (1970) which let ideas lead to new ideas. If the workshop had to be done again, it would be good to involve dealers since they are important actors.

20.17.3 Workshop with Experts at Scania

During the workshop with the experts at Scania a lot of new ideas were created, but also ideas that the authors of this thesis already had thought of which means that these ideas were important. Using the method by Pavey (2015) called Round Robin enabled all the participants to express their ideas but also give input to other’s ideas.

The number of participants during the workshop was low, three people. This was because it was impossible to find a date were more people could take part. If the workshop had to be redone, more participants from different departments should join to get a broader perspective, as recommended by Wilson (2013). Because of the low number of participants, the authors of this thesis had to be a part of the idea generation as well and not just observing. Since it was only five people participating, the authors included, one hour was enough.

20.17.4 Concept Selection

Doing a concept selection without having a well-defined goal, was a bit different than the concept selections described in the literature by Ulrich & Eppinger (2008), Pugh (1990) and Haik & Roy (2005). Using a design critique instead, as suggested by Berkun (2009), was helpful because the authors of this thesis understood that a method still had to be used in order to bring structure to the concept selection. The meeting with the business analyst and the business development manager, gave new perspectives and enabled to decide which concepts that were most interesting for Scania and other long-haulage OEMs.

The concept selection took much time, and this was because the authors of this thesis tried to evaluate the concepts in different ways by changing the ways of organizing them. Using an agile approach and iterate the concept selection made it easier to evaluate the first ideas, generate new ones and evaluate again. Using sticky notes and moving around the different concepts creating different flows, was very helpful. Finally, the decisions were always based on a discussion. This means that the total solution was influenced by the authors’ thoughts.

If the concept selection was supposed to be done again, it could be helpful to consult more experts in the long-haulage field in order to get an even broader perspective. Also, if there would have been time, focus groups could have been used in order to evaluate the total solution.
21 Concluding Discussions and Conclusions

Conclusions from the study are presented below by answering each research question. Finally, recommendations for future work are presented.

21.1 RQ1 – Definition of Transition Phase

The transition phase was defined as the period between one lifecycle phase and the following one, when the vehicle changes owner, utilization or both at the same time. It is the time when the ownership of the vehicle changes from the first owner to the second owner, the second owner to the third, and so on. It could also be the period when the truck changes from its intended original use to a new application. Looking at just change in ownership is not enough, since change in utilization can occur within the same business.

The lifecycle phases were divided into two categories: type A and B. Type A are lifecycle phases where the truck still could benefit from services offered by the OEM and when the vehicle is used in a professional transportation business. Type B are lifecycle phases near to end of life where the truck no longer would benefit from the OEM’s service offerings and the vehicle is no longer used in a professional transportation business. This means that a truck in phase B is not the primary source of income. If a truck is in a transition phase between type A and B, there is no longer a need to offer services to the owner. Defining the exact limits for the transition between type A and B is difficult. Scania expressed that the identification of these had low priority and this thesis’ main focus was to detect a transition in phase A. Therefore, this was left for further studies.

21.2 RQ2 – Identifying a Transition Phase Based on Usage Pattern

Every lifecycle phase of a truck is different and can be described by using certain parameters connected to the usage pattern. The combination of parameters was named phase-DNA and is composed by six parameters: Geography, Route, Traffic Condition, Driver, Assignments and Services. The content in these parameters is unique for each truck in each lifecycle phase. Looking at changes in the value of these parameters, it will be possible to detect a transition phase.

Going from short to long distances and vice versa and changes in amount of average stops during a day, could indicate that the truck has changed its usage area. If the vehicle changes owner it will probably be driven by new chauffeurs, which means that the driver IDs and driving style change. New drivers, do not always mean that there is a new owner, but it could indicate a change in utilization. If the utilization is changed, the roads that the vehicle drives on and the amount of traffic on these roads might change. This will affect the average speed and amount of stops of the vehicle. If there is a change in usage of the truck it will be seen in new assignments. Changing business or just changing utilization of the truck will lead to different goods handled by the vehicle, also a change in vehicle weight and body work. Depending on the type of business, there is a different need of services. Changes in the services supplied by the OEM could be an indicator of a transition phase.

To sum up, a change in one of these parameters does not mean that a transition phase has occurred, but a change in a few of them at the same time is an indicator of a transition phase.
21.3 RQ3 – Data Needed to Identify a Transition Phase

The six parameters that are part of the phase-DNA were translated into six types of measurable data in order to detect at transition phase. According to the results of an exploratory analysis and a statistical hypothesis test, Amount of Stops and Driver ID were the two data types that appeared to be most indicative. Driver ID was used in order to detect a change in ownership and Amount of Stops could both indicate a change in ownership and/or in utilization. Further, Run Time, Distance Driven, Idle Time and Route Shape were the second most indicative data types. These could be used for supporting the indication of a transition phase.

These types of data are today collected at Scania by FMS, and similar systems can be found at other long-haulage brands. The accessibility is the main reason why these data were chosen, and this means that in the future with expanded telematics, it would be possible to investigate other types of data for detecting a transition phase.

21.4 RQ4 – Design of the Transition Alert Service

The transition phase alert service (TAS) fulfils the five main needs identified from the stakeholder: ease start and cancellation of services, avoid unnecessary telecom expenses, avoid that information goes to the wrong customer, find new customers and customize services. In order to solve this, an algorithm detecting a transition phase was developed; it was done by searching for changes in the six data types: Driver ID, Amount of Stops, Run Time, Distance Driven, Idle Time and Route Shape. Depending on if the TAS indicates a change in ownership or only a change in vehicle utilization, the following steps differ.

In the case of a change in ownership, the FMS contract date is compared with the date for the transition phase detected by TAS. If the FMS contract is older than the TAS date, it means that the contract maybe still is registered on the previous owner, and the distributor can terminate the contract. The distributor has to inform the dealer that the vehicle has a new owner and that he/she might need services. This solves the problem with vehicle information going to the wrong customer, eases the start and cancellation of services and avoids unnecessary telecom expenses.

If TAS indicates a change in ownership and there is no FMS contract anymore, it means that there is a service sales opportunity for the dealer. This is a solution for finding new customers and ease the start of new contracts. Also, it becomes easier to customize the service offerings, since the dealer already before contacting the customer knows that it is a second-hand vehicle that needs other services than a new vehicle.

The last scenario is that TAS indicates a change in utilization only. Then the TAS date will be the same as the FMS contract date. Still there is a business opportunity for the dealer, since services more suited for the new business area can be offered. This is a way to find new customers and customize the services. It can also be seen as fulfilling the need of easing the start and the cancelation of services, since it makes it easier to find opportunities to start new services.

21.5 RQ5 – Applications for the Transition Alert Service

In total twelve applications for the transition alert service were developed: nine connected to change in ownership, two connected to change in utilization and one service used to be able to offer the other services. The latter was named Vehicle History and is based on collected historical TAS, both changes
in ownership and utilization, in order to be used to get information about a vehicle’s life. The services connected to change in ownership were divided into before, during and after the owner change. Services classified as before, are offerings that help the customer find the most suitable truck. Services described as during, help with the financing and valuation of the vehicle. Services after the change in ownership are offerings that enable the haulier to find new customers, sell services and keep the right spare parts in stock. Further, one service eases the process when big logistic companies hire hauliers. Connected to change in utilization one service helps the dealer to detect and handle if a customer has a wrong specified vehicle, and the second one is a service for tracking lost and stolen trucks.

Further, one total solution named “No Worries Second-Hand” was developed that includes five of the developed services. This total solution offers the customer the perfectly suitable second-hand truck without having to spend time searching for it. It also consists of a contract saying that if the customer signs a R&M contract, the dealer will buy back the vehicle and offer a new used vehicle when the old one gets too old or used. TAS makes this total solution possible by giving the dealer access to information about the truck and through this predict phase transitions.

21.6 Recommendations for Future Work

In the definition of transition phase two types of transition phases were presented: type A and B. The authors of this thesis decided to not define the exact limit between type A and B, based on the fact that Scania expressed the identification of this limit to be low priority and since the main focus of this thesis was to detect transition phases within type A. In order to be able to develop the transition phase alert service more and make it more accurate, it would be necessary to define the exact difference between type A and B. This would make the TAS algorithm more efficient, screening out all vehicles in phase B before controlling the six data types for identification of transition phases. Another recommendation in this area, is to investigate the assumption of type B not being interesting for OEMs.

Instead of using interview studies when searching for usage patterns and later translate them into measurable data, a purely statistical and analytical approach, analysing vehicle data, could have been used. This would probably give different results than presented in this thesis.

The validation of the hypothesis was based on an exploratory and a statistical test on eight random vehicles, and in order to control the result it would benefit from a quantitative validation as well. The recommendation is to find an automatic solution for testing the hypothesis on a large number of unknown vehicles, in order to get a more quantifiable result. Further, the statistical hypothesis test was just done on the data type Amount of Stops, since it was the most indicative numerical variable. Further recommendations is to conduct hypothesis tests for the rest of the data types, both the numerical and categorical ones.

When investigating the TAS algorithm, only the data type Driver ID was implemented. The test of the algorithm was finished before acceptable results could be achieved, because of time constraints. Therefore it cannot be said whether the algorithm works in practice or not. The recommendation is that the algorithm should be further developed implementing all six data types. This work would benefit from an agile approach: programming a first prototype, test, evaluate and improve, creating second prototype, and so on. Another recommendation is to further develop the TAS indication on change in ownership (T1) and change in utilization (T2). Today, there is only the data type Driver ID that describes T1, which cannot give a sure answer. One solution could be to investigate whether a
certain combination of the data types could be used for detecting a transition phase. Furthermore it can be discussed whether it is a relevant conclusion to divide TAS in T1 and T2. It might be easier to develop a working algorithm by looking at nonspecific transition phases.

Possible applications for TAS were presented on a conceptual level excluding technical descriptions, economical calculations and implementation plans, due to the delimitations of this thesis. To be able to take these ideas further, the aspects previously mentioned also have to be taken into account. Also, the concepts described are not the only possible applications and therefore the development of more concepts could continue. During the idea generation a lot of ideas that did not fit into the total solution were eliminated. According to discussions with internal specialists at Scania the ideas had potential, the recommendation is therefore to further examine these concepts in order to find a suitable application area.
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23 Appendix

Appendix A………………………..Observation of Truck Driver Protocol Template

Appendix B………………………..Interview Questions Haulier

Appendix C………………………..Interview Questions Salesperson Service Market

Appendix D………………………..Interview Questions Reseller

Appendix E………………………..New Interview Questions Reseller

Appendix F………………………..Cross Table Interview Questions

Appendix G………………………..Interviews with Hauliers

Appendix H………………………..Interviews with Salespersons Service Market

Appendix I………………………..Interviews with Resellers

Appendix J………………………..Result of Group Brainstorming Translating Parameters into Data

Appendix K………………………..Visualisations from the Hypothesis Validation

Appendix L………………………..Brainstorming on Transition Alert Service

Appendix M………………………..Brainstorming on Possible Applications
### Appendix A – Observation of Truck Driver Protocol Template

<table>
<thead>
<tr>
<th>Activities</th>
<th>Before driving</th>
<th>During driving</th>
<th>After driving</th>
</tr>
</thead>
</table>

- Are there any unique actions or settings done when using a new truck for the first time?
- Are there any unique actions or settings done when using a truck for the last time before it is sold?
Appendix B – Interview Questions Haulier

Introduction

1. Could you briefly describe the company and the business idea?
2. What are your work tasks?
3. How is your relation to Scania?
4. Where do you buy your trucks?

Business related

5. How many trucks do you have in your fleet?
6. What kind of trucks do you have in your fleet?
7. Are you using new or second-hand trucks, percentage?
8. Do you only have Scania trucks?
   a. If no, which other brands do you have, percentage?
9. How do you handle the driving schedule?
   a. How do you follow up the driving schedule?
10. What time margins are there when delivering goods?
11. How are delays handled?
12. How is the ratio between fuel consumption, driver salary, truck cost and charge for delivery delays?
13. How often are the trucks changing driver?
14. How many hours are the trucks running during a day?
   a. How much are they standing still?

Vehicle related

15. What functions are prioritized when buying a new truck?
   a. Which are not prioritized?
16. What functions are prioritized when buying an old truck?
   a. Which are not prioritized?
17. What functions are today added retrospectively on a new truck?
18. Which functions are today added retrospectively on an old truck?

19. Which service offerings do you have on your new trucks?

20. Which service offerings do you have on your old trucks?

21. Are the service offerings used to their maximum?
   a. Which parts of the service offerings are not used?

22. Which are the parameters that a first owner considers when selling a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

23. Which are the parameters that a first owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

24. Which are the parameters that a second owner considers when selling a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

25. Which are the parameters that a second owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

26. If a truck is broken, do you have a spare truck or do you wait until it is repaired?

27. With what kind of problems do you turn to an OEM? [new/second-hand]

28. With what kind of problems do you turn to a non-OEM? [new/second-hand]

29. Do you use original spare parts or substitutes? [new/second-hand]

30. What problems do you solve by yourself? [new/second-hand]

31. Which types of problems are ignored and not solved? [new/second-hand]

**Driver related**

32. How do the drivers influence the purchase of a truck? [new/second-hand]

   a. What do they influence?

33. How often do you have contact with the driver during a day?

34. How do you communicate with the driver? [sms, telephone, GPS] [new/second-hand]
   a. Who takes the initiative to contact?
b. What information is communicated?

35. How eager are the drivers to inform you about eventual problems? [new/second-hand]

36. What is the drivers’ attitude to FMP?

37. Which functions and services are used by the driver in a new truck?
   a. What is not used?

38. Which functions and services are used by the driver in a new truck?
   a. Which are not used?

39. How important is driver comfort when purchasing a truck? [new/second-hand]
   a. Which are high priority?

40. What kind of problems do drivers usually complain about? [new/second-hand]
   a. What is high priority?

41. Which improvement areas are there concerning driver comfort?

Others

42. What kind of user data should be collected, but is not collected today?

43. Is there anything else you would like to add?

44. Can we contact you again if we have additional questions?
Appendix C – Interview Questions Salesperson Service Market

Introduction

1. What are your work tasks?

Business related

2. What kind of customers buy new trucks?

3. What kind of customers buy old trucks?

4. What differences are there between first and second-hand owner when it comes to the use of the truck?

5. How does Scania Approved work?

Vehicle related

6. Which functions are prioritized when buying a new truck?
   a. Which are not prioritized?

7. Which functions are prioritized when buying an used truck?
   a. Which are not prioritized?

8. Which functions are added retrospectively on a new truck?

9. Which functions are added on retrospectively on an used truck?

10. Which services are mostly sold to the first owner?

11. Which services are mostly sold to the second owner?

12. Which are the parameters that a first owner considers when selling a truck? [time, value, mileage, problems]
    a. If many, how is the connection between these parameters?

13. Which are the parameters that a first owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
    a. If many, how is the connection between these parameters?

14. Which are the parameters that a second owner considers when selling a truck? [time, value, mileage, problems]
    a. If many, how is the connection between these parameters?

15. Which are the parameters that a second owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
    a. If many, how is the connection between these parameters?
16. Have you noted any differences between first and second truck owners regarding the frequency of controls performed by an OEM?

17. With what kind of problems are the customers turning to an OEM for? [new/second-hand]

18. What kind of problems are ignored and not solved by the customer? [new/second-hand]

**Driver related**

19. How do drivers influence the purchase of a truck? [new/second-hand]
   a. What do they influence?

20. What do the drivers communicate in case of problems with the truck? [new/second-hand]


22. What is the drivers’ attitude to FMP? [new/second-hand]

23. What are the most common reported problems among first owners?

24. What are the most common reported problems among second owners?

25. Have you seen any difference between new and used trucks regarding the use of high-tech solutions?

26. How important is driver comfort when purchasing a truck? [new/second-hand]
   a. What is high priority?

27. What kind of problems do drivers usually complain about? [new/second-hand]
   a. What is high priority?

28. Which improvement areas are there concerning driver comfort? [new/second-hand]

**Others**

29. What kind of user data, that is not collected today, should be collected?

30. Is there anything else you would like to add?

31. Can we contact you again at the event of additional questions?
Appendix D – Interview Questions Reseller

Introduction

1. Could you briefly describe the company and the business idea?
2. What are your work tasks?
3. How is your relation to Scania?
4. Vilka typer av lastbilar säljer ni?
5. Do you only have Scania?
   a. If no, what other brands do you have?
6. Are you selling new or old trucks?
   a. If yes old trucks, what is the reason behind customers selling back old trucks?

Business related

7. What kind of customers buy new trucks?
8. What kind of customers buy old trucks?
9. What differences are there between first and second-hand owner when it comes to the use of the truck?
10. How does Scania Approved work?

Vehicle related

11. What functions are prioritized when buying a new truck?
    a. Which are not prioritized?
12. What functions are prioritized when buying an used truck?
    a. Which are not prioritized?
13. What functions are added retrospectively on a new truck?
14. What functions are added retrospectively on an used truck?
15. Which services are mostly sold to first owners?
16. Which services are mostly sold to second owners?
17. Which are the parameters that a first owner considers when selling a truck? [time, value, mileage, problems]
a. If many, how is the connection between these parameters?

18. Which are the parameters that a first owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

19. Which are the parameters that a second owner considers when selling a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

20. Which are the parameters that a second owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

21. With what kind of problems are customers turning to an OEM? [new/second-hand]

22. What kind of problems are ignored and not solved by the customers? [new/second-hand]

**Driver related**

23. How do drivers influence the purchase of a truck? [new/second-hand]
   a. What do they influence?

24. How often have drivers and the hauliers contact during a day?

25. How do they communicate? [sms, telephone, GPS]
   a. Who takes initiative to contact?
   b. What is communicated?

26. How eager are the drivers to inform about eventual problems? [new/second-hand]

27. How do drivers feel about FMP? [new/second-hand]

28. How important is driver comfort when purchasing a truck? [new/second-hand]
   a. What is high priority?

29. What kind of problems do drivers usually complain about? [new/second-hand]
   a. What is high priority?

30. Which improvement areas are there concerning driver comfort?

**Others**

31. What kind of user data, that is not collected today, should be collected?

32. Is there anything else you would like to add?

33. Can we contact you again at if we have additional questions?
Appendix E – New Interview Questions Reseller

Introduction

1. Could you briefly describe the company and the business idea?

2. What are your work tasks?

3. How is your relation to Scania?

4. What kind of vehicles do you sell?

5. Do you only have Scania?
   a. If no, what other brands do you have?

6. Are you selling new or old trucks?
   a. If yes old trucks, what is the reason behind customers selling back old trucks?

Business related

7. What kind of customers buy new trucks?

8. What kind of customers buy old trucks?

9. What differences are there between first and second-hand owner when it comes to the use of the truck?

10. How does Scania Approved work?

Vehicle related

11. Which functions are prioritized when buying a new truck?
   a. Which are not prioritized?

12. Which functions are prioritized when buying an used truck?
   a. Which are not prioritized?

13. Which functions are added retrospectively on a new truck?

14. Which functions are added on retrospectively on an used truck?

15. Which services are mostly sold to first owners?

16. Which services are mostly sold to second owners?

17. Which are the parameters that a first owner considers when selling a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?
18. Which are the parameters that a first owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

19. Which are the parameters that a second owner considers when selling a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

20. Which are the parameters that a second owner considers when shifting the primary application area of a truck? [time, value, mileage, problems]
   a. If many, how is the connection between these parameters?

21. With what kind of problems are customers turning to an OEM? [new/second-hand]

**Driver related**

22. How do drivers influence the purchase of a truck? [new/second-hand]
   a. What do they influence?

23. How important is driver comfort when purchasing a truck? [new/second-hand]
   a. What is high priority?

24. What kind of problems do drivers usually complain about? [new/second-hand]
   a. What is high priority?

**Transition Phase**

1. How does the sales process work for a used vehicle?

2. What happens from the moment the truck stops being used by the first hand owner to the moment when the second-hand owner starts using the truck?
   a. How much time does it take?

3. How is the truck used during the transition phase from first to second owner? [e.g. driving distance]

4. Which services are done to the truck during the transition phase from first to second owner?

5. Is there any change of technology during the transition phase from first to second owner?

6. What happens with the FMS during the transition phase from first to second owner?

7. Which actors are included in the transition phase from first to second owner?

8. How does the vehicle change its geographical position during the transition phase from first to second owner?
Others

25. What kind of user data, that is not collected today, should be collected?

26. Is there anything else you would like to add?

27. Can we contact you again at if we have additional questions?
Appendix F – Cross Table Interview Questions

<table>
<thead>
<tr>
<th>Interview Questions Haulier</th>
<th>B1</th>
<th>B2</th>
<th>V1</th>
<th>V2</th>
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<th>D1</th>
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<tr>
<td>1. Could you briefly describe the company and the business idea?</td>
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<td>2. What are your work tasks?</td>
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<td>3. How is your relation to Scania?</td>
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<td>4. Where do you buy your trucks?</td>
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<td>5. How many trucks do you have in your fleet?</td>
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<td>6. What kind of trucks do you have in your fleet?</td>
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<td>7. Are you using new or second-hand trucks, percentage?</td>
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<td>8. Do you only have Scania trucks?</td>
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<td>a. If no, which other brands do you have, percentage?</td>
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<td>9. How do you handle the driving schedule?</td>
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<td>a. How do you follow up the driving schedule?</td>
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<td>10. What time margins are there when delivering goods?</td>
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<td>11. How are delays handled?</td>
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<td>12. How is the ration between fuel consumption, driver salary, truck cost and charge for delivery delays?</td>
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<td>13. How often are the trucks changing driver?</td>
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<td>14. How many hours are the truck running during a day?</td>
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<td>a. How much is it standing still?</td>
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<td>15. What functions are prioritized when buying a new truck?</td>
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<td>16. What functions are prioritized when buying an old truck?</td>
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<td>17. What functions are today added retrospectively on a new truck?</td>
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<td>18. What functions are today added retrospectively on an old truck?</td>
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<td>19. Which service offerings do you have on your new trucks?</td>
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<td>20. Which service offerings do you have on your old trucks?</td>
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<td>21. Are the service offerings used to its maximum?</td>
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<td>a. Which parts of the service offerings is not used?</td>
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<td>22. Which are the parameters that a first owner considers when selling a truck?</td>
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<td>a. If many, how is the connection between these parameters?</td>
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<td>23. Which are the parameters that a first owner considers when shifting the primary application area of a truck?</td>
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<td>a. If many, how is the connection between these parameters?</td>
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<td>24. Which are the parameters that a second owner considers when selling a truck?</td>
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<td>a. If many, how is the connection between these parameters?</td>
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<td>25. Which are the parameters that a second owner considers when shifting the primary application area of a truck?</td>
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<td>a. If many, how is the connection between these parameters?</td>
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<td>26. If a truck is broken, do you have a spare truck or do you wait until it is repaired?</td>
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<td>27. With what kind of problems do you turn to an OEM? [new/second-hand]</td>
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<td>28. With what kind of problems do you turn to a non-OEM? [new/second-hand]</td>
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| 29. Do you use original spare parts or substitutes? [new/second-hand]  | | | x
| 30. What problems do you solve by yourself? [new/second-hand]          | | | x
| 31. Which types of problems are ignored and not solved? [new/second-hand] | | | x
| Driver related                                                         | | | |
| 32. How do the drivers influence the purchase of a truck? [new/second-hand] | | | x
| a. What do they influence?                                             | | | x
| 33. How often do you have contact with the driver during a day?        | | | x
| 34. How do you communicate with the driver? [new/second-hand]          | | | x
| a. Who takes the initiative to contact?                                | | | x
| b. What information is communicated?                                   | | | x
| 35. How eager are the drivers to inform you about eventual problems? [new/second-hand] | | | x
| 36. What is the drivers' attitude to FMP?                             | | | x
| 37. What functions and services are used by the driver in a **new** truck? | | | x
| a. What is not used?                                                   | | | x
| 38. What functions and services are used by the driver in an **old** truck? | | | x
| a. What is not used?                                                   | | | x
| 39. How important is driver comfort when purchasing a truck? [new/second-hand] | | | x
| a. What is high priority?                                              | | | x
| 40. What kind of problems do drivers usually complain about? [new/second-hand] | | | x
| a. What is high priority?                                              | | | x
| 41. Which improvement areas are there concerning driver comfort?       | | | x
| Others                                                                 | | | |
| 42. What kind of user date should be collected, but is not collected today? | | | x
| 43. Is there anything else you would like to add?                      | | | x
| 44. Can we contact you again at the event of additional questions?     | | | x

169
Focus on delivery precision  |  High frequency use  |  Technically advanced functions  |  Vehicle reliability  |  Turn to OEM for R&M  |  Loyalty towards the owner and the business  |  Incentive to use technical devices in the driver environment  |  Focus on the driver’s working situation and comfort  |  Others

**Interview Questions Salesperson Service Market**

1. What are your work tasks?  
   - **Business related**
   - **Vehicle related**

2. What kind of customers buy *new* trucks?  
3. What kind of customers buy *old* trucks?  
4. What differences are there between first and second-hand owner when it comes to the use of the truck?  
5. How does Scania Approved work?  
   - **Vehicle related**

6. What functions are prioritized when buying a *new* truck?  
   - a. Which are not prioritized?  
7. What functions are prioritized when buying an *used* truck?  
   - a. Which are not prioritized?  
8. What functions are added retrospectively on a *new* truck?  
9. What functions are added on retrospectively on an *used* truck?  
10. Which services are mostly sold to the *first owner*?  
11. Which services are mostly sold to the *second owner*?  
12. Which are the parameters that a *first owner* considers when selling a truck?
13. Which are the parameters that a *first owner* considers when shifting the primary application area of a truck?  
   a. If many, how is the connection between these parameters?  

14. Which are the parameters that a *second owner* considers when selling a truck?  
   a. If many, how is the connection between these parameters?  

15. Which are the parameters that a *second owner* considers when shifting the primary application area of a truck?  
   a. If many, how is the connection between these parameters?  

16. Have you noted any differences between first and second truck owners regarding the frequency of controls performed by an OEM?  
   a. If many, how is the connection between these parameters?  

17. With what kind of problems are the customer turning to an OEM for? [new/second-hand]  
   a. If many, how is the connection between these parameters?  

18. What kind of problems are ignored and not solved by the customer? [new/second-hand]  
   a. If many, how is the connection between these parameters?  

19. How do drivers influence the purchase of a truck? [new/second-hand]  
   a. What do they influence?  

20. What do the drivers communicate in case of problems with the truck? [new/second-hand]  
   a. What do they communicate?  

   a. What do they communicate?  

22. What is the drivers’ attitude to FMP? [new/second-hand]  
   a. What is high priority?  

23. What are the most common reported problems among *first owners*?  
   a. If many, how is the connection between these parameters?  

24. What are the most common reported problems among *second owners*?  
   a. If many, how is the connection between these parameters?  

25. Have you seen any difference between new and used trucks regarding the use of high-tech solutions?  
   a. If many, how is the connection between these parameters?  

26. How important is driver comfort when purchasing a truck? [new/second-hand]  
   a. What is high priority?  

27. What kind of problems do drivers usually complain about? [new/second-hand]  
   a. What is high priority?
28. Which improvement areas are there concerning driver comfort?  

<table>
<thead>
<tr>
<th>Others</th>
<th>Focus on delivery precision</th>
<th>High frequency use</th>
<th>Technically advanced functions</th>
<th>Vehicle reliability</th>
<th>Turn to OEM for R&amp;M</th>
<th>Loyalty towards the owner and the business</th>
<th>Incentive to use technical devices in the driver's environment</th>
<th>Focus on the driver's working situation and comfort</th>
<th>Vehicle condition</th>
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29. What kind of user data, that is not collected today, should be collected?  

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30. Is there anything else you would like to add?  

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31. Can we contact you again at the event of additional questions?  

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**Interview Questions**

**Reseller**

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1. Could you briefly describe the company and the business idea?  

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2. What are your work tasks?  

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3. How is your relation to Scania?  

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4. Vilka typer av lastbilar säljer ni?  

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5. Do you only have Scania?  

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<th>Others</th>
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a. If no, what other brands do you have?  

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<th>Others</th>
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6. Are you selling new or old trucks?  

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<th>Others</th>
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a. If old trucks, what is the reason behind customers selling back old trucks?  

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<th>Others</th>
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**Business related**

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<tr>
<td>Question</td>
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<tr>
<td>What kind of customers buy <em>new</em> trucks?</td>
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<tr>
<td>What kind of customers buy <em>old</em> trucks?</td>
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<tr>
<td>What differences are there between first and second-hand owner when it comes to the use of the truck?</td>
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<tr>
<td>How does Scania Approved work?</td>
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**Vehicle related**

<table>
<thead>
<tr>
<th>Question</th>
<th>Mark</th>
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<tr>
<td>What functions are prioritized when buying a <em>new</em> truck?</td>
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<td>Which are not prioritized?</td>
<td>x x</td>
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<td>What functions are prioritized when buying an <em>used</em> truck?</td>
<td>x x</td>
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<tr>
<td>Which are not prioritized?</td>
<td>x x</td>
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<tr>
<td>What functions are added retrospectively on a <em>new</em> truck?</td>
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<tr>
<td>What functions are added retrospectively on an <em>used</em> truck?</td>
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<tr>
<td>Which services are mostly sold to <em>first owners</em>?</td>
<td>x</td>
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<td>Which services are mostly sold to <em>second owners</em>?</td>
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<td>What are the parameters that a <em>first owner</em> considers when selling a truck?</td>
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<td>If many, how is the connection between these parameters?</td>
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<tr>
<td>What are the parameters that a <em>first owner</em> considers when shifting the primary application area of a truck?</td>
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<td>If many, how is the connection between these parameters?</td>
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<tr>
<td>What are the parameters that a <em>second owner</em> considers when selling a truck?</td>
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<td>If many, how is the connection between these parameters?</td>
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<td>What are the parameters that a <em>second owner</em> considers when shifting the primary application area of a truck?</td>
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<td>a.</td>
<td>If many, how is the connection between these parameters?</td>
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<td>21.</td>
<td>With what kind of problems are customers turning to an OEM? [new/second-hand]</td>
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<td>22.</td>
<td>How do drivers influence the purchase of a truck? [new/second-hand]</td>
</tr>
<tr>
<td>a.</td>
<td>What do they influence?</td>
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<td>23.</td>
<td>How important is driver comfort when purchasing a truck? [new/second-hand]</td>
</tr>
<tr>
<td>a.</td>
<td>What is high priority?</td>
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<td>24.</td>
<td>What kind of problems do drivers usually complain about? [new/second-hand]</td>
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<td>a.</td>
<td>What is high priority?</td>
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<td>Transition phase</td>
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<td>25.</td>
<td>How does the sales process work for a used vehicle?</td>
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<td>26.</td>
<td>What happens from the moment the truck stops being used by the first hand owner to the moment when the second-hand owner starts using the truck?</td>
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<td>a.</td>
<td>How much time does it take?</td>
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<td>27.</td>
<td>How is the truck used during the transition phase from first to second owner?</td>
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<tr>
<td>28.</td>
<td>Which services are done to the truck during the transition phase from first to second owner?</td>
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<td>29.</td>
<td>Is there any change of technology during the transition phase from first to second owner?</td>
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<td>30.</td>
<td>What happens with the FMS during the transition phase from first to second owner?</td>
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<td>31.</td>
<td>Which actors are included in the transition phase from first to second owner?</td>
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<tr>
<td>32.</td>
<td>How does the vehicle change its geographical position during the transition phase from first to second owner?</td>
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<tr>
<td>Others</td>
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<td>33. What kind of user data, that is not collected today, should be collected?</td>
<td>X</td>
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<tr>
<td>34. Is there anything else you would like to add?</td>
<td>X</td>
</tr>
<tr>
<td>35. Can we contact you again at if we have additional questions?</td>
<td>X</td>
</tr>
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Appendix G – Interviews with Hauliers

Respondent A

Background

The respondent is a business owner at a Swedish distribution company. The business transports goods from producers and wholesalers to supermarket chains within an area with a radius of 200 km. The transportation is mainly goods demanding refrigerator and freezer units.

Business related

The company only buys new trucks and has 70 trucks and 130 employees. Most of the trucks are distribution trucks, 15 of them are ethanol vehicles. 70% of the fleet is Scania, 25% is Volvo and the rest is MAN. The driving schedule is made by the traffic management team. An order comes from the customer and then the traffic managers create routes for the different drivers. Usually the driving schedule for next morning is planned in the afternoon the day before. During the day the driving schemes are always modified. Some of the clients are doing the whole driving scheme themselves and some do not. It is up to the driver to follow the time margins and usually the margins are ± one hour. Delays are important to avoid and there can be fines. The respondent mentioned that the business is really complex and no system in the world can handle the scheduling perfectly. There are too many soft variables like the drivers’ daily emotional state, traffic and the weather that affects how well the truck can stick to its schedule.

Some trucks are driven by the same driver all the time, some vehicles have two to three drivers and some even have 40 people driving. The distribution trucks are running one shift a day and the long-haulage trucks are driving 24 hours a day. The distribution trucks have less driving hours because of the small driving distances and the high frequency of loading and unloading. The vehicles are driving around 30 000 km each year and handle 1000 orders each day. The amount of destinations during a day is approximately 20 for each vehicle.

Vehicle related

The most important factor when buying a new truck is that it works on the aftermarket. Very rarely, it happens that the company buys an used truck if there is an urgent demand on an extra vehicle. The used trucks that are bought are usually old Scania rental trucks. There are not so many technical functions added to the truck, the drivers use their smart phones for GPS and communication. The Scania service offerings used are those that are for free and other brand’s systems are used for order handling and time reports. 35 of the trucks have the remote download.

The trucks are used until they are eight years or older. After this the truck is either traded in when a new vehicle is bought or it is sold to a company that exports vehicles to Iraq. The company does not have any spare vehicles if a truck breaks down. All the vehicles have repair and maintenance contracts. The business has its own workshop and Scania mechanics visits this workshop once a week to repair vehicle faults. Drivers that have been in the business for a long time usually solve small problems like broken lamps by themselves.
**Driver related**

The traffic managers are in contact with the drivers every day and this is done by mobile phone. Usually it is the traffic managers who take the initiative to communicate and the communication concerns where the drivers are at the moment and eventual problems. The driver comfort is not as important for distribution vehicles as for long-haulage. Sometimes small cabins can be a problem for tall drivers.

**Others**

The respondent mentioned that it would be good if Scania offered a temperature control system.

**Respondent C**

**Background**

This interview was done with two people at the same time working at a Swedish transport business. One was the transport business owner and the other one was vehicle manager. The vehicle manager has a background as truck driver. The business transports their own products, which are kitchens, and they drive in whole Sweden and Denmark. The transportation goes from factory directly to customer. On the way back from the customer the company transports other companies’ products to minimize the time the truck is driven around empty.

**Business related**

The company only buys new trucks and has currently 19 trucks. Most of the trucks are Scania and two of them are Volvo. There are three transport managers that plan the driving schedule and this is done with help of Google Maps. Order handling is done with paper. When the truck is loaded the customer is told that the delivery is on its way, this happens during a two to three hours interval. One hour before delivery the customer is called by the driver and told to be prepared for delivery. If there are any delays the driver calls the customer. There are delay fines, but these are low and negligible. There are different groups with three drivers on two trucks. How much the truck is driven each day depends on where it drives; in north of Sweden it is driven for nine to ten hours and in the south of Sweden the vehicle is driven five to seven hours a day.

**Vehicle related**

When a new truck is bought focus is on what needs there are in the business. The respondents mentioned that they do not have any specification of requirements but the engine is important. Retrospectively television, microwave oven and coffee machine are added. Currently the Control and remote download services are used, and especially the vehicle manager tries to use these services as much as possible. When selling a truck, the decision is usually based on mileage, maximum 800 000-900 000 km. The respondents mentioned that sometimes a vehicle changes its utilization. One example is a vehicle that is getting close to exceeding its mileage connected to the service contract. Then this vehicle changes assignment with a truck that has more kilometres to drive before planned service. The respondents turn to OEM’s workshop with all types of vehicle problems, but some small problems like scratches are ignored.
Driver related

The drivers have influence when new trucks have to be bought. The company has created a group with drivers, traffic managers and the vehicle manager that together discuss before new trucks are purchased. The traffic manager has contact with the drivers five to ten times each day and the contact is by telephone or sms, the driver contacts the office and the traffic manager contacts the driver. Most of the communication is about workshop visits, deliveries and if something is missing in the delivery. If there are any problems the driver always communicates them.

Technical devices that are used in the driver environment are a smart phone application and a tablet for GPS and surfing. Driver comfort is very important, and the seats are the highest priority.

Others

The respondents stressed that it would be nice if the drivers could see the same information as the traffic managers when they use the FMS offerings. It would also be good if the fuel consumption could be shown in an easier way, e.g. as a pyramid. This would ease the understanding and the drivers could compete even more against each other when it comes to who has the lowest fuel consumption.

Respondent F

Background

The respondent owns and is responsible for the administration of a regional distribution business in Sweden that transports goods to a Swedish supermarket chain. The respondent has three trucks and five employees. The interviewee is part of a group of six small haulier companies that work together with in total 15-20 trucks. Before this job the respondent was a long-haulage driver, but not anymore. The interviewee is an operational test person for Scania trucks.

Business related

In total the respondent has three Scania trucks, two of them bough as new and one bought second-hand. The trucks are big, model P400, and the two of them that have a trailer drive two shifts. The vehicles running two shifts have two drivers and the truck that drives one shift usually has one driver. The maximum time the truck runs is 16 hours a day. The office schedules the routes given from the supermarket chain and assign them to the drivers. Paper and Excel is used for the planning. Eventual deviations and delays are noted by the supermarket chain and returned to the transport office as a report once a week. The time margin for delivery are ± one hour and there are delay fines, but they can be considered negligible.

Vehicle related

When buying a new truck it is important to adapt it to the work assignments. Most important is the trailer, it needs refrigerator and freezer units and it has to manage big loads. Second most important is the engine. The interviewee mentioned that sometimes it happens that a second-hand truck is bought when the business gets a new client or drive on a short notice. This is because it takes about three months to get a new truck, and a second-hand truck can be used directly. Functions that are added retrospectively are systems for temperature control, refrigerator, freezer unit and tail lift. Since
the respondent is an operational test person for Scania, all FMS offerings are used: Control Plus and remote download and the service and maintenance contract. The services are not fully used, as there is no time for this. When taking a decision about selling a truck, this is mainly based on the contract. The business has used its trucks for eight years before the contract has run out. Nowadays there are also demands from the client saying that the trucks have to have a special type of environmental class. It is hard to sell an eight years old truck, and therefore private sales of an old truck is nothing the business does. Usually the old trucks are traded in when buying a new one. Sometimes old trucks are kept as spare vehicles but this does not happen so often since it is too expensive to keep them. Therefore if a truck breaks down, usually a Scania rental truck is used or else the respondent borrows a truck from some of his colleague hauliers.

Since the business has the service and maintenance contract, almost all vehicle faults are solved by the OEM’s workshop. When it comes to the trailer, problems are handled by a non-OEM workshop because there are businesses more specialized on this than Scania. Also they are a bit cheaper. The haulier company repairs some small problems, e.g. exchange of wiper blades and lamps. Some faults that do not necessarily need to be repaired are ignored, e.g. if there is a small problem with the passenger seat.

Driver related

The drivers cannot influence the purchase of a new truck. Every day the respondent and the drivers are in contact and this is mainly done by sms. Every fourteenth day the driver is contacted by phone and once a month the respondent has a meeting with the drivers. The communication by sms and phone is usually about delays and the owner giving new delivery assignments. It differs a little whether the driver communicates if there is something wrong with the truck. If goods are broken during the delivery, this is not always told to the business owner. A breakdown or that something in the vehicle is broken, is always communicated.

Technologies used in the truck are GPS and a system for communicating with the drivers, but the communication feature is not used so much.

Driver comfort is important and the most important feature is that the opticruise system. The problems that the drivers usually complain about are ABS, electrical problems and warning lamps. The faults that affect the drivers' work are the ones that drivers mainly complain about.

Others

Once the respondent kept a long-haulage truck even though his business changed business area. The truck was rebuilt into a distribution vehicle. This was done because the vehicle was just one year old and it was not economically justifiable to sell it. This was a solution that was not really optimal but it did work.
Respondent G

Background

The respondent is a traffic manager and chauffeur at a Swedish business transporting private cars. The company has twelve employees, where four are working with the administration. Transportation is done in whole Europe.

Business related

The company buys only new trucks and has currently six vehicles, two of them drive in Sweden and four drive in the rest of Europe. All the trucks are Topline and the cabin model is G, P or R. Since ten years ago only Scania trucks are used. The driving schedules are planned one week at the time as new assignments are received continuously. No special system is used for the planning of the routes. Sometimes time margins for delivery are given, but never on the hour. Usually the truck is loaded at the beginning of the week and the delivery is at the end of the week. About 20% of all deliveries have time margins. If there are any delays, the customer is contacted and there are no delay fines. One driver has the same vehicle all the time and the vehicle is driven nine hours a day.

Vehicle related

When looking for a new truck the quality and how easy it is to get maintenance services matters. The respondent mentioned that used vehicles are never bought, but if it should happen it would be if the company gets a shorter delivery contract of just two years. After that the body work is the highest priority. Functions added retrospectively are microwave oven and coffee machine. The Scania offered services that are bought are service contract, Monitoring and remote download. According to the respondent these services are fully used.

The decision about selling a truck is usually based on the fact that a customer is lost or that the truck is worn-out. It never happens that usage area of a truck changes. No spare trucks are used in case of a break down. Problems solved at an OEM workshop are e.g. drivetrain and lamps. Tires and breaks are usually changed in their own workshop. There are no faults concerning the vehicle that are ignored.

Driver related

The drivers cannot influence the purchase of a truck. Communication with the drivers is done a couple of times each day via sms or phone calls. the communication between driver and office is mutual and is usually concerning problems with the truck or the delivery address. The drivers are eager to communicate problems, and the most frequent complaint is about engine faults. The drivers use tablets and smartphones as they work in the vehicle. Driving comfort is, according to the respondent, really important. When buying a Scania you know that it is good comfort, mentioned the interviewee. Highest priority are the seat and the interior. Also AC during the night is important.

Others

Today another brand’s solution for order handling is used since Scania do not provide any system for this.
Respondent I

Background

The respondent is a chauffeur and co-owner of a Swedish transportation business. Previously the company had three co-owners but one had to leave due to economic reasons. The company drives for an excavation centra in the Stockholm area.

Business related

The company buys only new Scania trucks and currently they have two vehicles both from year 2012. The respondent mentioned that one time they bought a used vehicle, but they will never do it again since it turned out to be very expensive. The assignments are given from the central office and there are no driving schedules since the vehicles are driven to landfills and gravel pits. The only time limits are the landfills’ opening hours. Since the vehicles are always driven in the Stockholm area the driver knows how many loads that should be delivered during a day. The driver uses its own vehicle and it is driven 90 hours during 14 days, which is the maximum according to the drive-and-rest regulations. The days are usually up to twelve hours.

Vehicle related

When buying a new truck the body work is important. The respondent does not only buy a chassis, but the whole vehicle with body work and chassis is bought at the same time. Extra functions that are added are tablets and some drivers might add a television. The used FMS is Monitoring since it was for free the first year and then the company continued to use it. Monitoring is highly valued since it gives a report about the fuel consumption. Since the company is very small, all the features in the service offering are not used.

The decision about selling a truck is usually based on the age and what the current driving assignments look like. It never happens that the truck changes usage area. If a vehicle breaks down a Scania rental car is used. Almost all vehicle problems are solved at the OEM’s workshop, but the tires are done at a specialized non-OEM workshop and exchange of broken lamps are done by the drivers. There are no faults that are ignored.

Driver related

The drivers are in contact with the central once a day and this is done by sms and mobile phone. Usually the communication regards the work assignments. Driver comfort is really important, the drivers spend a big part of their day in the vehicle and it often happens that they eat in the truck. Therefore the truck is equipped with microwave oven and coffee machine. Highest priority is the seat but also the cabin temperature and a low level of noise. The drivers complain about not enough storage space in the cabin and that the heating system is poor.
Respondent J

Background

The respondent is owner of a Swedish transportation business that to 90% drives for a bigger logistics company. All types of goods are transported except goods that need temperature control. The area the business works in includes the whole southern and middle area of Sweden.

Business related

The company buys only new trucks and has currently five vehicles, all of them are Scania 480. The drivers drive for eight to ten hours in a day shift, or ten hours during a night shift. The vehicles have four people for each route and runs 2,5 routes each week. The trucks are used from Monday morning until Saturday morning. In total a truck drives 20 hours a day. Usually the time limits are given by the customers but sometimes they can be set by the company itself. According to the respondent, the last case mentioned is the better one, because then they can optimize the routes. If there are any delays the driver calls the customer and tells him or her why the delivery is delayed, but according to the interviewee this does not happen so often. There are no delay fines.

Vehicle related

When buying a new truck the price is important. Usually the respondent buys one type of vehicle which is a concept car that is equipped with everything that is needed. Important is the platform body, transmission and tail lift. All the vehicles are equipped with service and maintenance contract, remote download and the Control package. The decision to sell a truck is usually based on the age and mileage, maximum five years or 1 000 000 km. It never happens that a vehicle changes usage area. If a vehicle breaks down and cannot be repaired within 24 hours the respondent uses the rental car that is provided by Scania.

According to the interviewee the vehicles are turned in to an OEM’s workshop for all types of problems, it is just tires that are changed by a non-OEM workshop and broken lamps that are changed by the drivers themselves. No problems or faults concerning the truck are ignored.

Driver related

The drivers cannot influence the purchase of a truck since, according to the respondent, it would be hard to satisfy all the different drivers’ needs. The drivers and the office are in contact many times each day and the communication goes through sms and phone calls. The communication is mutual and is usually concerning status of the vehicle, when and where the drivers have delivered the goods and eventual problems. The drivers communicate eventual problems almost always.

Driver comfort is important and according to the respondent the comfort in a truck is today better than in a private car. The highest priority are the seat and the refrigerator.

Others

The interviewee mentioned that the analysis of fuel consumption could be better and that the packaging of the service has to be improved.
Respondent R

Background

The respondent is a traffic manager at the Swedish part of a big worldwide logistics company delivering food for a fast food chain. The company works as a logistic partner and manages the purchase of goods and the delivery of them.

Business related

The company uses new trucks and keeps them for five years. Before the vehicles were purchased, but nowadays they are leased. In total the company has 30 trucks, both Scania and Mercedes. The vehicles used in the city are distribution trucks and the ones driving longer distances are long-haulage trucks.

The trucks are first loaded and then the route is planned. The driving schedules are adapted to the customer’s demand according to at what time they want the delivery. Also, the drive-and-rest regulations are being taken into account. All the products are scanned when they are delivered to get an exact time on when it was done. If there are any delays, the customers complain. The time margin is ± 30 minutes and the time for delivery is always followed up with statistics. If there are any delays the customers are contacted. There are no delay fines.

The shifts are pretty long, 13-15 hours and sometimes one or two days. Because of this it happens that the driver sleeps in the car. Vehicles driving in the city run for four to five hours and the trucks driving outside the city drive for nine hours.

Vehicle related

Important when buying a new vehicle is the possibility for installing a refrigerator and freezer units, something that is added retrospectively. The services, offered by Scania, that are used are Monitoring and remote download. Order handling and temperature control is solved by another brand’s system.

If a vehicle breaks down the Scania jour is called and a rental car is delivered. Sometimes trucks older than seven years are kept just for being used as a spare truck. All problems except for the ones concerning the refrigerator and freezer units are solved by the OEM’s workshop. Small problems like exchange of a broken lamp are done by the drivers. No problems are ignored, but it happens in consultation with the workshop that some faults are repaired later and not directly.

Driver related

The drivers always have opinions regarding which truck that should be bought. They are listened to, but the ideas from the drivers cannot always be taken into account when purchasing or leasing a new truck. One example, mentioned by the respondent, is that the drivers most always want a bigger engine than necessary. The traffic manager is in contact with the drivers when problems occur. This means that if there are no problems there is not so much communication and if there are a lot of problems a lot of communication is needed. How eager the drivers are to communicate eventual problems differs from individual to individual. Some drivers try to solve the problems themselves. Driver comfort is really important since it is the drivers’ working environment, most important is the seat.
It is annoying to have different systems just because the temperature control cannot be managed by Scania’s service systems.

**Respondent T**

**Background**

The respondent is a co-owner of a Swedish transportation company that drives timber and forest products, the company has seven employees. The interviewee does administrative work and drives one shift.

**Business related**

The company has five trucks and they are all first-hand Scania. The drivers are scheduled so that one week they drive daytime and one week night time. The goods are transported in one region in Sweden and there are no daily time limits for delivery, only weekly. In total nine drivers share five trucks and the trucks drive 23 hours a day.

**Vehicle related**

Most important thing to look at when buying a new truck is the quality, availability of service and the aftermarket of a truck. The interviewee has remote download of the tachograph data activated on the three newest trucks in the fleet as well as Monitoring, but it is not fully used. If a truck should stop or have any problems the Repair and Maintenance contract covers it so the company does not need a spare truck. All the problems that regard the trucks are taken care of by the Scania workshop, other problems e.g. concerning the trailer need a different workshop. The respondent does minor maintenance by himself e.g. brakes, tires and the replacement of the tubes of the hydraulic system. The decision about selling a truck depends on age and mileage, usually they are 4,5 to 5 years old. The area of use is never changed.

**Driver related**

Drivers have no power when deciding which truck has to be bought, especially not which brand. The drivers request a truck that is quiet and goes smoothly, because driver comfort is important. The interviewee said the drivers are contacted many times per day, by mobile phone and sms, in order to communicate assignments or problems.

**Others**

The respondent prints the weekly reports from the Monitoring service and gives them to the drivers so that they can see how they, and their colleagues have been driving.
Respondent U

The respondent is owner of a Swedish business transporting different kinds of goods, except goods demanding refrigerator and freezer units. Most of the transports are long-haulage. The company has twenty employees. The respondent also sometimes works as a driver.

Business related

The company has about ten vehicles and they are all Scania long-haulage trucks. 80% of the trucks are second-hand and the age of the vehicles is between 2008 and 2013. The driving schedule is done differently depending on what type of goods that has to be transported. Usually the customers set time limits for delivery. It happens very rarely that there are delays and how they are handled depends on the nature of the delay. Some of the trucks are driven by the same driver all the time and some are shared among two or three drivers. The ones that have one driver run for nine to ten hours a day and the vehicles with two or three drivers run 18 to 20 hours a day.

Vehicle related

When buying a new truck it is important that it is well-equipped and has a good engine, gear ratio and wheels. If it is a new truck the respondent orders exactly what he needs and there are a lot of parameters that are taken into account. Currently the respondent has chosen to never again buy a new truck, since it is too expensive. If a new truck has to be purchased it will be bought from another European country and not from Sweden. The interviewee argued that buying a new truck in Sweden is not economically justifiable. When buying a second-hand truck you have to compromise since you can never get exactly what you want, said the respondent. Highest prioritized are engine and gear ratio. Functions that are added retrospectively on both new and second-hand trucks are kitchen equipment and lamps. On new trucks Monitoring and remote download are used. The service offerings are not fully used and therefore the respondent mentioned that in the future he will not buy them anymore. It is too expensive and the interviewee will use other systems that are cheaper. When deciding to sell a truck the decision is based on age and mileage, it is the same for both new and second-hand trucks. It never happens that the vehicle changes usage area.

No repair and maintenance contract is used and if the vehicle breaks down it is not replaced with a spear truck. Sometimes the respondent goes to the OEM’s workshop when there are computer problems or big faults. The respondent mentioned that as much work as possible is done in the own workshop because it is too expensive to turn to Scania to solve problems. In the long run, no faults are ignored but sometimes small problems are not solved directly.

Driver related

The drivers cannot influence the purchase of a truck. Communication between the respondent and the drivers is done on a daily basis through mobile phone, sms and Facebook. The communication is mutual and usually it is just for company. The respondent mentioned that the relationship with the drivers is close and therefore they call each other just because it is fun. The drivers are quite eager to directly tell the owner about vehicle problems. Drivers usually have their own laptop in the vehicle and the business assists with mobile phone and internet. These functions are the same for new as for second-hand trucks.
Driver comfort is as important for new as for second-hand trucks. Most important is a good seat. The interviewee mentioned that the bed is really bad and it is always improved by the business owner retrospectively.

Others

The respondent mentioned that it feels like Scania trucks are sometimes designed just for being good looking and not so much attention is given to the driver that works and sleeps in the vehicle.

Respondent V

Background

The respondent is owner of a Swedish transport business and also works as a driver. The company has five employees and drives long-haulage of goods demanding refrigerator and freezer units.

Business related

The company has two vehicles and both are long-haulage trucks. One is bought new and one is second-hand, both from year 2013. The respondent has only Scania trucks, but mentioned that he might stop buying Scania. The reason behind this decision is that the respondent thinks that the employees at the Scania workshops are not service minded enough.

The company gets assignments from customers and the time margin for delivery is a slot of two to three hours. If there are any delays there will be fines. Since it is perishable goods the fines are very high. When it comes to fish transportation the delay fines can be 1,000 SEK for each ten minutes. A driver drives for a week and then he or she changes with another driver. The trucks are running nine to ten hours a day.

When buying a new truck the most important is the contact with the salesperson and then engine, the space in the cabin and smart solutions that will ease the drivers day. When buying a used truck the same criteria are applied. The respondent mentioned that they rather buy a new truck than an old one, since for a new vehicle the history is known and no hidden fault will occur later on. Both new and second-hand trucks have the remote download, Monitoring and repair and maintenance contract. The respondent said that the services are fully used. When taking a decision about selling a truck, bought as new or second-hand, the current market value is important. Sometimes it happens that a truck changes usage area, and this happens to both new and second-hand trucks. One example is a truck that used to drive in Norway but then changed to Denmark. The haulier company does not have any spare truck if a vehicle breaks down.

Because of the repair and maintenance contract all problems are solved by the OEM’s workshop. Nothing is ignored because the image is really important and driving around with a broken truck does not look good, said the respondent.

Driver related

The drivers can have requests on how a new truck should look like, but actually they cannot influence so much. Maybe the colour in the cabin. The haulier is in contact with the drivers every day and the communication is mutual. It is done by sms or mobile phone and usually the haulier and the drivers
are just talking for company. Of course, the respondent mentioned, they also talk about the driving schedule but most of the time it is just regular talk. The drivers are good at communicating eventual problems.

Driver comfort is really important as well for new and second-hand trucks. Highest prioritization have AC, seat and mattress for the bed. Also microwave oven is important since the driver might eat in the truck.

Others

The respondent mentioned that it would be nice if the refuelling could be seen on the map in FMP.

Respondent H

Background

The respondent is owner and chauffeur at a Swedish one-man business. The business drives for a bigger logistic company. The goods transported is usually garbage, scrap, paving stones and everything else that have to go to the landfill site or heating plant. The company is also transporting to building sites. Every day different distances between 50 to 450 kilometres are driven.

Business related

The company only buys new trucks and has currently one truck and it is a Scania from year 2012. Driving schedules are given from the transportation centre and there are no time margins given. The respondent always drives his own vehicle and this is driven nine hours a day.

Vehicle related

Most important when buying a new truck is that the repair and maintenance service works well. Of course it is also a question of price. The respondent describes himself as a Scania fan and has never driven any other truck than a Scania during his entire life. Scania are reliable trucks and the service functions well. Functions that are added retrospectively are microwave oven, alcohol lock and coffee machine. The kitchen equipment is added because the respondent usually sleeps in the truck. The service offerings that are bought are Monitoring and remote download, which gives a weekly report used to analyse the driving.

A decision about selling can be done when the truck has been paid entirely. The respondent mentioned that it is better to amortize the money on a new truck than putting all the money on repair of an old vehicle. If the vehicle breaks down the respondent calls for Scania help. Nowadays when everything is so high tech, it is hard for the respondent to solve any problems by himself. The respondent does not have the repair and maintenance contract but has just the maintenance contract. Big problems, like engine faults, are solved by the OEM’s workshop and smaller things like exchange of lamps are done by the respondent. No problems are ignored since it is important for the interviewee to keep the vehicle in good condition.
Driver related

The respondent is in contact with the transportation centre a couple of times each day and this is done by mobile phone. Also, an application is used to organize the routes but this is not Scania’s application. The communication is usually regarding the deliveries and where to go next. Driver comfort is really important. You need a good seat and have to feel comfortable in the cabin, mentioned the interviewee. Also the heating system and the view is important.

Others

The respondent argued that no more data should be collected since the drivers are already monitored a lot. More data collection would mean that Scania has even more control over the vehicles, which the interviewee mentioned as something bad.

Respondent AA

Background

The respondent is a business owner and traffic manager at a Swedish transportation business that transports new and second-hand cars in the whole of Sweden. The company has 110 employees.

Business related

The business has 52 trucks, 80% of them are long-haulage and the rest are distribution trucks. 75% are Scania and the rest are other brands. The plan is to just have Scania trucks at the end. Currently half of the fleet consists of second-hand trucks, but the idea is to increase the amount of new trucks. The reason behind this is that according to the interviewee it is more economical to buy new trucks. The company buys second-hand trucks mainly because they got a contract with a client that just lasts one year. The second-hand trucks used are maximum five years since they have to be Euro 5.

The drive schedule is adapted both to the customers’ requirements and the drive-and-rest regulations. Sometimes an assignment can arrive 48 hours before the delivery has to be done. The time margins are 12 hours because the distances driven are so long. Delays are usually communicated in advance and there are delay fines. These fines can be really high and they have to be avoided. The company uses two kinds of shift systems: two shifts were there are two drivers per truck during a day and the other one is when a driver drives for six days and then a new driver continues using the truck for another six days. As most a truck is used 18 hours a day, which according to the respondent is the most economic ratio.

Vehicle related

When buying a new truck the price is important, but not the only thing. Even more important is the availability of maintenance and repair. The same criteria apply to the decision of buying a new and a used truck. Functions that are added retrospectively are special trailers that demand hydraulic. Also tablets are added to the vehicles, both for new and second-hand trucks. This means that all trucks have the same equipment no matter what age.
The respondent has maintenance contracts for all vehicles and for some trucks the whole repair and maintenance contract. Ten of the trucks are using the FMS offerings and this is a test period that might lead to that all future vehicles in the fleet will use FMS.

Usually the trucks are used until they are worn out. This is because the body work is really expensive and new trucks cannot be bought so often. Lately the company has changed to a cheaper body work which means that the trucks do not have to be used as long anymore. The respondent mentioned that in the future they might trade in their used vehicles when buying new ones. It happens that the trucks change usage area. Since the company uses so many trucks, there is always a need for a truck even though it is old. This means that older trucks usually change utilization but stay in the company until they are totally worn out. These old trucks are sometimes used as spare trucks.

The respondent turns to the OEM’s workshop with more or less all problems, no matter if it concerns new or second-hand trucks. It happens just sometimes that problems are solved by non-OEM workshops e.g. if the breaks are broken. Things that do not need special tools can sometimes be solved in the business’ own workshop. There are no faults that are ignored, since according to the interviewee this will be more expensive at the end than turning to a workshop directly. The haulier mentioned that there is no difference in how the new and the second-hand trucks are handled when it comes to repair and maintenance.

Driver related

The drivers have some influence on the choice of colour and equipment like coffee machine and microwave oven when a new truck is bought. In the choice of second-hand trucks the driver has not any influence, since most important features are the engine and mileage. The drivers are contacted a couple of times a day and this is done by the communication central through phone or sms. The communication is mutual and is usually about changes in the transportation schedule or new orders. Whether problems with the vehicle are communicated depends on the individuals.

Driver comfort is important and there are no differences between a new and a second-hand truck. The respondent mentioned that the difference in comfort is rather connected to the brand. Most important is the seat, and here there is a big variance among the different brands. The problems the drivers usually complain about are imbalance in the front and end, and shakings in the steering wheel. There are differences between new and second-hand trucks because in new vehicles usually everything is perfect and then as the age increases more problems occur.
Appendix H – Interviews with Salespersons Service Market

Respondent B

Background

The interviewee is working at the service sales department at the Scania distributor in Sweden and is product responsible for FMS and tachograph. Also the respondent educates the resellers and works with support when it comes to FMS and tachograph connected services.

Business related

Since the respondent works with sales of services and not sales of vehicles not so much information regarding the owner of a vehicle could be gathered. The difference between first and second-hand owner, mentioned by the respondent, was that the truck is adapted for the first owner which means that the second owner has to take the vehicle for what it is. One example mentioned was Ecolution, that is adapted for how the first owner is going to use the vehicle.

Vehicle related

When buying a new truck, the haulier usually trust the reseller to 100% and the truck proposed by the salesman is usually the one that is bought. The functions added to a new vehicle depend a lot on what kind of business it is going to be used in. Examples of functions added are telephones, tablets and systems enabling the time reports. If it is a company working with food transportation, a system for temperature control is added and if it is distribution a system for order handling is installed.

When it comes to services sold to new trucks, the respondent argued that if the haulier has more than five trucks Control is useful. The distributor’s goal is that 90% of all sold trucks are going to have Monitoring and 40% remote download. Second-hand owners of vehicles are a bit harder to sell service to, since the distributors do not have as much contact with them as with the hauliers buying new trucks. The reason why a haulier is selling a truck, is the same for those buying new and second-hand trucks. Usually it is because the business lost a client or got a new one with other demands. Mileage is another parameter. If a vehicle, new or second-hand, is changing utilization within the company, this is usually because the business lost a client and not so many vehicles are needed anymore for a specific type of assignment.

The respondent mentioned that there could be seen some differences between hauliers with new trucks and those who buy second-hand when it comes to the tendency to turn to OEM for repair and maintenance. The first year there is a guarantee on the new truck and then the owner turn to the OEM for every little problem. With the increasing age of the vehicle, the visit to OEM for repair and maintenance decreases. The customers who have a service and maintenance contract go to OEM frequently. The most important for the haulier is that the truck is working and rolling on the road, which means that sometimes small problems can be ignored.

Driver related

The interviewee mentioned that how much the driver can influence when a new truck is bought differs from business to business. The communication between the driver and the business differs also
depending on the company. Driver comfort is always important, no matter if it is a new or second-hand truck. Most prioritized are the seat, the setting that can be done and the comfort of the bed.

Others

The respondent answered that during the transition phase, the vehicle can be standing still for a month before the new owner starts to use it. Also, the truck can be changed regarding weight and power outlets.

Respondent D

Background

The respondent is a service market salesperson at a Swedish private Scania reseller and is responsible for the sales of the Scania offered services and service support.

Business related

The customers that buy new trucks are usually old customers that come back and buy a new better truck. These customers use the truck for five years, usually 180 000 km each year, and they trade in the vehicle before it has lost too much of its value. The ones buying second-hand trucks are usually foreign customers and clients with less capital e.g. one-man businesses. The first-hand owner can be a bigger company with enough money for buying a new truck and the second-hand owner can be a smaller company or a big company that needs a spare vehicle.

Vehicle related

When buying a new truck, according to the respondent, a low fuel consumption is important. Second-hand buyers are not as interested in the fuel consumption, but prioritizes mileage and body work. Functions that are added retrospectively on a new truck are usually extra lamps and horns. Some customers can “pimp” their new truck for two million SEK. Second-hand owners do not “pimp” their vehicle as much, since usually the focus is to get back all the money that was spent during the purchase of the truck.

First-hand owners are mainly buying Monitoring and remote download services. Also Control is sold. If the technique is available in the second-hand truck, remote download can be sold. Parameters that are important when doing a decision about selling a truck that was bough new, are mileage or that the vehicle breaks down a lot. If the customer has a service and repair contract, they might sell the vehicle when this contract period is over. Second-hand owners usually come back when their business is growing and they need a better second-hand vehicle. Customers with new trucks go to the OEM’s workshop with every little problem and the second-hand owner just solves bigger problems at the OEM’s workshop. Customers buying used vehicles have more knowledge about “do-it-yourself”.

Driver related

According to the interviewee it is hard to tell how much influence the driver has on the purchase of a truck. Mentioned was that in small companies it is easier to influence. The driver comfort is important in both new and second-hand trucks. Usually the customer tries different brands to find out which is
most comfortable. The highest prioritization is that the truck goes smooth, vibrations are not accepted and is something that the drivers usually complain about.

Respondent E

Background

This interview was done on two people at the same time. One was a service market salesperson working at a captive dealer in Sweden selling service and maintenance contracts and doing the service support. The other one was a salesperson of new vehicles at the same dealer. Before this person sold used vehicles.

Business related

The ones that buy new trucks are those with a well-developed business plan and that drive a lot. Usually two shifts are used. The customers that buy used trucks can be big companies that want to try a new assignment or that need an extra vehicle and it can be beginners with less capital. Also businesses that are expanding buy used vehicles. The difference between owners of new and used trucks is that when buying a new truck you can get it customized. It is seldom that a used vehicle is rebuilt by the second owner.

Vehicle related

When a customer is buying a new truck he or she is usually looking at the fuel consumption and the possibility to adapt the vehicle to the work assignment. When buying a used truck the engine and mileage are of most importance. It can be hard to add any extra functions to a new truck, but they can be “pimped” with refrigerator and lamps. Sometimes the lacquer is done and sometimes power outlets are installed.

The services sold to first-hand customers are the Control package and remote download. To second owners it is harder to sell services especially because not so many used trucks have C200 yet. In the future the respondents think that there will be special service package for the second-hand owners mainly because in some years also used trucks will have a communicator.

The main reason why trucks that were bought new are sold is because of the mileage and age. Also sometimes the customers have demands on the environmental category of the vehicle. Another reason can be that the business lost its customer. When it comes to trucks bought as second-hand, it is pretty much the same. The customer buying a second-hand truck usually comes back after a while and buys another better second-hand truck.

The interviewees argued that the tendency to turn to OEM for repair and maintenance decreases with the truck’s increasing age. The problems that usually are solved by the OEM’s workshop is electrical problems that only can be solved by Scania’s computers. To the second-hand owner they usually try to sell spare parts. Owners of second-hand trucks sometimes ignore small electrical problems and broken lamps in the cabin. Some of these owners only solve the problems that has to be done according to the vehicle inspection by “Bilprovningen”. Owner of new vehicles can sometimes, according to the respondents, ignore ESB-problems and some warning lamps.
Driver related

If the drivers can influence the purchase of a new vehicle differs in different haulier businesses. The interviewees stressed that in Sweden the drivers have the possibility to influence a bit. Regarding the purchase of a second-hand truck, it is hard to take the drivers thought and ideas into account since the vehicles are in the conditions as they are and that is hard to change. Sometimes a customer buying a used vehicle can get a more well-equipped truck than if a new truck was bought. The driver comfort is important, but is according to the respondents always good in a Scania, new as second-hand. Most prioritized is the seat and this is also what the second-hand owner looks for when buying a vehicle.

The most common reported problems concerning the vehicle, among the first-hand owners, are broken lamps, warning lamps and strange sounds. Sometimes the first-hand owner even imagine problems. Second-hand owners report pretty much the same problems, but usually they accept a bit more problems than the first-hand owner.

First-hand owners use the application for error reports. Most of the technological equipment in the truck is installed by the haulier business itself and therefore this equipment is taken away from the truck before sales. This means that the second-hand owner has to install its own equipment.

Others

According to the respondents they are very good at starting the service package, but ending it is hard since sometimes the vehicle is sold to privates.
Appendix I – Interviews with Resellers

Respondent K

Background

The respondent is a salesman of an Italian Scania authorized reseller and has been working at the same business for 39 years. Both new and used trucks are sold at the company.

Business related

The company sells new Scania trucks and used trucks of all brands since they are trade-ins. Used trucks are sold to all kind of customers due to the economic crisis. Both one-man businesses and companies with one to ten trucks in their fleet buy used trucks. Second-hand vehicles are used for a more local transport with shorter distances, but it depends on the type of used vehicle and how “used” it is.

Driver related

Driver comfort is very important, reliability and safety are the highest priority. With used trucks you take what you can find, it is hard to choose mentioned the respondent.

Transition Phase

The sales process can take from 20 days to maximum three months. Also, it depends on the demand. If the truck that is turned in is older than ten years the reseller does not do anything with it, it is sold as it is. If it is a truck up to five years old, it will be refurbished and eventually it is possible to offer warranty (i.e. Scania Approved). The truck is never moved during the time it is at the resellers’, unless it is test driven by a customer.

Respondent L

Background

The respondent is a salesperson at a Scania authorized reseller in Italy selling both new and used vehicles.

Business related

The new trucks that are sold are just Scania and used trucks are of all brands. The customers that buy second-hand trucks are usually one-man businesses or companies with a small fleet that want to renew their fleet but cannot afford buying new vehicles. Used trucks are also sold to traders that in turn export the cars abroad. The biggest market abroad is East Africa, the trucks sold can be second-, third- or fourth-hand. There are no differences in the use of a truck between the first and the second owner.

Vehicle related

The reason behind the decision to sell a truck was earlier the amortization period. When the period came to an end it was time to buy a new truck and start a new amortization period. Now the financial needs are changed and the owners look at age and mileage when selling a truck.
Transition Phase

Usually the sales process of a truck starts with an evaluation together with the team of salesmen, after that if the truck is sold to an end customer it is brought to the a workshop in order to get an offer so that a decision can be taken. Otherwise if it is decided that the truck should be sold to a trader nothing is done in order to improve the condition of the truck. The next step is to advertise through internet or magazines. Lately this is done less because the number of trade-in vehicles has decreased. Sometimes the truck is offered to a known customer or the resellers wait for some customer that is interested. The whole sales process takes between 45 to 60 days, with exception for special vehicles.

During the transition phase, depending on the age and on the mileage of the truck, some services are done. Usually nothing is done before the customer asks for it. The reseller suggests what services have to be done, and finally the customer decides what he or she wants to do. In some cases warranty can be offered.

No new technologies are added during the transition phase. C200 is not installed on used trucks because used truck customers do not care or do not know about FMS. Most of the used truck owners are one-man businesses and do not need to monitor themselves. Those businesses who need FMS almost never buy used trucks, according to the respondent.

Respondent M

Background

The reseller is an authorized Scania reseller in Italy selling heavy vehicles over 18 tons. The trucks sold are trade-in trucks of all brands.

Business related

The customers that usually buy used trucks vary from one-man businesses, to new companies and those that cannot afford a new truck. There is no difference between the use of new and second-hand trucks.

Vehicle related

The decision of selling a truck is based on mileage and age. When a customer buys a used truck it is important with mileage since he or she wants to use it as much as possible, but mileage is not a decisive factor.

Transition Phase

The sales process starts with a visual estimation followed by a technical evaluation. The following step depends on if the truck is to be sold to a trader or to a final customer. In the first case the truck is cleaned superficially and then sold. In the second case the truck is cleaned, small reparations are done and tires are changed until it has reached a good condition. This process takes up to 60 days. The truck is not utilized or moved during the transition phase. FMS are not used for second-hand trucks since they do not have C200, according to the respondent.
 Respondent N

Background

The respondent is the area sales manager for Spain and Portugal at a Scania distributor in Spain.

Business related

The typical customers that buy used trucks are single truck owners, but there is not any statistics on that. Nowadays some fleet companies are using old trucks as well. At the moment there is no export, but in the past years three trucks have been exported to Scania Belgium. Very old trucks, eight years or 1,000,000 km, are sold to traders that sell them to the Middle East. At the moment 90% of the trucks are sold in Spain. The market is strong in Spain and Portugal, the demand for used vehicles is high, which could be connected to the economic situation.

Vehicle related

No technical functions are added retrospectively on a used truck. It is hard to sell services to second-hand owners, there is no demand for FMS.

Transition Phase

The sales process for a used vehicle is very complicated and varies depending on what type of dealer it is, according to the respondent. Non-captive do not always follow the routines regarding the reception and refurbishing process. The respondent said the resellers are pushed to follow the routines and some resellers are better than others, but the respondent still does not have any power over them.

The sales process of a used vehicle follows a special routine and there is a protocol for this. The respondent summarized the Spanish protocol during the interview. There are two forms that have to be signed. Within 24 hours these documents have to be sent in to the distributor. One is a contract, a legal document that says that the truck company has delivered the truck to the dealer. The second one is a form that the salesmen sign after doing an inspection (not mechanic inspection) of the truck. This one is signed by the truck company to confirm that the inspection is correct. Within 48 hours the truck has to pass the workshop.

Usually the vehicle has an average stay at the resellers’ below 120 days. This is reported to “Scania Used Vehicles”. During the transition phase from first to second owner the truck is exhibited in a yard and from time to time it is started up to charge the battery. Sometimes the trucks are used for education and sometimes people from the aftersales market use them for try-outs, but that is not so common and happens maybe three times a year for a couple of days.

Most of the times there is no change of technology during the transition phase from first to second owner, most of the work done is mechanical. There is no demand for FMS when it comes to the second owner. The distributors are trying to sell services, but it depends on the dealers whether they offer the services or not. Usually the truck stays in Spain during the transition phase, if it is not a really old vehicle.
Respondent O

Background

The respondent is a mechanic at an authorized Scania used vehicle reseller in Spain.

Business related

There are customers from all the countries that buy used vehicles. When trucks are intended to go to Morocco or Arabic countries no checklist are used because the trucks are used in a different way than in Europe, sometimes they take out the engine and sell spare parts. Trucks that go outside Europe are older than 12 years. Trucks that are younger, about two years, are sold mostly to Spanish small companies.

Transition Phase

During the transition phase at the workshop there is a checklist with 100 different points about engine, gas, differential and body, and all points have to be checked. Very few times new units are put into the truck, the most common is the alternator, C200 is never installed on a used truck. The truck is then moved from the dealer to the ITV that checks if the vehicle is roadworthy. The actors that are included in the transition phase from first to second owner are salesmen, mechanic, the painters, and the cleaners.

Respondent P

Background

The respondent is an area sales manager for used trucks at an Scania distributor in Czech Republic.

Business related

All kind of companies buy used trucks. Big companies with more than 50 vehicles buy second-hand trucks very rarely. Companies with 30-50 trucks buy second-hand trucks more often, but mostly vehicles with the age of maximum three years. Smaller clients that have up to 20 vehicles buy older trucks, up to five years old if the condition of the truck is good. Customers buying old trucks have to be flexible, you cannot always find exactly what you are looking for. If the trucks are older than six years the type of customer depends very much on the condition of the vehicle and on the specifications. Especially when it concerns export, because certain receiving countries are interested in certain types of vehicles. The diversity of the market has to be kept in mind. The road condition in some countries is not good enough and therefore big trucks are a bit problematic because they are heavy. For customers in these countries probably smaller trucks with manual gears are much better. The less electronics the truck has got the better it is for these clients. The Russian market has a high demand on Highline models, because it’s a huge country and the road condition varies a lot. Other markets like the African market and the Middle Eastern market require other specifications.

Transition Phase

Used trucks have different sources: trucks that come back with the warranty, trade-ins, free purchase from external companies and import. The imported trucks usually arrive from Benelux, Germany and
France, but right now there are enough used trucks in the country so the number of imported vehicles is very small compared to other countries. Then a last source of used trucks is the young used trucks of the rental fleet.

When the truck is bought from the client, the condition is checked and the truck is prepared for the marketing. It is advertised through internet, but mostly these trucks are sold directly. The interested clients go to the yard and check out the trucks, the price is discussed and then if the deal is done the truck is ready to be delivered.

The time it takes to sell a truck differs a lot. Sometimes the truck is sold in a couple of days, sometimes it is sold before it is even bought, and sometimes it stays one year in stock which is of course something to avoid. If a truck stays more than 180 days the effort to sell it is increased, then after one year in stock the goal is getting it out as soon as possible. Since it is a cyclical business sometimes it takes 90-100 days and sometimes 200 days, its depends on the size of the stock and on the economic cycle. When the trucks are good enough and the volume and the timing is right then they are sold like “hot cakes” according to the respondent. Sometimes it is the other way around, and resellers end up with trucks staying quite a long time in stock and become even more difficult to sell.

No technology is added during the transition phase. Upgrades or downgrades are not done even though it is possible. It did happen for some export markets but that was purely technical functions. The only thing that is done is adding hydraulic systems when it is needed. Otherwise it is about having the truck in as good shape as possible. The technical condition is one of the most important matters in used vehicles. Resellers in Czech Republic try to keep a high standard.

FMS is not used on second-hand trucks. Very few used vehicle clients are interested in having these systems. Usually maintenance is done by the owners themselves, they only go to the workshop if they have a problem that they cannot do themselves.

**Respondent Q**

**Background**

The respondent is a reseller of used vehicles at a Scania authorized reseller in Poland.

**Business related**

Customers buy used trucks if they do not have enough many for a new one. Usually it is small companies with five to ten employees. But lately big companies buy old trucks as well, mainly because of the economic situation.

**Transition Phase**

When the truck enters the dealer a service is done and eventual damages are repaired. Then the truck is sold. After a few years the same customer comes back to the dealer and buys another truck. The time it takes to sell the truck depends on how much time the service takes, usually the service takes a few days. Then it depends on what customers and what trucks there are. Sometimes it takes a few days and sometimes it takes a few months to get the truck sold. The average time is a few weeks. Trucks with Euro 5 engines are more popular and stand shorter time on the yard. In some cases the
truck is moved to another city where the demand is higher. When it comes to export this dealer did not sell to any other countries than Poland, but the trucks that were sold were not only from Poland, they were also imported from Western countries like Germany and Holland.

**Respondent S**

**Background**

The respondent is a used vehicle salesman at a Scania owned dealer in Sweden. The sold trucks are on average five to seven years old.

**Business related**

The reason behind why used trucks are sold to the dealers could be the age of the truck, mileage or the fact that the owner does not need the truck anymore. A large number of the used trucks are exported. There is no typical customer of used trucks, it could be any company from one that owns five to one that owns 60 trucks. Usually a truck that was intended for long-haulage when new, will be used for the same purpose when entering a second phase, this stands usually for all types of trucks.

**Vehicle related**

The main reason why a haulier sells a truck is that the amortization period is over, that the Euro class has to be updated or that a work assignment is lost.

**Transition Phase**

The sales process for a used vehicle starts with the advertisement on the web page and in magazines, after that customers call and go to see the truck. The customers test drive the truck and later the price and funding are discussed. If a deal is done the truck is later delivered to the customer.

When the vehicle enters the dealer the truck is controlled through a protocol. Then it is checked whether any reparations and services need to be done. The truck is then cleaned and pictures are taken for the advertisement. After this the truck is put outside on the yard. The whole process could take everything from one to 300 days. Sometimes the truck is moved between dealers in three cities due to the lack of space. Services are made during the transition phase, software are updated but installation of C200 never happens unless the customer asks for it. FMS services are sold only to trucks that stay in the area. It is much harder to sell services to second-hand owners.

Most trucks are sold to Sweden, when it comes to European export it depends on the current Euro rate. Some export goes to the Baltic countries and Finland. From Finland the trucks go to Russia. Before trucks were also sold to Greece but now this market is pretty dead. Iraq buys trucks from year 2005 and newer.

**Respondent W**

**Background**

The respondent is a salesperson for used vehicles at a Scania authorized reseller in Denmark.
Business related

At the moment 35% of the market is used vehicles and 65% of this goes to export. The export is mostly to Finland, Holland and Poland. Trucks that are not Scania are normally sold to traders. The second-hand trucks that stay in Denmark are normally construction trucks, truck-units and long-haulage trucks, normally 3-axles. Most of all tractor units in Denmark are 3-axle because there are big hills, but in Eastern European countries or Poland they only need 2-axles because the country is flat, according to the respondent. The second-hand trucks that are trade-ins and that are three or four years old are usually sold to Danish clients. Many newly started businesses start with a truck that is three or four years old. Normally the beginners only drive in Denmark so they do not have any demand for long-haulage trucks. Smaller companies, with only one owner and one driver buy used long-haulage trucks.

Vehicle related

When buying a used truck mileage and price are prioritized. At the moment the Euro of the engine is also important, because in Germany road taxes have to be paid according to the Euro class of the engine.

Transition Phase

The sales process consists in cleaning, taking pictures and put the add on the internet. Sometimes a client that might be interested is called. The customer takes a look at the truck and then maybe buys it. This process can take from one week up to four months, if it is a special truck it takes more time. The truck stands still on the yard during the whole phase. Services, reparations and installation of new technology on a second-hand truck are only made on the client’s demand.

The respondent said that they try to sell services to the clients, if the truck has a C200. The whole package of services are tried to be sold. According to the interviewee second-hand owners are interested in the FMS.

The actors that are included in the process are firstly the salesperson of new trucks, who sells the new truck and take back the old one. The trade-in truck is taken into the shop and a health check is made to see if something is wrong. Then the used truck salesperson has to sell the old truck. Some clients want some extras so the workshop has to be called and maybe a service is done or extra things are added. Now the service salesperson tries to sell a service contract to the customer, if the client wants a financial contract there has to be a finance salesperson and then the truck goes to the client with the whole package.

Respondent X

Background

The respondent is a salesperson for used trucks at Scania owned dealer in Sweden.

Business related

The new trucks sold at the company are Scania and used trucks are of all brands since they are trade-ins. Right now most of the sold used trucks are model year 2006-2009. Hook loaders and dump trucks are sold a lot during spring, vans for long-haulage are sold more during autumn. Distribution trucks are
sold evenly all year around. There is no standard regarding used truck customers, it could be anyone from small to big companies, but the majority are small haulier companies with less than ten trucks in their fleet. Trucks that are built for a specific use are used accordingly even when they change owner.

**Vehicle related**

When a used vehicle is bought the important factors are the general condition, tires standard, last inspection, and test drive tells a lot about a truck if the test driver has a lot of experience. Customers also look if the car is clean and neat. In a used truck conversions are made, but it depends of what kind of truck it is. Clients that buy in autumn sometimes add a plow attachment and some add hydraulic systems.

80-85% of the new truck customers buy the Repair and Maintenance contract. For the used truck customers the most common service offerings are: financial contract, maintenance contract and Scania insurance. The service salespersons calculate how much the maintenance contracts should cost, based on what kind of truck, how far the customer will drive and what kind of goods that are to be transported. The truck's current condition does not affect the price of the maintenance contracts. The repair and maintenance contract includes repairs and it is usually not profitable to have on a used truck.

95% of the used trucks that are sold are trade-ins, the main reasons for a truck owner to buy a new truck and trade in the old one are the fact that the client got a new type of route, new type of goods that require a different truck, or a better Euro class is needed. When it comes to why a used truck owner trades in the old truck to buy a new used vehicle, it mostly is because a different type of truck is needed due to a new assignment.

**Driver related**

In small companies the drivers have more power to influence the purchase of a truck than in big companies. Regarding the driver comfort there is not a big difference in Scania trucks from the last ten years, so customers know what they get when they buy Scania. The seat is the most important factor when it comes to driver comfort.

**Transition Phase**

The first the dealer does in a transition phase is to sort out the trucks intended for export, because those trucks will not go through the workshop. The cheapest trucks, below 100 000 SEK, are forwarded as they are. The remaining trucks go through the workshop and follow a test protocol with 120 points. The average truck that comes as a trade-in goes through a “trade-in-test”, a reconditioning and a service if the last one occurred long time ago. After this, pictures are taken and the truck is advertised on the homepage. All this is supposed to take one week but usually it takes two. When the add is up customers start to call in. Three to four clients are processed at the same time. The customers take a look at the truck and discuss the price and eventual additional work to be done. A deal is signed and funding is discussed. When the deal is signed the truck is delivered. A used truck deal usually takes ten days.
The trucks stand on the yard on average 200 days but the goal is 120. In this period it is not moved a lot, maximum 50-100 km. No technology is added unless the customer asks for it. FMS is not sold to used trucks because they do not have C200, but in four years it is going to change a lot.

**Others**

Trucks that have C200 are almost exclusively sold in Sweden. The first owner has the vehicle five to six years and the lifetime of a truck in Sweden is ten years. Trucks that are older than ten years are exported. Finland buys trucks with 4-axles. Holland has two to three big purchaser, they buy standard cars, chassis, simple flatbed trucks and crane trucks. Out of this 70% of the trucks are successively exported to Africa. In Africa, the trucks are older than ten years and are in bad conditions. Iran, Iraq and Afghanistan want small vans, chassis and refrigerator vans when they become ten years old. South America buys Volvo.

Trucks in Sweden and trucks in Europe are not the same, they are used in different ways. In Sweden, the trucks are very specialized, in the rest of Europe they have a much larger fleet. Fleet owners in Europe have a truck for about four years but it is used very intensively and after four years it is a wreck. Swedish trucks are handled in a completely different way, they are handled much better. That is why Dutch companies buy trucks from Sweden, they get a much better truck for the same money.

**Respondent Y**

**Background**

The respondent is a salesperson of used vehicles in Sweden. The company is not Scania owned but sells Scania trucks, both new and used vehicles. The company has four facilities in Sweden, and three of them also have workshops. Used trucks are never bought actively, they are all trade-ins. Most of the used trucks are from year 2001, 2008, 2009 and 2010. At the moment there are no trucks that are from year 2011 or younger.

**Business related**

Used truck owners according to the respondent are companies that use the truck as a complement to their main activity, and companies whose income do not entirely rely on the truck.

**Vehicle related**

Today, when a new truck is bought, the focus is on fuel consumption. New trucks are adapted to the customers' request. The most popular service today is Repair and Maintenance contract, but it is only for new trucks. A new truck is usually turned in after the amortization period is over, five to seven years, or because the requirement of Euro class is changed.

**Driver related**

The drivers can, to some extent, influence the purchase of a truck in smaller companies. In bigger companies it is harder. Those who buy second-hand cannot choose that much, so it is mostly a coincidence and you take what you find. The most important factor for the comfort of the driver is air suspension and automatic gear.
Transition Phase

The sales process of used trucks looks different depending on the category of the vehicle. In Sweden there is no demand for trucks that have a mileage of over 1 000 000 km, those are exported to Bolivia or sold to Swedish traders that successively export to Dubai, Finland, Latvia and Russia. Some trucks are also sold to Denmark. For trucks that are in a better condition a trade-in check-up is made. All problems are noted and solved but only after discussion with the customer. After that the trucks are charged and they stay at the dealers’ until they are sold. The trucks are also advertised on Scania’s used trucks home page. It takes usually between two months to one year before the truck is sold. No service nor installation of C200 are made unless it is on demand of a customer. FMS is not sold to used trucks.

Respondent Z

Background

The respondent is a sales manager at a non-captive Scania dealer in Sweden. The company sells both new and used trucks from year 2000 to 2013. Last year’s sales volume was 140 new trucks and 110 second-hand trucks.

Business related

According to the respondent everyone wants to buy a new truck, only those who cannot afford a new truck buy a used one.

Vehicle related

The priorities when buying a new truck depend on the type of use. Those who drive long-haulage need a spacious cabin because they have to sleep in it. Those that drive in northern Sweden need a big engine and those who drive to landfills need flexible trucks. Second-hand vehicle buyers “pimp” the vehicles sometimes.

The main reason for trade-ins of first-hand tucks is mileage, because the owners do not want to come to a point where they have to make big reparations to their trucks. For second-hand trucks the main reason for trade-in is because the customers want to trade up to a better second-hand truck. It happens as well that trucks change their primary use.

Driver related

The drivers power to influence the purchase of a truck depends on the company. Some companies let the drives decide everything and some nothing. If the company buys used trucks no one has much power to choose, it depends on what is available at the moment.

Transition Phase

When a used truck is collected it is tested, washed, cleaned, and what is broken is repaired. To sell a used truck can be more difficult than selling a new, sometimes customers can be much more picky than new truck customers. Sometimes the clients want the reseller to repair the vehicles so that they look like new, mentioned the respondent. The sales process takes from half a year up to two years. If
the truck stays a long time on the yard the chances are high that the truck needs to be repaired again. Sometimes trucks are rented out, but it is not common. No technology is usually added on a used truck and FMS services are not sold because the customers just want a cheap truck.
Appendix J – Result of Group Brainstorming Translating Parameters into Data

- Service
  - Applications
    - Driver competition app
    - Ways app
    - Messaging
  - Tachograph
    - Remote download
    - Tacho basic
  - FMS
    - Monitoring
    - Service planning
    - Control
  - R&M
    - R&M contract
    - Workshop visit frequency
    - Scania Assistance
  - Coaching
    - ADAS
    - Scania driver coaching
  - Platooning
Appendix K – Visualisations from the Hypothesis Validation

Reference Vehicle

Amount of stops two weeks before and after middle

GPS positions two weeks before and after middle
### Drivers two weeks before and after middle sales date

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Fuel consumption two weeks before and after middle

Run time and idle time two weeks before and after middle
Distance driven and coasting two weeks before and after middle

![Graph showing distance driven and coasting for a reference vehicle. The x-axis represents the date, and the y-axis represents distance in kilometre. The graph includes two lines: one for distance driven and another for coasting. The equations for the lines are given as: y = 729.29x - 3E+07 for distance driven and y = 125.87x - 5E+06 for coasting.]
Vehicle 1215

Amount of stops two weeks before and after sales date

![Graph showing amount of stops vs date for Vehicle 1215. The graph includes two lines:
- A solid line with the equation $y = 7.8158x - 325582$, representing the amount of stops before the sales date.
- A dashed line with the equation $y = 5.74x - 239087$, representing the amount of stops after the sales date.]

GPS positions two weeks before and after sales date, vehicle 1215

![Maps showing GPS positions for Vehicle 1215 before and after the sales date. The maps highlight the routes taken by the vehicle in red dots.]
### Drivers two weeks before and after sales date, vehicle 1215

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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting two weeks before and after sales date

Vehicle 1215

Distance driven and coasting two weeks before and after sales date

Distance : Kilometre

Date

Sold
Distance driven
Coasting
Vehicle 1949

Amount of stops two weeks before and after sales date

GPS positions two weeks before and after sales date, vehicle 1949
Drivers two weeks before and after sales date, vehicle 1949

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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting two weeks before and after sales date

![Graph showing distance driven and coasting for Vehicle 1949](chart)

Distance : Kilometre

Date

Vehicle 1949

\[ y = 117.85x - 5 \times 10^6 \]

\[ y = 14.484x - 6.03385 \]

\[ y = 151.68x - 6 \times 10^6 \]

\[ y = 27.426x - 1 \times 10^6 \]
Vehicle 1967

Amount of stops two weeks before and after sales date

![Graph showing amount of stops before and after sales date](image)

y = 11,108x - 462359

y = 12,817x - 533601

GPS positions two weeks before and after sales date, vehicle 1967

![GPS positions map](image)
Drivers two weeks before and after sales date, vehicle 1967

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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting two weeks before and after sales date

Vehicle 1967

- Distance: Kilometre
- Date

Driven
- Distance
- Coasting
Vehicle 2053

Amount of stops two weeks before and after sales date

GPS positions two weeks before and after sales date, vehicle 2053
Drivers two weeks before and after sales date, vehicle 2053

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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting vehicle 2053 two weeks before and after sales date.
Vehicle 2931

Amount of stops two weeks before and after sales date

GPS positions the whole period before and after sales date, vehicle 2931
GPS positions two weeks before and after sales date, vehicle 2931

Drivers two weeks before and after sales date, vehicle 2931

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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting two weeks before and after sales date
Vehicle 5124

Amount of stops two weeks before and after sales date

![Graph showing fuel consumption and GPS positions for Vehicle 5124](image)

GPS positions the whole period before and after sales date, vehicle 5134

![Map showing GPS positions](image)
GPS positions two weeks before and after sales date, vehicle 5134

Drivers two weeks before and after sales date, vehicle 5134

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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting two weeks before and after sales date

Distance: Kilometre

Date

Vehicle 5124

Distance driven
Coasting
Sold

$y = 344.88x - 1 \times 10^7$

$y = 62.65x - 3 \times 10^6$

$y = 255.13x - 1 \times 10^7$

$y = 38.264x - 2 \times 10^6$
Vehicle 6680

Amount of stops two weeks before and after sales date

GPS positions the whole period before and after sales, vehicle 6680
GPS positions two weeks before and after sales date, vehicle 6680

Drivers two weeks before and after sales date, vehicle 6680

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Fuel consumption two weeks before and after sales date

Vehicle 6680

\[
y = 131,04x - 5E+06 \\
y = 188,29x - 8E+06
\]
Run time and idle time two weeks before and after sales date

Distance driven and coasting two weeks before and after sales date
Vehicle 8230

Amount of stops two weeks before and after sales date

GPS positions two weeks before and after sales date, vehicle 8230
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Fuel consumption two weeks before and after sales date

Run time and idle time two weeks before and after sales date
Distance driven and coasting two weeks before and after sales date
Appendix L – Brainstorming Transition Alert Service
2nd hand owner

Customer in phase 3!

Sell services adapted to right phase

Get into about 2nd hand owner to be able to adopt the services and create new ones

TAS?

Dealer

Create services

S&D

Customer in phase 3!

TAS?

Activities

Effect

Customer made service

TAS?

Contact customer and sell

Close services adapted to right phase

Which phase 1, 2, 3...

TAS?

Distributor

Contract

Compare

OLD OWNER

Distributor received TAN

Data

New owner

Effect

Avoid info in wrong hands

Contact the new owner and confirm

CANCEL OLD ONE and start up NEW ONE

CONTACT THE NEW OWNER AND CONFIRM
**Effect: Avoid unnecessary telecom costs**

**Idea:** Automate cancellation when crossing a border.

- Fast cancellation
- Automatic cancellation
- Do not lose any vehicles going abroad
  - Cancellation of all contracts, even those that should not be cancelled
  - No use of TAS
  - What if the driver can choose to cancel service or not?
  - How find the customers with cancelled contracts?
  - How start contact again.
  - It is not unusual that the vehicles cross borders during their assignments.

**Actions/Activities**

- Vehicle crossing a border
- The system detects the crossing of a border together with GPS coordinates
- The contract is cancelled and data flow is sending in to LMPA
- Avoid unnecessary telecom costs

---

**How to avoid unnecessary telecom expenses**

- Stop the data flow when abroad
- Simultaneous roaming + core
- Data upload options in the roaming

---

**Telecom collaboration**

- International connection + roaming
- Not SIM card dependent
Switching SIM Cards

- The SIM cards have to be inserted when the truck is bought.
- Within the truck, change country/country
- Might be technically hard
- bulky solution
- All SIMs have to be registered for the same vehicle.
- impossible

Activities

- Truck drives over the border
- GPS reads SIM cards
- SIM cards activate the truck

Effects

- Avoid unnecessary telecom costs
- No distributor included in the process
- Automatic

Activities

- Vehicle passes a download station on the road
- The driver connects to the station and starts the download
- The station sends the data to Scala

Effect

- Avoid unnecessary telecom costs

Activities

- Will take care of downloading the stations?
- Needs stations
- No SIM card necessary
- Automatic download on the road
- Not so flexible solution
- Dependent on the download stations
- Data will not be sent as often as with the current solution
- Needs WiFi
- The driver has to make a stop on the road when downloading
- What if the driver forgets to download?
- Forces the driver to take a break
Appendix M – Brainstorming on Possible Applications
Idea: Keep the technology updated in the vehicle.

- More sales opportunities for the workshop.
- The customer feels important that Scania cares about them.
- People to customize.
- The vehicle owner might not want to be contacted.

Idea: Create a system that tells the workshop that a vehicle in a specific type of life cycle phase needs a specific workshop visit and special spare parts, etc.

- The workshop will find new potential customers.
- The vehicle owner might feel special.
- The vehicle owner might not want to be contacted.
- Who will take care of the system?

System:
Vehicle in phase 1 usually needs:

Vehicle in phase 2 usually needs:

Vehicle in phase 3 usually needs:

Vehicle in phase 4 it might need:

Hi, I said that you have received a invoice, and since it is in phase 4, it might need this type of R/L.
+ NEW BUSINESS OPPORTUNITY FOR SCANIA
+ THE NEW OWNER WILL BE OFFERED THE RIGHT KIND OF SPARE PARTS
+ THE NEW OWNER MIGHT FEEL A BIT SUPERVISED AND CONTROLLED
+ NOT SCANIA'S MAIN BUSINESS
+ TAB ALONE IS NOT ENOUGH, A PROGRAM HAS TO BE CREATED

COULD THE SERVICE BE SOLD TO OTHER SPARE PART DEALERS AS WELL, AND NOT JUST SCANIA?

VEHICLE OWNER
WHERE IS MY TRUCK

DISTRIBUTOR → POLICE

+ EASE THE POLICE'S JOB
+ FIND LOST VEHICLES FASTER
+ MIGHT LEAD TO THAT THE AMOUNT OF STOLEN VEHICLES DECREASE
+ MAKES THE SCANIA BOARD STRONGER, MAKES THE OWNER'S BUSINESS
- NOT SCANIA'S MAIN BUSINESS
- IN THE DISTRIBUTORS HAVE BEGUN FOR THIS KIND OF JOB?

DOES THIS HAPPEN AS OFTEN THAT THERE IS ANY USE FOR THIS KIND OF SERVICE?

VEHICLES IN LATER TRANSITION PHASES

TAB

IN NEED OF SPARE PARTS

BY TAB

IDEA: SELL INTO ABOUT VEHICLES IN NEED OF SPARE PARTS TO SPARE PART DEALERS

STOLE THE TRUCK

GPS COORDINATES

TAB
NEW BUSINESS OPPORTUNITY
- SCANIA
- THE DAHLER WILL FIND THE BEST TRUCK
- THE SALESPERSON RENT
- THE SALESPERSON WILL BE HONORED.
- IS IT EASY TO SELL DATA
- ABOUT ANOTHER PERSON'S USE OF A VEHICLE?
- SELLING INFO IS NOT
- SCANIA'S MAIN BUSINESS
- THE FIRST ORDER MIGHT
- USE THE VEHICLE AS A BETTER WAY SINCE IT
- SHE KNOWS DATA IS
- COLLECTED AND WILL
- BE USED.

SELL TRANSITION PHASE
- BECAUSE OF
- HOLLERS WHEN THEY WANT TO BUY
- USED TRUCK FROM A PRIVATE PERSON.

BEFORE:
- PROGRESS IN SELLING
- HOLLERS TO OTHER HOLLERS
- SENDING ASSISTANCE TO THE REPAIR TRUCK

ADDD:
- MORE DATA
- TAS CONNECTION NEEDS
- TO BE ENHANCED
- THROUGH DATABASE?