



Expertise
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Jenna Metsola

Bringing Valuable Data to Transportation Companies with Advanced Vehicle Telematics

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<p>Insinööriyön tutkittavana kohteena oli raskaiden ajoneuvojen telematiikan ja datan avulla tuotettujen kalustonhallintapalveluiden kehittäminen ajoneuvovalmistajan näkökulmasta. Tutkimuskysymys kuului seuraavasti: "Kuinka kohdeyritys voi kehittää Fleet Management -palvelujaan tuottaakseen asiakkailleen suurempaa lisäarvoa ja ohittaakseen alalla vallitsevan kilpailutilanteen?"</p> <p>Ensimmäiset kappaleet pohjustavat työn taustoihin ja kartoittavat yleisymmärrystä vahvasti työhön liittyvistä aihealueista, kuten big datasta ja kuljetusalan globaaleista megatrendeistä, jotka vaikuttavat kohdeyrityksen asiakkaiden vaateisiin vahvasti erityisesti lähitulevaisuudessa. Näiden jälkeen työssä selvitetään raskaiden ajoneuvovalmistajien keskinäistä FMS standardia, joka on osittain mahdollistanut alan kilpailutilanteen.</p> <p>Työn tutkimusosuus alkaa kohdeyrityksen nykytilanteen ja kilpailijoiden kartoittamisella sekä analysoinnilla ja jatkuu kohdeyrityksen asiakkaiden haastatteluihin. Haastateltavina yrityksenä olivat kohdeyritykselle merkittäviä asiakkuuksia, joilla on käytössään erilaisia telematiikkaratkaisuja ja halukkuutta kaluston hallintaan liiketoiminnan kehittämiseen ajoneuvosta ja kuljettajista saatavan tiedon avulla.</p> <p>Haastatteluista kerätty data ryhmiteltiin aihealueittain ja taulukoitiin tärkeimpien haastattelutulosten priorisoimista ja tulkitsemista varten. Tulokset jakaantuivat selvästi nykytilan kehittämiseen liittyviin osa-alueisiin, joilla kammitetaan nykyinen kilpailutilanne sekä kokonaan uusiin osa-alueisiin, jotka tuovat täysin uusia liiketoimintamahdollisuuksia.</p>	
Avainsanat	Ajoneuvodata, älykkäät ajoneuvot, etäyhteydet, telematiikka, big data, kuljetukset, FMS, seurantajärjestelmät

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<p>The research object of this thesis was to develop the fleet management services with telematics and data from heavy vehicles from the vehicle manufacturer's perspective. The research question was "How can the case company develop their Fleet Management services to create more value to their customers and tackle the current competition in the field?"</p> <p>The first chapters outline the research background and increase the knowledge of basic topics related to the work, such as big data and global transportation megatrends. The megatrends are strongly affecting on the case company's customer-needs in the near future. Next chapters after these explain the common FMS standard agreed between the main vehicle manufacturers which has partly enabled the current competition in the market.</p> <p>The empiric part of this research starts with analyzing the current state of case company and mapping out the competitors and continues with case company's customer interviews. The interviewed companies are significant customers of the case company and have variety of different telematic systems in use and are interested in fleet management and improving their businesses with the data collected of the vehicles and their drivers.</p> <p>The data from the interviews was then categorized by the topic and divided into a chart to prioritize and reveal the most important findings. The findings split clearly up to areas that focus on developing the current state and tackle the competition and to totally new areas that enable new business opportunities.</p>	
Keywords	Fleet data, smart vehicles, connectivity, telematics, big data, transportation, smart trucks, FMS, FMS standard

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List of Abbreviations

API	Application Programming Interface
CAN	Controller Area Network
ECU	Electronic Control Unit
FMA	Fleet Management App
FMP	Fleet Management Portal
FMS	Fleet Management System
IoT	Internet of Things
M2M	Machine to Machine
OEM	Original Equipment Manufacturer
rFMS	remote Fleet Management System

1 Introduction

1.1 Research Background

Today, data can be collected from almost any possible object. The same applies for transportation industry and heavy-vehicles where the data can be collected of anything from tires to the vehicle bodies, trailers, refrigerator systems and the vehicle itself. The vehicle manufacturers alongside with other suppliers are offering software solutions for transportation companies to take better control over their fleet and drivers. The development and competition in this field is increasing rapidly and new service providers trying to enter the market.

The vehicle manufacturers need to develop an improve their offerings if they prefer to keep up with the competition and even take the leading position. Today, the increasing number of mixed fleets (=fleets that consist of vehicles of different makes) and the scattered data from different systems force customers to buy third-party solutions that can be customized to meet their needs and to be installed in every vehicle and equipment regardless of its manufacturer.

Also, there is a big amount of data that is or could be collected from the trucks but is not made available for the customers yet. The valuable data is information that is comparable with money. If it can help businesses to increase their revenue either by increasing the sales or saving the costs or time, it is defined as valuable fleet data.

1.2 Case Company

1.3 Objective and Scope

The objective of this study is to find out how the case company could improve the Fleet Management services to bring more value and valuable data to their customers and tackle the competition of the third-party service providers. Part of this study is also to identify, analyze and suggest a new business case for the case company.

Even though the data from the vehicles is used for many operations at the case company, the scope of this study is to focus on developing the customers' Fleet Management services and identifying the most beneficial new data or new functions. This research focuses on the Finnish market. If some information is brought to the researcher's knowledge that the case company could use to improve their services or to create another saleable solution to the customer, it will be included in the result and suggestions for further investigations.

1.4 Research Methodology

This research is based on literature study, the researcher's own experience and observations in daily work, and most importantly, on customer interviews and feedback. The main results are based on findings and analysis of these interviews and they represent a form of qualitative research. The interviews were held with companies of big vehicle fleets where there is a higher interest and understanding for improving the businesses with high-quality data.

The interview questions were prepared, but the interviews were carried out as open or semi-structured depending on the conversation flow. Half of the interviews were recorded, and the other half performed on the phone and therefore required taking notes. The interviews are followed by an analysis phase supported by the information from the theoretical research. All the results and findings are saved and presented to the case company in the results section with suggestions for actions and further research.

The online sources (websites, articles, studies) and the case company's internal material played an important role of collecting the information for literature study and the current state analysis.

1.5 Research Structure

After the introduction, this research is divided into three main areas: theoretical review, the case company's current state and the findings from customer interviews. The theo-

retical review introduces to big data and telematics and how they are used in fleet management. The research also covers megatrends in transportation industry, which helps to understand the customer challenges when analyzing the results of the interviews.

The part after the theoretical review, introduces the current state within the area of connectivity and vehicle telematics. The section includes an introduction and analysis of the main competitors and outlines their main advantages and disadvantages. Last part of the research consists of the analysis and findings from the customer interviews and suggestions for next development steps for the Case company.

2 Theoretical Background

The basics of big data collection, usage and benefits in business analytics and smart devices are explained in this chapter for the reader to gain wider perspective of the research topic. Besides the basics of big data, the chapter includes the requirements for telematics and presents the global megatrends that affect the transportation companies and their needs.

2.1 Big Data

Big data means an immense amount of raw, unprocessed data that is used to reveal patterns, trends or associations by analyzing it. Big data is often described by 3V's, Volume, Velocity and Variety, to explain the huge data volume, the speed the data is generated at, and diversity of the sources the data is collected from. The type of sources the data is collected from depends a lot on the field of business. In general, the data is pulled from hundreds or even thousands of sources, including everything from operations systems, customer and sales interactions to mobile devices, applications, weather conditions, social media and vehicle telematics. [Lebied, 2018; LTX, 2018]. Figure 1 illustrates what Big Data is.

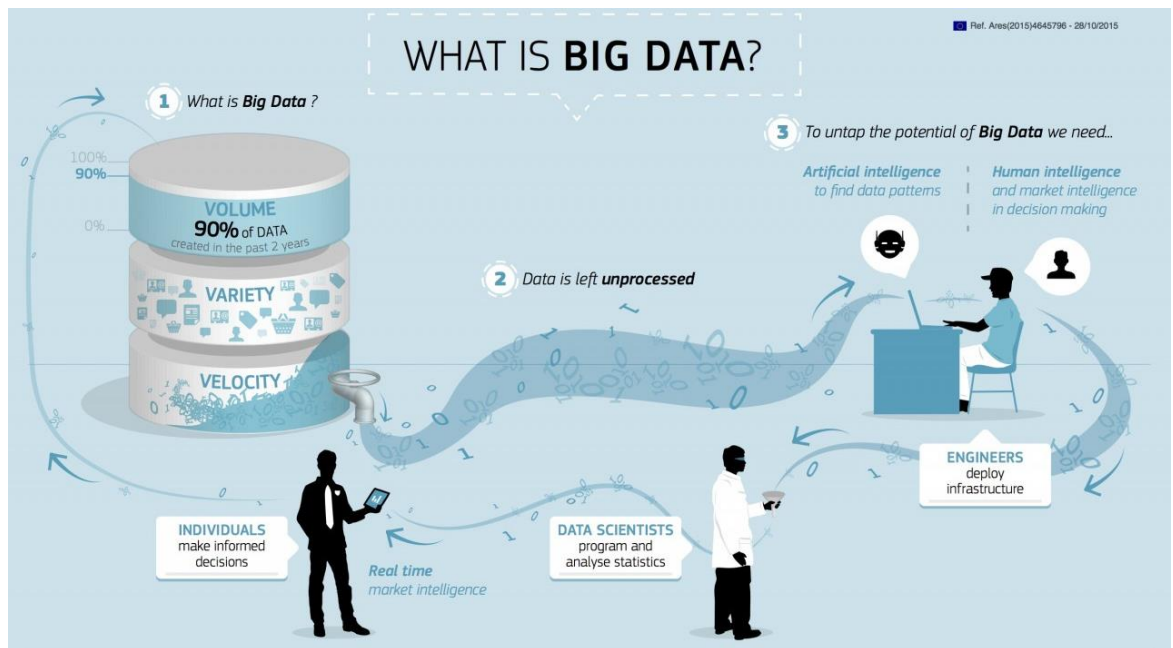


Figure 1 What is big data?

As seen in the Figure 1, the raw data requires further processing to become beneficial. Advanced and predictive analytics is one of the major usages of big data, which is also one of the prerequisites of urban, “smart” cities and allows people to make fact-based business decisions. [Walter, 2018.]

Big data plays an important role in telematic services, but when telematics mean collecting data from the vehicle, big data includes the raw pieces of information that can be collected and gathered from practically any equipment. [Lebied, 2018.]

It’s important to identify the need for data and define the innovations that are expected or necessary, such as IoT (Internet of Things). When transportation networks and logistics management grow, the data becomes more complex and the amount of data sources increases. This is when different business intelligence tools become handy. There is a huge untapped potential for improving operational efficiency and creating useful new business models [Talari, 2018].

Companies in every industry need to invest in the right tools and find the right people and the right data sets for their needs, to benefit from the big data. Because of the digitalization-era, big data is quickly changing the transportation industry. It is important for

the businesses to adapt a new mindset or it will become more and more difficult to compete in today's business. [Johnny, 2018.] The digitalization and big data may seem distant for some transportation companies, but it has already been seen to change bigger companies' way of working extremely fast by creating possibilities to improve their business on a new level. [Lebied, 2018].

The massive flows of goods in the logistic sector create large data sets of millions of shipments including the tracked information of their destinations, sizes, weights, contents, temperatures and locations. This data might hold a lot of "untapped potential for improving operational efficiency or customer experience and creating useful new business models" [Talari, 2018.] As an example, Talari points out the benefits of integrating supply chain data streams from multiple logistics providers. That kind of usage of big data could eliminate market separation and enable vigorous new collaboration and services. [Talari, 2018].

Route optimization is a good example of improving efficiency and customer satisfaction in logistics by data collecting. Route optimization requires variety of data from the vehicle and its environment, such as real time position data, road data (max weight, max height, maintenance, constructions), traffic data, and digital tachograph-data of driving times. An extreme proof of route-optimization and its benefits comes from a logistics company, UPS, when they introduced their No left-turn policy. According to UPS, the route-optimization enabled the company to save "annually 10 million gallons of fuel, delivers 350,000 more packages and emits 20,000 tons less of carbon dioxide" [Lebied, 2018].

2.2 Internet of Things

Internet of Things (IoT) is a relatively new term to describe smart, connected products. The IoT products are connected to the Internet to send information from sensors or receive commands to perform needed actions, like start the coffee machine or lock the car remotely. These products can be anything from small equipment to big transportation assets and they enable collection of big data and help create new services and develop current businesses [Geotab, 2017; Lequerica, 2017].

2.3 Telematics in Heavy Vehicles

The term ‘telematics’ comes originally from words “information technology” and “telecommunications”. It is a way to monitor a vehicle by collecting position and performance data and other diagnostics directly from the vehicle using satellite position (GPS) and reading the operational data from the vehicle’s controller area network (CAN) bus. The information is recorded and transferred wirelessly over cellular network by a separate telematics device for further use. [Michael, 2018; Holt, 2017]

GPS fleet tracking is often described as a synonym for telematics, but to be clear, telematics is a much wider concept, which can include driver performance and other highly developed functions, such as geofencing and advanced cruise control functionalities. The use of telematic services can be beneficial for any type of businesses. Today it is most common within logistics and transportation industry, but it is widely used in other industries, such as emergency organizations [Johnny, 2018].

2.3.1 FMS Standard

Since the telematics started to play a more important role for transportation companies, it became an issue for companies with mixed fleets to monitor their whole fleet. The third party telematic devices were installed and connected directly to vehicle CAN bus, which caused errors in the vehicle operation. That resulted in the creation of a common FMS (Fleet Management System) standard within the main truck manufactures to enable easy access to some of the agreed vehicle data. The FMS standard was created in 2002 when the main truck manufacturers agreed on creating a common FMS interface. [LogiCom GmbH, 2018].

In other words, the FMS interface, also known as the FMS Gateway, is made for a safe connection to vehicle data, regardless which OEM (Original Equipment Manufacturer) produced it. Besides the vehicle operational data, the FMS standard covers remote download of digital tachograph [LogiCom GmbH, 2018].

Due to digital development and increasing demand of accessing the vehicle data via API’s (Application Programming Interface), a remote FMS (rFMS) standard was created.

The rFMS was published in 2017 to help gather the vehicle data over cloud services from different OEM's without expensive hardware installations. With the current rFMS API-version, it is possible to fetch vehicle information and position data directly from OEM's 'servers in an agreed, reliable way. [LogiCom GmbH, 2018.]

The latest version of the FMS standard, version 4, was published in October 2017 together with the rFMS standard specification. The detailed description can be found online from the FMS standard description. [LogiCom GmbH, 2018.]

2.3.2 Telematics in Fleet Management

Telematics is a crucial technology for fleet management. It supports multiple areas for better success in transportation business, such as productivity, optimization and safety – just to name a few. The OEM's and a wide scale of different third-party suppliers offer Fleet Management services directly to the transportation companies or benefit from it by creating other services that are based on telematics and performance data. [Geotab, 2017.]

For increased productivity and improved optimization, telematics enable flexible services, more efficient route-planning and vehicle tracking, predictive maintenance and remote diagnostics. It also helps businesses to react to fuel costs by following up driving behaviors and vehicle performance. Safety is increased by alerts from the vehicle, tracking a lost vehicle, offering a possibility to pay attention to risky driving styles and by tracking dangerous cargo. [Michael, 2018.]

Fleet Management services are developing rapidly which creates huge possibilities in the transportation industry. Telematics are in the heart of future development when it comes to autonomous vehicles and platooning functions (communication with nearby vehicles). Connectivity enables truck owners to remotely control the vehicle behavior in specific areas. Digitalization and increasing demand of IoT builds smart cities, where fleet management plays an important role. [Michael, 2018.]

2.3.3 Aplicom Telematic Device

Aplicom is the main manufacturer of telematic devices and softwares for third-party service providers, vehicle manufacturers and system integrators who provide solutions and services to end-customers with commercial vehicle fleets, such as transportation companies. They deliver customized solutions to their customers and provide development toolkits for their partners. Aplicom products and services are sold to other service providers, which result with most of the third-party telematic providers actually using the same telematic device for their services.

As explained in the FMS standard-section, the main truck manufacturers have designed a common interface (FMS) as an open standard to collect CAN data from the heavy vehicles. Aplicom device enables third-parties to collect available data via FMS interface (located in FMS connector). However, this connector is not mandatory accessory in the vehicles and may not always be installed as default. “If the standard FMS connector is not in place, the FMS interface can exist in other vehicle connectors” [Aplicom, 2019]. Finding the FMS CAN bus or retrofitting this connector requires consulting the vehicle manufacturer or dealer.



Figure 2 Aplicom telematic device (Aplicom, 2019)

Aplicom doesn't only offer the vehicle FMS data but is useful for other fleet management functions, such as protection of drivers, vehicles, assets and cargo. Combining their telematic device with other accessories, functions like vehicle door control, vehicle or

asset theft protection, fuel theft control, and driver assault alarms are all possible. [Aplicom, 2019.]

2.4 Global Transportation Megatrends

Megatrends are described to be global changes forced by technological, cultural and environmental development. Megatrends affect our businesses, personal lives, cultures and economics. Megatrends affect different industries and objects in different ways and therefore it is important to analyze and understand the effects of each megatrend to specific fields of businesses separately. [Efrat, 2018.]

In some studies [Efrat, 2018], the megatrends are divided into different key areas or key themes to simplify analyzing the effects and to make it easier to identify the most important ones. The key themes often include the following:

- Economy
- Energy and Environment
- Infrastructure development
- Social
- Technology
- Urbanization

For example, some megatrends that are analyzed to have a high impact on transportation industry are urbanization, smart cities, digitalization, generation Y, cloud computing, satellite technology, robotics, e-mobility, infrastructure development and wireless intelligence. [Efrat, 2018.]

Urbanization describes the increase of population in urban areas and the integration of core cities with their suburb areas. Urbanization expands city limits and therefore impacts on the future mobility and logistics, working life and employment, and the societies [Efrat, 2018]. The urban areas that create sustainable economic development and high-quality life are called smart cities. They require high knowledge of different key areas, such as economy, mobility, living and people. Developing urban areas also need human capital, social capital, and ICT infrastructure [Business Dictionary, 2018]. Generation Y is used

of the generation of educated, so called digital natives, from age 15 to 35 with a high purchasing power. Their lifestyle and behavior influence the technological development and marketing strategies and they will be the most adaptive generation to new technologies and future changes. [Efrat, 2018.]

Digitization as a megatrend is affecting most industries. It enables transportation companies to apply big data and improve their other operations by, for example, replacing the paper-based processes with new digital solutions. This megatrend has been ongoing for some years now and the digital development combined with new innovations keep constantly creating more opportunities to companies to improve their efficiency. [Riedl, 2016.]

Let's take 5G network as an example of digital development. Figure 3 describes how the new fast-speed data transfer can affect the smart city operations from different aspects:

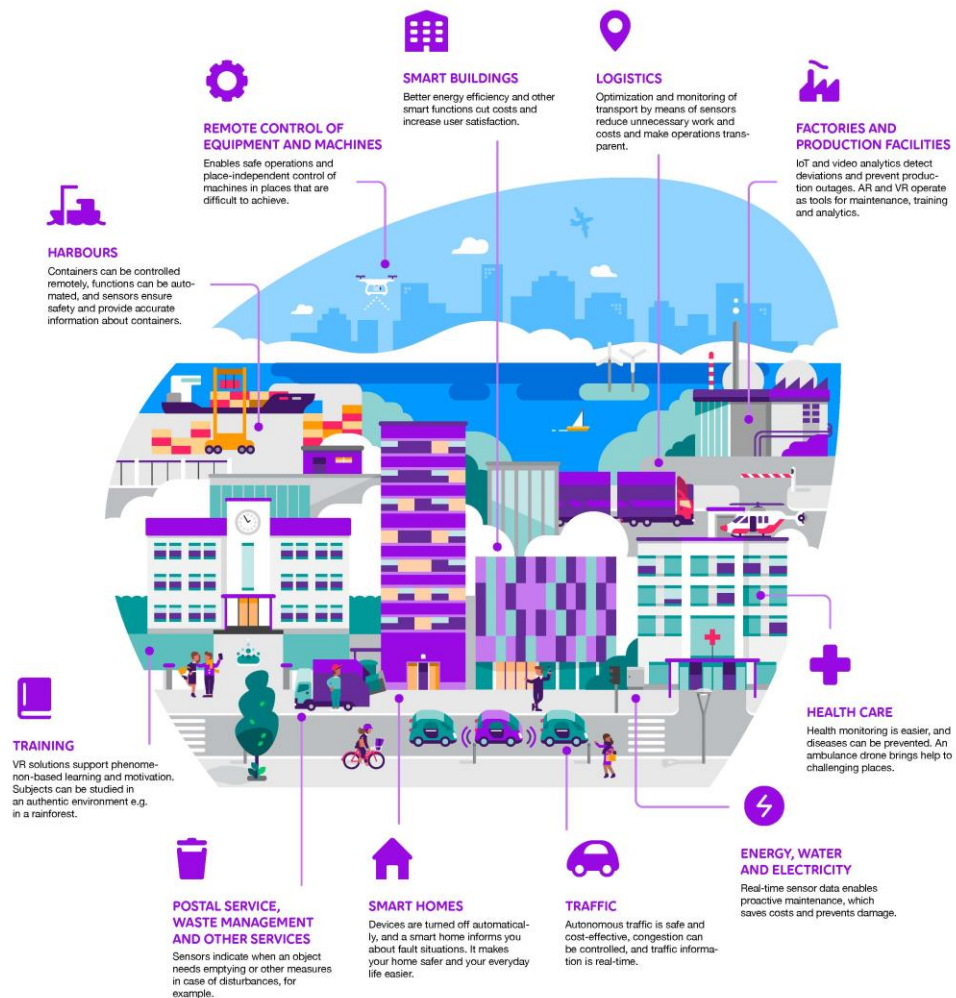


Figure 3. 5G network effect on cities [Telia, 2018]

As seen in Figure 3. 5G network effect on cities, this new step of development creates so many new innovations and possibilities around different areas. 5G comes with almost twenty-times faster speed of data transfer, more reliable connections on mobile devices and better responsiveness. All these functionalities enable and support development of innovations like virtual reality and self-driving (autonomous) vehicles. Before these types of innovations become reality for transportation companies, 5G might become handy for Fleet Management services with better reliability and real-time data (although this requires OEM's to develop telematic-units that support 5G network). [Telia, 2018.]

3 Current State Analysis

The analysis of case company's current state is presented in this chapter starting with their current market situation and telematics to be continued with the competitor analysis. Current market situation and competitor analysis are based on research of online materials, case company's internal material and writer's own experience and observations.

4 Analysis of the Interview Data

The main research method, besides online research and researchers own observations on the topic and customer feedback, was select customer interviews. The interviews were open interviews with some semi-structured parts in the beginning of the interviews.

This chapter contains the results from the interviews. The results are grouped by the topic and not identified towards the interviewed companies. When looking at the results, it needs to be remembered that the opinions and ideas may vary a lot depending on the person's role and experience. A fleet responsible may not share the same visions of data benefits and future than the people responsible for running the business/business development.

The companies that were selected for these interviews have their own interest in developing their business. When choosing the companies, the smaller ones were left out on purpose.

4.1 The Interviewed Companies

Common for all selected companies is that they all operate in Finland, even some of them have associated companies abroad. The fleet sizes of these companies are bigger than average in Finland (2-5 vehicles) which was a cognitive decision to receive a wider understanding of the competition on this field of vehicle telematics and to find out what needs to be included in the system for them to be able to benefit from it.

The customers have experience from either vehicle manufacturer FMS systems, cooler telematics and/or third-party telematics. All of them have a little different interest and opinions of how the business could be improved or managed with valuable data or what data should be available for them directly and what should be analyzed and used for the new services offered for customers. Main commonalities include the fact that data should be easily accessed or available for integrations, regardless of the vehicle manufacturer, to get the whole fleet under same systems.

4.1.1 Current State and Requirement for Data

4.2 Data Findings

After collecting almost hundred data codes from the interviews, they were evaluated and the most irrelevant or unique ones that didn't include value for the analysis were excluded. The rest of the data codes were grouped and then categorized by themes to make it easier to analyze the research findings, connections between the findings, and value of them. The data codes were categorized as follows:

Customer needs that lead them using other telematic systems and service providers include

Customers require more data and developed tools to support their business in the following areas

Possible functions based on positioning data that could develop route-planning and fleet management

General customer preferences

Other findings

4.3 Data Prioritization Chart

The main topics from the data findings are listed on a prioritization chart to find out the most important objects for further analysis by giving points on several sections. This helps with prioritizing and structuring the data findings in the previous step.

Topics are categorized to create groups to understand connections between the data-requests. The topic is then given points from 1 to 5 based on how significant it is from following aspects:

1. Importance to customer. Number one equals not important and number five equals extremely important, a customer demand and a reason to switch a service provider or to take another system by side.
2. Level of difficulty describes how difficult and big of a contribution it is to execute this topic. Number one equals very difficult and requires lots of development around the topic and/or background and number five equals very simple.
3. Commercial potential describes the importance from the business perspective. Number one equals no new commercial potential at all and number five equals high commercial potential / new business case opportunity.

4.4 Analysis of the Chosen Development Points

5 Results and Suggestions

Based on the prioritization of variety of topics and analysis of the most beneficial development points, the main suggestions for the Case Company's next actions on developing their business around the Fleet Management services are presented in this section.

6 Conclusions

6.1 Implications for the Case Company

Based on the analysis of the interviews and knowing the current state of the competition within vehicle telematics, there are two main topics that would influence positively the businesses of today's transportation companies.

6.2 Recommendations to Further Studies and Actions

The previously mentioned main findings and suggestions are the first and most beneficial steps for the Case Company to take first based on the analysis of interviews and current market situation.

6.3 Final Words

The valuable data is such a wide concept and requires lots of analysis and development to become valuable for the end-user and therefore needs constant research, development and new use-cases. With these result the case company can start to develop the current service but is also given ideas for further actions and possibilities

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Interview questions – Base/frame

Perustiedot

- Haastateltavan nimi ja tehtävä yrityksessä
- Asiakasyrityksen ajoneuvokalusto
 - (a) Määrä, merkit ja ikäjakauma
 - (b) Ajotehtävät ja ulkomaanliikenne?

Tiedon kerääminen

- Millaista dataa ajoneuvoista, perävaunusta ja kuormatiloista kerätään tällä hetkellä?
- Eroaako datan kerääminen eri merkkien osalta?
- Miten dataa kerätään?
 - (a) FMS järjestelmät, kylmäkoneet
 - (b) Sensorit, tägit, muut laitteet

Tiedon jatkokäyttö ja käsittely

- Miten tietoa käytetään tai hyödynnetään eteenpäin?
- Millaisia käyttökohteita ja ketkä sitä hyödyntävät?
- Onko tämä data raakadataa vai valmiiksi analysoitua ja mitä se olisi ideaalitulanteessa?

Haasteet ja mahdollisuudet

- Millaisia haasteita kohtaatte ajoneuvojen ja/tai perävaunujen seurannassa?
- Onko rahdin ja/tai ajoneuvojen seurannalle asetettu vaateita asiakkaiden suunnalta? Onko tämä tuonut haasteita?
- Millainen tieto kuljetuksista tai ajoneuvoyhdistelmistä toisi teille kilpailuedun muihin alan yrityksiin nähden?
- Millaista tietoa ja missä muodossa voisi dataa tuottaa haasteiden minimoimiseksi tai liiketoiminnan tueksi?
- Miten kaluston hallinta tapahtuisi ideaalitulanteessa?
- Miten näette digitalisoitumisen? Mitä haasteita tai mahdollisuuksia se tuo mukanaan?