Where's Our Scooter?

An evaluation of Suppliers for GPS Fleet Monitoring Technology

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Var är vår Scooter? En utvärdering av leverantörer inom GPS-teknologi för flottahantering

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Abstract

Today’s online shoppers expect an ever-faster and more transparent delivery experience. To meet such demands, delivery companies require the latest technologies to track deliveries, manage staff and technology assets. This qualitative research project was done in collaboration with Cooltra, one of Europe’s leading scooter rental companies – and investigated the technologies that enable fleet management, and highlighted benefits and risks of implementing various. It also aimed to find out how companies can evaluate the various supplier, considering the different requirements specifically for fleet management users.

Data was collected through 13 interviews with Cooltra executives, customers and suppliers, and using a literature study with the latest works in fleet management and supplier evaluation. It was found that the GPS solution has the greatest potential of enhancing logistical operations and enable fleet management. As a result of the evaluation, Cooltra was suggested to invest in a GPS-solution provided by Supplier 2, as the supplier scored highest on the proposed evaluation framework; including factors of flexibility, credibility and financial situation. Moreover, the interviews revealed price as a less important factor, and that companies like Cooltra need a strategic supplier with large flexibility to jointly develop custom made solutions. The study proposes a 10-criteria supplier evaluation framework to evaluate suppliers and help decide new fleet management solutions.

Key-words

Fleet management, GPS, supplier evaluation, ICT, platform
Sammanfattning

Dagens online-kunder förväntar sig en allt snabbare och transparent leveransupplevelse. För att möta växande krav behöver leverantör utnyttja den senaste tekniken för att spåra leveranser, hantera personal och tillgångar. Detta kvalitativa examensprojekt genomfördes i samarbete med Cooltra, ett av Europas ledande scooteruthyrningsföretag - och undersökte de teknologier som möjliggör flottahantering och belyser fördelar och risker med att implementera dessa. Ett annat syfte var även att identifiera hur företag kan utvärdera olika leverantörer, med fokus på de krav som specifikt gäller för användare av managering av flottor.

Kvalitativ data samlades in genom 13 intervjuer med Cooltra-chefer, kunder och leverantörer samt en litteraturstudie baserad på de senaste terorerina inom flottahantering och leverantörsutvärdering. En av slutsatserna var att GPS är den lösning som har stört potential att förbättra logistikverksamheten och möjliggöra flottahantering. Cooltra rekommenderades att investera i en GPS-lösning från leverantör 2, eftersom bolaget presterade högst enligt den framtagna utvärderingsmetoden, inklusive faktorer såsom flexibilitet, trovärdighet och ekonomisk situation. Vidare visade intervjuerna att priset är en mindre viktig faktor än vad som beskrevs i litteraturen, och att företag som Cooltra behöver en leverantör med stor flexibilitet för att gemensamt utveckla skråddarydda lösningar. Studien föreslår en mall för inköpare baserad på 10 kriterier som stöd att utvärdera leverantörer och hjälpa utvecklingen av nya lösningar inom flottahantering.

Nyckelord
Flottahantering, GPS, ICT, evaluering av leverantörer
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Foreword

Thanks to colleagues in Barcelona I was part of “Consulting Nights” in the spring of 2016, where we did a case study for the local scooter rental company Cooltra. Little did I know that a year later, I would be writing my Master thesis together with the same company. As I contacted KTH to ask whether my idea for thesis with Cooltra made sense, I received prompt and valuable feedback from Bo Karlsson within the Industrial Management department. A decision was made to write the project, and since then my supervisor Jannis Angelis has been key to help me reach this far. He provided guidance and his expertise in Operations Management served as great background to understand the challenges Cooltra were facing. At Cooltra, their COO Javier was very helpful with welcoming me to Cooltra, introducing me to stakeholders, and explaining their challenges. It has been a fruitful collaboration, and for that I am truly grateful.

Cheers,

Gianfranco Gabassi

Barcelona, September 2017
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1 Introduction

This section explains the background of the thesis. It begins with an introduction of Cooltra, explaining the importance of fleet management, and how it relates to supplier evaluation. The problem formulation and research questions are then explained, followed by delimitations, timeline and expected results.

1.1 Background

1.1.1 Cooltra

Cooltra was founded in 2006 and is today one of the leading companies in Europe providing mobility solution, with ca 6,000 scooters, 17 stores and 100 rental spots. The company is present in Spain, Italy, France, Brazil, and Portugal and has partnerships with Europcar, Cartrawler, Uber, Burger King and JustEat. Cooltra is adding offerings to its B2B business, and an increasingly important feature is to provide a fleet management platform.

To support this technology, Cooltra will need to purchase position tracking technology to embed in each of their scooters. Cooltra offers its fleet via a Business to Customer (B2C) and Business to Business (B2B) channel. The mobile application provided by Cooltra shows available scooters on a map, spread out in a random manner on public parking spots. Users can unlock the scooter via phone and leave it anywhere in the city. For the B2B business, companies can rent a fleet monthly rather than having their own fleet of scooters.

Cooltra’s B2C offering consists of three parts:

- Long term rental (typically exchange students using for 6 months)
- Short term rental (for holidays, 2-3 days)
- Rent to buy (renting for a couple of years, similar to leasing)

The B2B offering also consists of three parts:

- Long term rental (Self-employees)
- Fleet rental (companies like Pizza-hut, Glovo, Just-Eat that rent whole fleets for their own delivery services)
- Rent to buy (renting for a couple of years, similar to leasing)

1.1.2 The need for fleet management solutions

Managing a fleet involves keeping track of drivers and scooters, ensuring each driver is operating within limits and according to business practice. Recently, fleet managers from Cooltra’s customers have requested a solution to track their fleet on a map, to see in real-time where deliveries are going and where their drivers are at any given time. These companies want to ensure drivers comply with rules, and be able to utilize the premium reduction offered by local insurance companies to scooters installed with GPS-monitors. Furthermore, if an accident occurs during the trip, fleet managers have little chance of knowing this unless the driver informs about the accident.

To meet these challenges, Cooltra is evaluating different suppliers of ICT-solutions for fleet management. ICT stands for Information and Communication Technology and refers to equipment, applications and services that involve communication. Examples include computers, cellphones, and television, radio and satellite systems. As such, ICT is a broad term and there are many technologies available for use. Technologies include Global Positioning Systems (GPS), General Packet Radio Services (GPRS) and
Geography Information Systems (GIS), in synergy with online applications are examples of solutions that provide fleet managers instant localization and traceability of deliveries and order status. A fleet management solution is needed by two types of companies; fleet management companies and those who manage their own fleet. In the case of Cooltra, it is required both for tracking their own consumer scooters and to sell a fleet management solution to their business customers, as a way of expanding their offerings.

The worldwide trend is very positive, with the market for fleet management solutions expected to grow from $13.78 Billion in 2017 to 28.66 Billion by 2022, at a Compound Annual Growth Rate (CAGR) of 15.8% (Research and Markets, 2017). The major driver for the increase in demand is argued to be the decline of hardware and connectivity costs. The major barrier is expected to be the cost sensitivity of fleet owner, which is restricting the adoption rate of advanced fleet management solutions. Other barriers may include data protection rules adopted by the European Parliament, with the aim of protecting the privacy of drivers as cars and vans are increasingly monitored (Roberts, 2016). This requires a relationship between the fleet manager and the driver, to ensure a balance of interest between the two parts. Drivers should give the consent once being fully aware what data is collected, how it may be used, who can access it and that it is safely stored.

1.1.3 Urbanization and rapid population growth

The world population is becoming increasingly urban, moving away from rural areas to seek new opportunities in the cities. In 1950, 30% of the world’s population lived in cities, a figure that grew to 54% in 2014 and is expected to reach 66% by 2050. Regional differences are present, with Asia reaching an expected 50% urban population already by 2020, and Africa by 2035. Globally, the population is expected to grow by 2.3 billion people until 2050, during which 2.6 billion will move into urban areas and 300 million will leave rural areas for a life elsewhere (United Nations, 2014).

Today cities are, especially in developing countries, experiencing unplanned rapid growth, making it increasingly difficult to ensure sustainable development (United Nations, 2014). Although cities provide a higher standard of living, the inequality gap is much higher than in rural areas, with hundreds of millions of city-inhabitants living in poor conditions. Rapid, unplanned growth leads to cities lacking adequate infrastructure and policies to ensure that benefits of the city life are shared equally among its residents. Although occupying only 2% of land area, cities contribute to 70% of world’s greenhouse gas emissions (Kacyira, 2012). This has led to an increased focus on sustainable urbanization to address critical development challenges such as energy, access to water, production, disaster readiness and climate change.

1.1.4 A way forward for European cities

In Europe, the urbanization trend is evident, though with substantial differences between four regions (United Nations, 2011). From 2000 to 2030, urbanization levels in Northern Europe are expected to grow from 83.4 to 87.4%, Western Europe from 76.2 to 87.4%, and Southern Europe from 65.4 to 82.6%. With the population growth alongside, cities throughout the region are facing increasing problems from transportation and traffic.

Transportation accounts for roughly a quarter of greenhouse gas emissions and is the main cause of air pollution in cities (European Commission, 2016). With urban mobility accounting for 40% of all CO₂ emissions, the urgent task lies in improving mobility, while reducing congestion, accidents and pollution (European Commission, 2015). Governments are keen to reap the rewards of such improvements, as congestion in the EU is expected to result in yearly costs of roughly EUR 100 billion, or 1% of EU’s GDP (European Commission, 2015).
To further push for a global shift towards low-carbon and the ability to respond to growing mobility needs, the European Commission launched its low-emission mobility strategy in July 2016. The strategy is defined within 3 target areas (European Commission, 2016):

1. **Increasing the efficiency of the transport system**, by heavily utilizing digital technologies, smart pricing and further encourage the transition to lower emission transport ways.

2. **Boost deployment of low-emission alternative energy for transport**, including electricity, hydrogen, renewable synthetic fuels, biofuels, and remove obstacles that hinder the electrification of transport.

3. **Moving towards zero-emission vehicles**. Apart from further improving the internal combustion engine, I must speed up the implementation of zero-emission vehicles, such as electric vehicles.

The first topic of EU’s strategy is to implement low-emission alternative energies and vehicles, public transport or shared mobility schemes, such as bikes, car-sharing and car-pooling in order to reduce pollution and congestions. The European Commission also states that the focus of policy development should be on improving the efficiency of the transport system, further development and deployment of electric vehicles, second and third generation biofuels and other alternative, sustainable fuels as part of a more holistic and integrated approach.

1.1.5 Rationale for research

Cooltra’s solutions can play an important role in combating challenges faced by cities today, such as traffic congestion, pollution through the move to zero-emission vehicles (electric Cooltra scooters) and digital technologies (fleet management solutions). However, with the large amount of technologies available today, companies need to understand what solutions are suitable for fleet management.

Further than assisting Cooltra on this journey, this research is of academic significance as it bridges an existing research gap and adds to the existing body of knowledge of ICT procurement. Supplier evaluation is a well-explored research area, with researchers agreeing on it being one of the key aspects for an efficiently managed supply chain. Supplier evaluation helps to identify cost savings, as well as to reduce risk and create a process for continuous improvement (Gordon, 2008). Companies with a low quality supplier evaluation process may find that the cost of nonproductive work can reach levels of up to 50% (Gordon, 2008).

Evidently, businesses that do not develop a proper supplier evaluation model may run risk of missing out on large saving potential and operational improvements. One of the goals of this thesis is to create a new supplier evaluation framework designed for procurement of fleet management solutions to help companies in this field determine the right supplier. This study will further stress the need for procurement practitioners to understand the need of developing appropriate supplier evaluation criteria, rather than leaving out the responsibility of procurement performance to the suppliers.

This thesis will study ICT systems within fleet management and its effect on companies implementing similar systems. This will help fill the gap today in fleet management – where fleet managers often lack awareness on the benefits offered by Fleet Management Systems (Automotive Fleet, 2013). Furthermore, it will compare four different vendors of fleet management solutions and recommend Cooltra which one to select. In this way, the study builds on existing academic literature on supplier evaluation and fleet management technologies. It will provide new research grounds for future researchers who can take use of the recommendations of topics that need further research.
1.2 Purpose
Working with the right supplier is important as they play a critical role for the organization and can have a large impact on reaching the company’s set goals. The purpose of this study is to understand how ICT enables fleet management and how companies can decide on a vendor of these technologies. This will result in developing a supplier evaluation and selection model for fleet management companies such as Cooltra. Cooltra is in the phase of evaluating four vendors that offer GPS trackers for fleet monitoring solutions, and this study proposes which of the suppliers they should choose. This study is needed to understand how ICT will affect the company’s fleet management capabilities and also what criterions are important when comparing the vendors.

1.3 Research Questions
This master thesis solves the following main question:

Main research question
- How do companies evaluate suppliers of ICT for fleet management monitoring?

Sub research questions
In order to answer this question, it is first required to provide a basis for what fleet management means, what fleet management products require, and how ICT solutions affect fleet management. Thus the first sub research questions is:

1. How does ICT enable fleet management?

Once the first questions is answered, an adapted framework can be proposed based on feedback from Cooltra, together with research in supplier evaluation, fleet management platforms and monitoring technologies to support evaluation of the various suppliers.

2. What framework can be used to evaluate vendors of positioning and tracking technology?

1.4 Delimitations
This study is restricted to the company of Cooltra and its suppliers in the Barcelona area. Cooltra is present in multiple companies, but its operations is centralized to HQ in Barcelona, which is why the results will be focused on this region. Results gained from this research may therefore not be applicable for other cities or countries. The use of fleet management technologies may impact different companies in various ways; this thesis focuses on what is most important for Cooltra and similar fleet-operating companies. This means the study focuses on how ICT affects fleet management and how Cooltra can compare the suppliers they have engaged with. This thesis does not make a Return on Investment calculation, although it is suggested by the author as an area for further research. Following an initial analysis by Cooltra, it was decided to limit the evaluation to 4 suppliers which is covered in the analysis. The research is limited to 5 months and the result will therefore be affected by society, laws, technology and economy during that time.

1.5 Timeline
Interviews are needed to get the necessary information regarding customer needs, thus they were set up in the beginning of the project. Before conducting interviews, the literature review was done to ensure the researcher was well-read on earlier research. This was important to understand gaps in literature, and form questions to highlight these during the interview. For the evaluation framework, this was crucial as the theory
saved as a discussion basis for the interviews. The literature review was performed in the first two months. Meanwhile, stakeholders within Cooltra were contacted as outlined in the methodology section to schedule interviews. With the literature review in place, sufficient information was collected to conduct interviews. Much of the time was spent at Cooltra’s office discussing with the COO and CEO and gathering feedbacks from employees and suppliers. Interviews were finished after three months with one month of completing the evaluating stage. During the fourth and fifth month, most parts of the report was written.

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**Table 1.** Plan of the thesis.


2 Literature review

This section provides an evaluative report of the existing information found in the literature related to the research topics. It serves as a theoretical base and determines the nature of the research, focusing on the most relevant works that have been made in this field. In order to understand why fleet management is an important topic, and to which field it belongs, the literature study begins with a short introduction of supply chain and the execution parts of this. This provides an understanding of where in the organization fleet management plays its role. Following is a more in-depth study of various fleet management technologies and their effects on organizations which have invested in these technologies. Lastly, research within supplier evaluation frameworks is presented. This is further developed in the results chapter where an adapted supplier framework is made for Cooltra, to select a supplier of fleet management solutions.

2.1 Supply Chain Execution

The processes within Supply Chain Management (SCM) can be categorized into three large categories: planning, sourcing & procurement and execution (Decide Software, 2016). Supply chain planning (SCP) involves activities within forecasting material requirements and planning production and distribution (Giaglis, Minis, Tatarakis, & Zeimpekis, 2004). Supply chain execution (SCE) covers the implementation of the supply chain plan through processes covering production and stock control, warehouse management, delivery and transportation (Lambert, Cooper, & Pagh, 1998). Sourcing and procurement covers relationships with suppliers and customers, managing inventory spending, sourcing contracts and integrations with suppliers.

![Supply Chain Management Diagram](Image)

*Figure 1. Domains within Supply Chain Management (Cybage, 2016)*

Throughout the last decades, Supply Chain Planning has received much contributions from researchers, who identified its benefits of improving customer service, reducing costs and increasing competitiveness. Out of this research numerous technologies have evolved that assist the work of SCP, such as Enterprise Resource Planning (ERP), Material Resource Planning (MRP) and Manufacture Resource Planning (MRP-II). In short,
SCP applications manage assets to optimize the delivery of goods and services, and coordinate data from supplier to customer to balance supply and demand (Decide Software, 2016).

Supply Chain Execution, which covers order fulfilment, procurement, warehousing and transportation, has not received the same focus from the research community (Giaglis, Minis, Tatarakis, & Zeimpekis, 2004). Mobile solutions for SCE are increasingly being adopted, thanks to wide acceptance of RFID, Barcode, GPS and mobile applications. Although activities including warehouse management and stock control have been studied and aided by tools such as Warehouse Management Systems (WMS), the area of distribution management remains with significant improvement potential (Min, Jayaraman, & Srivastava, 1998).

![Figure 2. Domains within Supply Chain Execution (Cybage, 2016)](image)

Fleet Management Systems (FMS) is a term used for a wide range of solutions that enable real-time monitoring of vehicle fleet-related applications in various fields including transportation, distribution and logistics (Jamaluddin, 2013). The systems utilize parameters such as vehicle location, velocity, field data (e.g. load temperature), to supervise and control fleet operations based on available transportation resources and constraints (Billhardt, o.a., 2013). The objective of FMS is to reduce risk, improve quality of service and increase fleet’s operational efficiency, while lowering costs (Vasileios, Giaglis, & Minis, 2007).

FMS is increasingly supported by tracking technologies. ICT is declared the leading enabler of integrating and putting together disconnected suppliers, manufacturers and transportation companies (Manecke & Schoensleben, 2004). The interconnectedness of ICT, together with rapid growth of mobile devices has led to an escalation of technology solutions, some of which to help manage fleets.

Today’s modern logistics systems require real-time monitoring and engagement with fleet vehicles to achieve high fleet utilization and faster response to customer needs (Muhammad, Sahaar, Hasan, Faisal Mohd Fiah, & Mohd Nor, 2014). The technologies that enable the real-time logistics requirements are mobile communications; global positioning system (GPS), geographical information system (GIS), general packet
radio service (GPRS), as well as Internet-based services, which provide increased transparency and detailed data about shipment data and deliveries. GPS systems are space-based radio positioning systems that provide 3D position, speed and time at any time of the day to users equipped with the right equipment (Malladi & Agrawal, 2002). Its effect is most dominant in more sophisticated logistics with multi-tiered suppliers and manufacturers that are spread across the globe.

In order to track the position of vehicles, there are mainly five emerging technologies (Turner, 1996):

**Automatic Vehicle Identification**

Automatic Vehicle Identification (AVI) uses long-range Radio Frequency Identification (RFID) to help users get quick access, by using a transponder attached to a vehicle. Radio frequency signals are sent out by overhead antennas put on traffic lanes, which are reflected by the transponders in the vehicles (Zhu, 2000). This produces a modified signal sent back to the central computer system until it passes another antenna where the vehicle’s tag is identified again. The computer system collects the data and calculates the travel time of vehicles carrying the tags. It is used by many taxi companies to manage queues and ensure vehicles are allowed to passenger pick up areas in the correct order, as well as in mining, and for tracking trains when entering and leaving stations.

**Automatic Vehicle Location**

Automatic Vehicle Location (AVL) uses transmitters on-board (also known as telematics devices). These enable to determine the location of the vehicle throughout frequent intervals or continuously. The locations can then be projected onto a map, and travel times can be calculated using the vehicles average speed and changes in time. The most common used technology for this is the Global Positioning System (GPS), which will be described further in the coming sub-chapter. GPS provides the capability of mobile fleet localization, providing the exact vehicle position in real time, helping operations of vehicle and cargo transportation. A driver can be informed about the latest location of accidents along his route, weather conditions, delays at terminals and so forth – all providing time savings by suggesting alternative routes.

**Electronic Distance Measurement Instruments**

Electronic Distance Measurement Instruments (EDM) are used in a wide area of applications including route numbering, addressing emergency 911 incidents, calculate area and volumes, and linear distance measuring for pavement markings. The instruments are very accurate when they are calibrated, with an accuracy of 0.19 meter/km (Turner, 1996).

**License Plate Matching**

License Plate Matching are technologies to collect vehicle license plate numbers and arrival times at different checkpoints, which matches the earlier measurements to calculate travel time. The collection of data can be done in either of four ways; manually (pen and paper or audio tape recorder and manually entering into a computer), portable computer (collecting the plates using a laptop that provides an arrival time stamp), video with manual transcript (recording the passing cars and transcribing license plates through human observers) and video with character recognition which collects video and uses computers to recognize license plates. The last version was used in Stockholm, Sweden to reduce inner-city traffic and congestion, which will be further discussed in the coming sub-chapters.

**Cellular Phone Tracking**

This involves two data collection techniques, cellular telephone reporting and cellular geolocation. Cellular telephone reporting requires a driver to call to a central facility to record time, location and driver ID. By calculating the time between the two measurements, travel time and speed can be determined for vehicles that
have cellular telephones, which probes once the system detects a telephone call. However, due to many vehicle drivers missing checkpoints or failing to report their locations at the right time, the method is only recommended for low-accuracy demanding studies.

Cellular geolocation tracks cellular telephone calls to collect travel time and monitor freeways. Due to privacy reasons, the method is limited to test environments. It uses an existing cellular telephone network, a device for locating vehicles and central control facility to store data. With the large amount of mobile phones available, the technology offers a large potential sample and requires no in-vehicle equipment to install. What remains to overcome prior to widespread adoption are the privacy issues, as people have been expressing fear of telephone calls being monitored and vehicles tracked.

2.1.1 GPS Fleet Management System

The GPS is a satellite-based navigation system consisting of a network of 32 satellites orbiting around the globe, developed in 1978 by the Department of Defense (DoD) in the United States. The GPS is a satellite technology that through a constellation of satellites transmits precise microwave signals which can be picked up by GPS receivers to determine the current location, time and velocity (Munir, 2009). Managed by the United Air Force 50th Space Wing, it is widely used outside the military as a navigation system for vehicle tracking and navigation purposes. Generally no subscription fees or charges are needed in order to utilize GPS, which makes it the best vehicle navigation system available today – and is frequently integrated into the existing vehicle infrastructure among many companies (Zeimpekis & Giaglis, 2006).

With regular intervals, the GPS helps to identify the location of an object, individual or other assets. The position is stored regularly and can be sent to a local central database or via Internet connection to computers, through the use of General Packet Radio Service (GPRS). This data can then be used by a customized software or web service to provide an interface with overview of the fleet, which can be provided by different vendors.

Today roughly 75% of tracking devices are based on GPS receiver chips, much due to its lower price compared to other technologies. Through recent technology advancements, GPS has become increasingly abundant, with handheld GPS gadgets being used for outdoor sports such as hiking, boating, sea and car navigation. It is used in many industries; it enables fire-fighters to locate the nearest fire hydrant, and natural park rangers to quickly find the right map and update it with changes in the natural habitat while working in the field (Connolly, 2007).

The GPS/Global System for Mobile Communications (GSM) based system is the most important system, integrating both GSM and GPS technologies (Valarmathy, Vanitha, Thiruppathi, Selvaraju, & Thangam, 2013). The GPRS-based GPS monitoring system communicates through the GSM modem, as illustrated below.
The GPS architecture is built up by three components: space, control and user:

- The space segment includes the satellites orbiting around earth. Their height is approximately 20,200 kilometers orbiting in 24 hour schedules.
- The control segment consists of 5 master control stations spread across the globe, with the main one (MCS) located in the United States. This ensures the satellites are functioning properly, and help satellites determine location and status of atomic clocks.
- The user segment includes the GPS receiver that decode signals from satellites to determine position, speed and time. The services offered to GPS users are the civilian Standard Positioning Service (SPS) with 100 meter accuracy and Precise Positioning Service (PPS) for military, with 20 meter accuracy. For users, the communication consists of two parts. A first requirement is the mobile access network (GSM) to connect the control center with the on-board devices. Secondly the GPS position must be collected, using a GPS receiver.

2.1.2 Types of GPS Navigation Systems

The atomic clock in the satellite sends information of the user’s current location and time to the GPS system. With this data, the GPS can pinpoint the location on a map (Mohinder, Angus, & Bartone, 2013). Most GPS systems will locate the position in formats of latitude/longitude on a detailed map with information about streets, highways and landmarks. For car navigation systems there are three types of GPS systems - stand alone, handheld devices and solutions designed to be integrated in laptop. Each has its own benefits and limitations; with stand-alone being the most well-known, offering steady power supply and turn-by-turn direction.

To pick up the transportation navigation GPS signals, there are mainly three types of antennas:
Passive

Passive systems send information only when the user connects the GPS tracking unit to a docking station, which is usually connected with a land-line telephone. They can also be wirelessly connected, and are the most economical way to manage data. It is not as user friendly as the active version, as it doesn’t track the driver’s progress in real time and thus cannot be used for the same purposes.

Active

The active, real-time system is based on a GPS-mounted wireless receiver that continuously downloads information without the user managing it. These are internet-based with real-time components, and data transmit interval can be set manually, such as every second or with minutes between. This kind of system is convenient since the user doesn’t have to wait to download data to a computer (as is the case for passive systems). The real-time systems come with a software which enables users to track an object in real-time, and supervise it through a computer (TrackingTheWorld, 2016).

Hybrid

Hybrid systems provide real-time vehicle data, with comprehensive storage capabilities. This makes them more adaptable to business needs, but also in need of both Internet connection and a dedicated computer – thus more expensive. The system reports information every couple of hours, and in the case of an alarm, it triggers the real-time active system.

2.2 Evaluating and implementing ICT

Integrating ICT into the transportation processes through GPS fleet management provides many benefits, such as improving the quality of data and increasing process efficiency. To ensure maximum benefits, it is vital to first get a thorough understanding of the business processes and the impact position-based information systems has on these (Ruppel, 2004).

2.2.1 Deciding on the right technology

To ensure the right technology is implemented, it is key that all relevant managers and users are involved, bringing in relevant information flows. An operational risk management approach is needed to determine what the business needs are and understand the potential risks of implementing the wrong technology. To help ensure a successful implementation of SCM technology, a number of steps are recommended to take (Aberdeen Group, 2006):

1. Begin early, before your competition.
2. Determine your goals.
3. Choose the right suppliers and do not manage too much yourself without being a subject expert.
4. Be aware if the information architecture determines if the project becomes worth the investment (positive ROI).
5. Perform a pilot test. This reduces the risk of incorrect design or costs, helping to reduce the time to ROI.
6. Experiment with different “what-ifs”, and go beyond compliance.

2.2.2 Organizational impacts of technology in logistics

Real-time IT logistics solution can bring several benefits - lower inventory levels, increased efficiency within warehousing, reduced need of ordering and forecasting, as agreed by numerous studies (Kehoe & Boughton, 2001) (Cordon, Vollmann, & Sundtoft Hald, 2005). Real-time systems also enable to optimize information
flows between different departments, which can lead to increased collaboration between business partners and higher customer service levels. This is shared by (Gustafsson & Norrman, 2001), who argue effects include improved service, better inventory management and less administration.

To get the most benefits of these solutions, much work is needed within business modelling. This means to enable an internal integration of companies, as today insufficient resources are spent on B2B integration (Li, Kumar, & Lim, 2002). To solve this, companies should think in supply chain model-terms, to determine the process flow, structure of organization and dependencies as a foundation for the Internet-based integration. A number of dimensions can be used to help model these dependencies.

Firstly, the scenario model explains the whole supply chain as a network of interconnected businesses with flows of products and services. This should be connected and linked through Internet based solutions and applications. Secondly, the interdependency model explains the connections between the different parts of the network and how they relate. The third model is the process model which provides a view of all activities that control the interdependencies and lead to the products and services requested by the customer. Last is the information model, which is created based on the results from the process model.

Central to IT implementation is the notion of the three discrete phases occurring during the cycle of IT innovation: diffusion, adoption, during and after implementation. Diffusion means the process of products moving into a market, with some consumers being more receptive to the innovation (innovators) than others (laggards). The adoption phase covers the decision-making process of investing in IT. Following is the implementation phase which is the physical deployment of IT tools in companies. Last is the post-implementation phase which covers the continuing of adoption and sophistication.

2.2.3 Best practices when implementing new technologies

As outlined earlier, it is vital to ensure alignment of people, functions and information flows when implementing a fleet management solution. Future changes must be analyzed by looking into the strategic goals of the company, link these to the goals of the change project, and evaluate the possible impact. The most important changes should be prioritized (ranging from 3-5), and likewise determine potential obstacles that may inhibit the changes. Following this, the organization must formulate the processes needed to execute the goals set for the change project. This is can be done by modelling information flows and processes, to identify links between business activities. With the view over the processes and information flows, the work of selecting a suitable technology can begin.

When improving one process, it may often impact several business units, which is why it’s important to meet targets of multiple stakeholders. In the end, new processes should ultimately be designed to make an impactful difference for the customer. One should be aware of the many requirements behind adopting a new ICT solution, as it often comes with large investments in both hardware and software. Furthermore, managing the new technology on a daily basis requires expertise and support which may lead to further costs (Li, Kumar, & Lim, 2002).

2.2.4 Effects on companies that implement ICT for Fleet Management Systems

The need for technology within logistics becomes apparent when you weigh in the high share of costs coming from transportation. It is the most expensive logistical process, accounting for over 40% of expenses in most companies (Waiyaki, 2013). With the use of ICT, the supply chain process can be improved in primarily three different ways (Banister & Stead, 2004):

- Increasing travel demand as a result of new offerings being developed
- Substitution of travel as activities will be done remotely, instead of traveling
Modifying travel through logistics and ICT processes to enable new ways of carrying out these activities

It is agreed among many scholars that using technologies for tracking goods has a positive impact on logistics performance, reduces costs and improves customer satisfaction (Giannopoulus, 2004). In a report for the freight industry, (European Commission, 2009) highlights the need of telematics applications for interconnection of seat reservation systems, real-time information systems and on-board telephone communications as ways to make the railway sector more competitive. The services further include web-based booking services, delivery notifications and receiving information from mobile telephones, GPS systems to provide location data – all to help the user manage logistical resources in an increasingly demand-driven freight distribution system.

A summary of benefits when implementing ICT systems from various literature was done by (Pokharel, 2005). According to his report, ICT helps human activities, increases operational or even personal efficiency, reduces time to execute activities, improves logistics efficiency, and increases transparency to stakeholders, increases adoption of improved business practices to meet service level agreements and increases flexibility in organizations to adopt to a dynamic environment.

The Government of Denmark has invested 90 million USD to support digital, communicative, analytic tools and Geographical Information Systems (GIS) to create smart transportation technologies in Northern Denmark. In Sweden, IBM helped the Swedish capital Stockholm, through the use of License Plate Matching and other technologies, to manage the city traffic. After a 7 month trial, traffic congestion was decreased by 20% (Ho, 2007). In the UK, fleet management is used by over a quarter of vehicle fleets. Adoption is the highest among commercial vehicle fleets (30%), and large fleet operators with more than 100 vehicles (31%) (Michaelides, Michaelides, & Nicolaou, 2010).

A survey performed with users of tracking systems identified benefits such as increased productivity, lowered costs and improved fleet performance. They also mention effects of reduced overtime claims, lowered insurance premiums, fuel usage, communication costs and administration. It has been found that ICT is the single most important factor with greatest potential of enhancing logistical operations (Closs & Xu, 2000).

Apart from improving logistical processes, it offers significant opportunities of launching new logistics strategies and ways of structuring organizations.

With benefits such as reduced labor costs, improved safety, better fleet utility, less theft and superior maintenance reminders, GPS is becoming the preferred and most widely used information system in logistics, with an especially large success within the transport industry. As outlined, companies investing in ICT by using GPS have the potential to generate large savings, with the quickest return coming from labor and fuel costs. Another advantage is an increased employee accountability as each driver can be better managed, resulting in fuel savings, less maintenance costs and improved safety, with quicker correction of faulty vehicles. The benefits experienced by logistics service providers that implement GPS fleet management systems are summarized below (Waiyaki, 2013):

**2.2.4.1 Decreased accident rates and safer driving**

One of the benefits of implementing GPS tracking is improved safety and as a result, reduced accident costs (Telogis, 2016). Rather than managing drivers via phone, fleet managers can use on-screen notifications according to if time and routing are being met. It can highlight unscheduled stoppages, or other events not part of the scheduled routine. For further improvements, this can be followed up with analysis and corrective actions when the drivers has returned. With many insurance companies offering rate reductions for safety equipment such as GPS tracking devices, companies can generate massive savings on insurance premiums as a result of lower level of accidents and an improved safety record (Waiyaki, 2013).
GPS recorders can be likened to the black box in an aircraft at the event of an accident, recording the direction and speed of the vehicle at the point of which the accident occurred. In addition, when drivers are aware that they are being monitored, they tend to drive in a safer and more considerate manner that reduces the risk of accident.

2.2.4.2 Higher level of fleet availability and staff productivity

By connecting the fleet management to the phone or SMS, the system can establish real-time communication with the driver, providing information about events along the route (Vivaldini, Pires, & de Souza, 2012). The fleet manager can have a full overview of the current fleet status, which helps personnel management and identifies which driver is not driving in a compliant way. Drivers can be taught how to drive in a more fuel efficient way to help reduce speeding and generate fuel savings. It can also help track the working hours of the staff, automating the tracking of start/end times and improve service planning.

2.2.4.3 Fuel savings and environmental factors

Tracking devices can measure the actual fuel consumption and compare against what is reported by the employee. By having the route set up in advance, companies can track the fuel required for each trip. For food deliveries, such as to restaurant chains and hospitals, it is crucial to ensure the right delivery temperature. Tracking the temperature in the cold compartment helps the fleet managers understand how the refrigeration equipment is working along the route. When delivered, the temperature can be measured by the receiving part, generating a database of performance records and temperature quality which can be analyzed per driver, vehicle, route etc.

2.2.4.4 Reduced overall transport operational costs

ICT for fleet tracking can provide details of maintenance dates, which helps ensure that oil changes and other critical services are performed. This will lead to a fleet with less downtime and higher fuel-efficiency. The connection between vehicle and fleet management platform reduces the time to identify issues, thus lowering the risk of the vehicle being further damaged.

2.2.4.5 Improved responsibility and information flow

GPS fleet tracking technology enables tracking of position, speed and heading which can help fleet managers understand how their drivers are performing. Rules can be established according to the required route, including stops and points of delivery or collections. With this monitoring, notifications can be sent when rules are not followed. The system can also help monitor the drivability such as maximum speed, braking, engine revs, fuel consumption etc. After a completed trip, a report can be created covering all deviations from the route, such as speed, drivability or non-compliance of stopping points.

2.2.4.6 Better recovery of stolen motor vehicles

With online GPS technology, companies can almost guarantee the return of the vehicle and avoid monetary loss – in vehicle cost and downtime. Alerts can be setup to send notifications upon movement after normal business hours, or when entering out-of-zone areas. If the vehicle is stolen, the user can be notified and thus begin visual tracking. With the ping-functions, the user can be given continuous updates on location and provide this to the police (Vivaldini, Pires, & de Souza, 2012).

2.2.4.7 Increased customer satisfaction

Express delivery services are increasingly important to ensure competitiveness of companies, and is expected to be more important as the world becomes more integrated (Oxford Economic Forecasting, 2005). As an increasing number of companies have contracted freight transportations and logistics services, some of the
major trends they face include “increased information exchange capability”, “global coverage and management capability” and “importance of equipment condition and availability” (Transportation Research Board, 1999). Thus, when demanding rapid, guaranteed delivery, customers will be pleased by GPS-solutions sending continuously updated arrival times, with the possibility of tracking the delivery on a map, and being promptly notified in case of any error.

2.2.5 Limitations of Fleet Management Systems

Although the GPS enables anyone on the planet to determine its location accurately and for free, the technology bears some limitations. Due to the GPS calculating its location based on signals from a minimum of 4 satellites, it’s important to avoid obstructions for longer periods of time, as the reception may be disturbed. When obstructions appear, the GPS may not answer, give wrong answer, or an answer with insufficient accuracy. Issues with the GPS signal may be divided into three parts; signal reception, signal integrity and signal accuracy (Kleusberg & Langley, 1990).

Signal reception

To avoid signal reception issues, the signals sent to the GPS receiver must not be disturbed. Due to signals not being able to penetrate water, soil or walls in any efficient manner, the GPS cannot operate in submarine or mining environments. Above land, GPS reception loss can occur between tall buildings, inside a tunnel or when driving through an area with large tree canopy – which are all common environments for a vehicle. As a result, the signals may be hindered for a longer period of time or left continuously unavailable.

Signal integrity

The GPS receiver/processor takes use of position and time measurements from GPS satellites, encoded in the transmitted signal. In cases of incorrect satellite positions, or wrong range measurements, a wrong calculation of receiver position will be given. If the incorrect signal is not identified, the user will not be aware of the problem – which can have catastrophic results for users such as commercial aircraft pilots. To reduce the risk, two solutions have been developed. The first, GPS Integrity Channel (GIC) – installs stationary receivers at known positions to identify irregularities with the result from received GPS signals. The second, Receiver Autonomous Integrity Monitoring (RAIM), does not require any extra monitoring stations to compare with – but takes use of more than 4 satellites for its measurements. In this way, abnormalities can be identified to alert users.

Signal accuracy

The GPS receiver measures length by calculating travel times by the speed of light. These measurements can be inaccurate due to User Equivalent Range Error (UERE). This can be solved in two ways, and the first way is by subtracting the error from the result, using mathematical models. The second way is changing the way to make measurements, which adds cost, logistics complexity and data processing time.

In spite of above mentioned limitations, the GPS is still the leading all-round positioning system available today.

2.3 Supplier evaluation

2.3.1 Introduction to supplier evaluation criteria

In order to gain the above mentioned benefits of implementing GPS technology, Cooltra must choose a provider of the technology and enter into a purchasing agreement. To decide on the right supplier in a
systematic way, below chapter will uncover some of the important findings of supplier evaluation theory and the criteria used to compare different vendors. Working with the right supplier is central as they play a critical role in the organization and can have large impact on reaching the company’s set goals of supply chain performance.

Research on supplier evaluation can be dated back to the beginning of 1960s, when (Dickson, 1966) surveyed 273 purchasing managers in various companies and identified 23 important criteria. Out of all criteria, he deemed quality, delivery and performance history as most important. Similarly, (Weber, Current, & Benton, 1991) found that quality is the most important factor, followed by delivery performance and cost. This was based on to which extent the factors were mentioned in the 74 reviewed supplier evaluation articles from 1966 to 1991. The importance of the various criteria mentioned by Weber and his team has been further developed by (Chen, 2011), found in below table 2. A more contemporary study was done by (Hu, 2004) which analyzed 24 studies published after 1991, and identified price, quality and production capacity and delivery as the most important evaluation criteria.

Some researchers have divided the various criteria into different sectors, such as organization structure and manufacturing capabilities, quality system, supplier implementation capabilities. (Huang Keskar) divided evaluation criteria into 7 categories – reliability, responsiveness, safety and environment, flexibility, financials and infrastructure.

With increasing significance of strategic sourcing, and the rapidly moving global market, suppliers are entering a new role within the supply chain. Other criteria are becoming increasingly important, such as technological capacity, financing options, after-sales services and other strategic matters. Recent research, such as the report by (Dey, Bhattacharya, & Ho, 2015) suggests a move from the traditional focus of evaluation criteria on lagging factors, such as quality, delivery schedule and cost/value. They argue companies should increase focus on leading factors (organizational practices, risk management, environmental and social questions), and balance this with the traditional lagging factors.

2.3.2 Framework for evaluating suppliers

Below framework was proposed by (Dickson, 1966) and later developed further by (Chen, 2011), who included ranking scores from other prominent researchers (Weber, Current, & Benton, 1991).

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Reference quantity</th>
<th>Dickson ranking</th>
<th>Weber ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>61</td>
<td>6</td>
<td>Very important</td>
</tr>
<tr>
<td>Deliver on time</td>
<td>44</td>
<td>2</td>
<td>Very important</td>
</tr>
<tr>
<td>Quality</td>
<td>40</td>
<td>1</td>
<td>Extremely important</td>
</tr>
<tr>
<td>Equipment and capability</td>
<td>23</td>
<td>5</td>
<td>Very important</td>
</tr>
<tr>
<td>Geographic location</td>
<td>16</td>
<td>20</td>
<td>Important</td>
</tr>
<tr>
<td>Technical capability</td>
<td>15</td>
<td>7</td>
<td>Very important</td>
</tr>
<tr>
<td>Management and organization</td>
<td>10</td>
<td>13</td>
<td>Important</td>
</tr>
<tr>
<td>Industrial reputation</td>
<td>8</td>
<td>11</td>
<td>Important</td>
</tr>
<tr>
<td>Financial situation</td>
<td>7</td>
<td>8</td>
<td>Very important</td>
</tr>
<tr>
<td>Historical performance</td>
<td>7</td>
<td>3</td>
<td>Very important</td>
</tr>
<tr>
<td>Maintenance service</td>
<td>7</td>
<td>15</td>
<td>Important</td>
</tr>
<tr>
<td>Service attitude</td>
<td>6</td>
<td>16</td>
<td>Important</td>
</tr>
<tr>
<td>Packing ability</td>
<td>3</td>
<td>18</td>
<td>Important</td>
</tr>
<tr>
<td>Production control ability</td>
<td>3</td>
<td>14</td>
<td>Important</td>
</tr>
<tr>
<td>Training ability</td>
<td>2</td>
<td>22</td>
<td>Important</td>
</tr>
<tr>
<td>Procedure legality</td>
<td>2</td>
<td>9</td>
<td>Very important</td>
</tr>
<tr>
<td>Employment relations</td>
<td>2</td>
<td>19</td>
<td>Important</td>
</tr>
</tbody>
</table>
As highlighted by (Dey, Bhattacharya, & Ho, 2015), supplier evaluation criteria should be aligned with strategy and thus related to business processes and the requirements of all stakeholders. Clearly this is unique for each company and situation, and no single solution can be done for every selection process. Based on the set of product, strategy, market and others factors, the criteria will be different. Some criterions are more common among various researchers – such as on-time delivery, flexibility, cost and quality.

Jeff Bezos, the eccentric CEO of Amazon once said in an interview that he tries to identify “universal truths” – such as being able to deliver products in a shorter time – and works deliberately to improve on these. At Amazon, this is done by adding drones to its delivery options and finding new logistics solutions. In January 2017, Amazon Inc. was granted its patent on a solution for reversible lanes using autonomous cars, which changes direction depending on the bulk of the traffic flow (Hern, 2017).

<table>
<thead>
<tr>
<th>Communication systems</th>
<th>2</th>
<th>10</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutual negotiation</td>
<td>2</td>
<td>23</td>
<td>Important</td>
</tr>
<tr>
<td>Previous image</td>
<td>2</td>
<td>17</td>
<td>Important</td>
</tr>
<tr>
<td>Business relations</td>
<td>1</td>
<td>12</td>
<td>Important</td>
</tr>
<tr>
<td>Previous sales</td>
<td>1</td>
<td>21</td>
<td>Important</td>
</tr>
<tr>
<td>Guarantee and compensation</td>
<td>0</td>
<td>4</td>
<td>Very important</td>
</tr>
</tbody>
</table>

**Table 2.** Evaluation criteria for suppliers (Chen, 2011)
3 Research Methodology

This section outlines the research process, motivating why the research process was chosen and how the data was gathered and analyzed. In the following chapters it discusses the validity, reliability and objectivity of the study, and an outline of the project plan.

3.1 Research strategy

To conduct this study, the below strategy was used:

Figure 4. Outline of research strategy for this study.

Figure 5 illustrates the research approach. Although there are clear steps, the reader should be aware some of these were done simultaneously. The literature study was key to find a suitable research problem, and the results also helped the analysis. A short introduction to the urbanization trends and emerging mobility technology was also provided in the first chapter. Some of the literature study was done while conducting interviews. The research questions was created by identifying the purpose, background and existing theory on the research topic.

To achieve this, a broad range of literature within the field of supplier evaluation, fleet management, ICT systems, GPS-technology with its background, benefits and limitations was studied. This set the frame for the thesis and helped plan and execute content-rich interviews and observations that could add new knowledge to the research field. It was important to identify the right stakeholders within and outside the studied company to ensure the empirical research would be sufficient. The thesis ends with discussion and recommendations for further research.

3.2 Qualitative and quantitative research

There are various research methods available for a researcher, each one affecting the way data is collected. Research can be divided into qualitative and quantitative approach (Colley & Hussey, 2013). Quantitative research has historically been used primarily within medicine, natural sciences using lab experiments and numerical methods. They mostly often use numbers, have a deductive approach and require an initial hypotheses (Bryman & Bell, 2007).
Qualitative studies do not need a hypotheses to start with. It seeks to get a deeper understanding of the subject, with use of interviews, questionnaires, observations to understand the motivations, feelings of selected groups towards a subject (European Commission, 2015).

Because of the novelty of the research topics and the lack of data about performance at Cooltra, a number of stakeholders were interviewed in-depth. The aim was to get an understanding of their current situation, their challenges and daily tasks to better understand what impact ICT solutions can have. For this reason, the study is based on a qualitative theoretical research with interviews to get detailed understanding of the topics and provide a basis for the empirical findings.

3.2.1 Explanatory case study

According to (Yin, 1994), the choice of research strategy is a result of three conditions, (a) type of posed research questions, (b) to which extent an investigator has control of behavioral events and (c), the degree of focus on contemporary vs historical events.

With research questions of this study focused on how ICT can help fleet management within Cooltra and why this solution can help address their challenges, it is considered an explanatory study. For these, case studies and experiments are proven the most successful research strategies (Yin, 1994). Together with the descriptive and exploratory case study, the explanatory is one of the three main case study types.

The purpose of this study is to better understand how ICT can improve fleet management, and how Cooltra can evaluate the various GPS-technology vendors in the field. This goes well with the typical explanatory research that aims to determine whether a variable or circumstance is the cause of a habit, behavior or result.

The second type of case study is the descriptive which can be fit into both quantitative and qualitative research methodologies (AECT, 2001). The descriptive study tries to find out “what is”, and can be applied in the following way “Do students have positive attitudes of computers at schools? What are the activities where fifth-graders are using computers and how often do they occur?” As the descriptive study collects data on participants taking part in the study, observational and survey methods have shown to be the most common (Borg & Gall, 1989).

Thirdly, explanatory case studies research the data both at the surface and at a deeper level, to explain the phenomena in the data. The goal is to provide understanding of a situation usually with a causal relationship, which is too complex for survey or experiments (Milliot, 2016). Research question tend be of the “how” or “why” type, such as why did a particular campaign lead to increased sales? As the research questions involve “How”, and the aim is to find out how certain technologies can effect selected parts of supply chain domains, a case study was deemed beneficial for this study.

The case study is also preferred in a study like this due to a large focus on contemporary events such as recent technology, ongoing operations from interviews and benchmarking with today’s competitors. The researcher using case studies doesn’t have to rely only a historian’s primary and secondary data as resources, but also on his or her own observations and interviews (Schell, 1992). According to (Yin, 1994), the case study allows to understand the holistic and true characteristics of real-life events, whether they are organizational and managerial processes or industry maturity.

As a result of the less defined problem definition of this project, an explanatory research type was chosen. With this research, I were able to develop an improved understanding of Cooltra’s challenges within its operations. Case studies are often criticized for lack of well defined, standardized methodology. Thus, it’s critical to ensure the case study is correctly prepared and understand the different approach types normally used (Schell, 1992).
3.3 Data collection

An early understanding of the subject was gained by interacting with the CEO and COO of the company during multiple events before the project. Internal company challenges, business opportunities and industry trends were discussed with great interest. Although this provided valuable insight, large amounts of data was required in order to conduct the study. There are mainly two types of data, primary data and secondary data. Primary data refers to information that is collected by the researcher (such as surveys, interviews), while secondary data is created by someone else for another purpose (such as books, news articles) (Colley & Hussey, 2013).

3.3.1 Interviews

There are numerous methods to collect data, with the most common ones for primary data being (1) direct personal interview, (2) questionnaires sent via mail, (3) interviews by researcher and (4) telephone interview (Singh & Mangat, 1996). Taking into account costs, desired precision and timeframe of the project, it was decided to use personal interviews to gather enough primary data.

Planning for the interviews and creating an interview protocol is key to ensure validity of the research. It puts expectations on the researcher to be familiar with and have knowledge within the scope of the research, a clear vision of the objectives, and how the data eventually will be analyzed. In this case, the researcher has finished a long list of courses within production, supply chain, cooperative IT-design, as well as personal contacts within the studied company.

Interviews are good to understand the thinking, assumptions and attitudes which may influence the perceived behavior of the respondents involved (University of Sheffield, 2014). These can be conducted using three fundamental interview techniques; unstructured, semi-structured or structured.

Structured interview uses verbally defined questionnaires with predetermined questions, leaving little room for changes or follow-up questions to elaborate new findings. Semi-structured interviews includes key questions to be explored, but allows the interviewer to leave the topic in order to explore an idea further. Thirdly, the unstructured interview does not begin with any theories or ideas and are handled with less direction. Open-ended questions are asked from start, and they are often more time-consuming and can be difficult to organize. It’s mainly used in studies requiring significant depth or where very little is known about the topic.

For this study, a semi-structured interview was chosen, opening up for a richer and informative data collection method, which, as mentioned above, is key for a successful explanatory study. The interviews were held in different ways depending on the stakeholder, with different follow-up questions occasionally being used when clarifying respondent answers. To ensure the interview was focused on the right topic, a pre-prepared guide was used. This enabled to begin with standardized questions and follow up with a more open discussion related to the interviewee’s response. In order to get full understanding of the current situation at Cooltra, and their ideal future state within each department, interviews were held with the following people:

<table>
<thead>
<tr>
<th>Role</th>
<th>Length</th>
<th>Interview date</th>
</tr>
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<tbody>
<tr>
<td>Chief Executive Officer (CEO)</td>
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</tr>
<tr>
<td>Chief Operations Officer (COO)</td>
<td>2 x 60 min</td>
<td>Semi-structured</td>
</tr>
<tr>
<td>Customer 1</td>
<td>10 min</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>15 min</td>
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<tr>
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<td>type</td>
</tr>
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</tr>
<tr>
<td>Head of Fleet Management/</td>
<td>2 x 60 min</td>
<td>Semi-structured</td>
</tr>
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<td>GPS technologies</td>
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<tr>
<td>Head of Purchasing</td>
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</tr>
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<td>Head of Second Hand Sales</td>
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</tr>
<tr>
<td>Supplier 1</td>
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<td>Unstructured</td>
</tr>
<tr>
<td>Supplier 2</td>
<td>15 min</td>
<td>Unstructured</td>
</tr>
</tbody>
</table>

| Table 3. Conducted interviews during the empirical research. |

Interviews with CEO and COO were key to the initial phase of the project and discover interesting research topics. After having studied some literature, different ideas were discussed, and it was decided to focus on one that was most suitable for this time-frame and the resources available. More interviews with these stakeholders have followed and there has been a continuous communication throughout the project. The CEO and COO recommended to speak with the Head of each of the four divisions, ERP Systems, Fleet Management, Purchasing and Logistics. Each the interviewees had their opinion and perspective on the research topic, and it was key in order to propose a solution that weighs in all the different stakeholders.

3.3.1.1 Determining evaluation criteria and rating suppliers

Interviews were a key part to solve the main research question (how to evaluate companies) and especially research question 2 (what framework can be used). Initially, a list of common evaluation criteria were presented to the interviewees from Cooltra to understand what they sought from a supplier. After collecting feedback from each interview, an average was calculated and used as the final criteria weight. Although this thesis focuses on B2B segment, some short interviews were held with B2C customers, which was due to the availability of interviewees. Customers were interviewed to get a more balanced view of the company, and understand external stakeholders’ perceptions and views of the organization. These interviews didn’t follow a set agenda and ranged from customers within the B2B and B2C segment, to bring in the opinions of the customers across all business units. Suppliers were also interviewed as they are a critical asset in the supply chain, which helped to understand to what extent they could answer Cooltra’s needs. Due to limited time and availability, only two of the four suppliers were interviewed.

With the evaluation criteria in place, the data gathering began to collect information about suppliers to enable a sufficient analysis. Different information was gathered from different parts of Cooltra. Evaluation of the technical criterions, such as product quality, back-end and front-end capabilities, were done together with the software and hardware engineers at Cooltra. Factors like customer service, flexibility, contract terms, price, were judged in cooperation with the COO. The suppliers were given a score between 1 and 10 for each criteria. For the technical features, a basic quantitative method was used where the performance was proportional to the criteria score. For the qualitative features, the score was reached through a mutual discussion, which served as a good way of sharing ideas and increase the quality of the results.

3.3.2 Literature study

Secondary data means data which has already been made available from other sources, and was collected for other purpose than the immediate research problem (Boslaugh, 2007). It’s an inexpensive method to quickly obtain data that isn’t found through primary data sources, and provides access to international and historical data. This eliminates the need of extra research staff, and the researcher can work independently, focusing on the analysis of the data.

A large disadvantage of secondary data is the availability. The data will most likely not answer the specific research questions, as it was not collected for that purpose in the first place (Hyman, 1972). Also, the study
may have been done in a different geographic region, time or focused on a different industry. Due to the researcher not being able to participate during the study’s data collection phase, there is less understanding of how exactly the study was performed and data accuracy – forcing the researcher to “read between the lines”.

During this study an extensive literature study was performed. To help manage the various literature, the books, articles and research papers were divided into folders according to category. The categories where Fleet Management, Supplier-Buyer Relationship, Supplier Evaluation and Information and Communication Technology. A number was added in the beginning of each file name, to indicate “score” as to how well the paper was related to the chosen research topics and how well it could help answer the questions. This saved a lot of time when going back to the literature and look for more information about a specific subject.

To understand the subject of fleet management, a case study was analyzed which was performed when implementing fleet management system in Kenya Power & Lightning Company, as well as a case study about optimization of logistics operation using GPS technology solutions. These led to other sources, including “Performance Impacts through Intelligent Transport System” which highlighted benefits of increased efficiency and improved customer levels when implementing Intelligent Transportation Systems (ITS).

Supply Chain Management was one of the first areas to research in order to get a broader perspective of the problem formulation and which subject relates to the research questions. This helped to narrow down the literature review and get a deeper understanding of the specific area of supply chain management that I studied. With the supervisor from KTH being a researcher within Operations Management, he large amount of expertise and relevant literature. Through this, I learned about the role of applications of ICT systems for logistics, Charles Fine’s Industry Clockspeed and Competency Chain Design, Information Sharing in Supply Chain, and Management of Supply Chains.

To collect details about the suppliers for the evaluation framework, the search-engine Google proved very helpful. Some information about suppliers was not available online, which was sent personally by their sales representatives. Many of the criterions for the supplier evaluation required testing of products, and was provided by engineers from Cooltra who tested the different products according to the company’s individual needs.

ICT was studied by focusing on a number of reports, such as “A Research in Relationship between ICT and SCM”, “Exploring the Impact of ICT on Integration in Supply Chain Control”, and “The Value of ITS on Supply Chain Operations”. These reports served as a basis for how ICT can help manage and control supply chain information and material flow.

Enterprise Resource Planning was also studied as some researchers argue fleet management is a sub-part of this broader subject. Fleets can be considered a resource for logistics companies which has to be managed efficiently. One report was especially studied, called “ERP – The Implementation Cycle” by Dr. Stephen Harwood. Stephen has been active within IT since 1970s with extensive experience in information management, business strategy and organizational change.

To understand the effects of implementing GPS-based fleet management technologies, studies covering fleet management technologies where analyzed. These studies explained the different technologies, organizational impacts, best practices and benefits and limitations of GPS solutions. Technologies around GPS-enabled fleet management systems is well described in a study from KTH, named “Analysis and Design of Embedded GPS Applications for Automotive Environment”. It shares the latest trends within fleet tracking and provides insights for Cooltra’s operations.

With that information at hand, research within supplier evaluation was studied to identify how a company can successfully source the right products and create a good buyer-supplier relationship. In order to describe
supplier evaluation frameworks, a number of sources within this field was gathered, case studies covering subjects from fashion retail to oil & gas were analyzed. This helped to get an understanding of the differences in the various sectors and apply the relevant arguments on this thesis.

3.3.3 Consulting projects

Prior to beginning this thesis, the author of this thesis was part of a consulting project at Cooltra performed as a voluntary project together with some colleagues. He were given 6 weeks to help solve one of Cooltra’s problems that they sent to us. It included weekly meetings with Cooltra representatives to ask questions and dig deeper to help answer the questions better. Happily, the team won the project and were able to go out for dinner with Cooltra and some colleagues. The consulting project enabled to get an introduction to a wide range of contacts within Cooltra and understand the organization before this thesis was started. Their topic was to identify possible markets to grow in, thus the topic was different from this thesis. However, with multiple interactions with Cooltra’s CEO, it gave a solid understanding of their challenges, goals and what support was needed.

3.4 Reliability, Validity and Objectivity

To ensure the quality of an explanatory empirical research, three tests are generally used: validity (construct, external) and reliability. Internal validity can be used for explanatory or causal studies, but is not adequate in this case. 

<table>
<thead>
<tr>
<th>Test</th>
<th>What has been done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Same method used for each case, with the same procedure for interviews and collecting secondary data. Regular meetings and feedback from supervisor.</td>
</tr>
<tr>
<td>Validity</td>
<td>Well-prepared interviews and interviewees who were well aware of research focus, enabling them to recommend other people if they did not have the right knowledge. Logical flow throughout study, helps understand how questions lead up to literature study, empirical finding, results and conclusion.</td>
</tr>
<tr>
<td>Objectivity</td>
<td>Research content was decided by the researcher, avoided being influenced by surroundings and focus on content that was important for the study.</td>
</tr>
</tbody>
</table>

3.4.1 Reliability

According to (Joppe, 2000), reliability can be fined as:

“The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable”

A leader in the case study research field, (Yin, 1994) recommended to continually analyze the quality of the case study design. To specifically improve reliability, he highlights the use of case study protocol and developing a case study database during the data collection phase. This means to use the same data collection procedure for each case, and having a consistent set of initial questions in each interview.

In this study, the same method has been used for each case, with the same procedure for interviews and collecting secondary data. However, some of the interviews with customers and suppliers were of a less-structured approach, which means it could have a negative effect on the reliability. All interview transcripts and notes have been collected into a database, and sent to interviewees to confirm content.
As this thesis was written by a single author, there were limited possibilities of discussing the results with a colleague (other than supervisors), which is a procedure often pursued to increase reliability of collected data.

3.4.2 Validity

There are two types of validity in qualitative research, internal and external validity (Bryman & Bell, 2007). Internal validity refers to which extent the researcher investigates what is claimed to investigate (Farquhar, 2012). A way of improving construct validity is through triangulation, using a number of data sources to reduce bias. Suggested by (Remenyi & Money, 1998), another improvement action is to create a clear chain of evidence that helps the reader follow the researcher’s way from research question to conclusion.

The interviews were well-prepared and interviewees were aware of the focus of the research, which enabled them to recommend other people if they felt they did not have the right knowledge. With a logical flow throughout this study, the reader can understand how the questions lead to an accurate literature study and empirical finding, followed by results and conclusion.

External validity refers to how well data and theories can be applied beyond the immediate study (UC Davis, 2016). With a high external validity, the researcher is confident in generalizing results or findings across different populations, situations and times. One should consider the researchers’ claims in regard to generalizing results with findings, as well as how participants were sampled. For this project, the validity was increased by using different sources such as journals, books, presentations from leading universities and research institutes, and interviewing a large set of people with different backgrounds and roles. However, the study was limited to a single company in a city in Spain, which means the results may not be generalized for the whole industry nor country.

3.4.3 Objectivity

This master’s thesis was written with feedback from Cooltra, and supervised by KTH Royal Institute of Technology. There is a risk that the person ordering the thesis wants to influence the results of the research in order to follow their agenda (Bryman & Bell, 2007). Thus, all research decisions should be taken by the researcher and avoid being steered by the person ordering the thesis. Throughout this thesis, the company provided insightful advice, but left the design and conduct of thesis to the author. Also, the suppliers were graded after discussions with Cooltra employees. There is a risk that the perceptions of Cooltra employees might influence the results, although this risk is deemed as very low.
4 Results and analysis

This section presents the findings and are presented as outlined in the methodology. The data was gathered using in-depth interviews, archive data and observations. The logical approach is to follow a chronological order of the research questions, meaning that the chapter starts with presenting the elaborated framework. Following is an evaluation of the five vendors according to the fleet management capabilities and effects, as well as other factors part of the evaluation framework.

4.1 Fleet Management

When studying fleet management, it was decided to focus on three dimensions. The first dimension covers fleet management technologies, to understand how ICT enables fleet management, the solutions available and benefits each one provides. The second dimension covers the GPS, as it plays an integral part in all the previous solutions. Lastly, the third dimension covers effects of implementing ICT, key lessons for Cooltra’s management once they have chosen a supplier for fleet management solutions.

4.1.1 Fleet Management Technologies

Fleet Management Systems is a term covering solutions enabling real-time monitoring of vehicle fleet-related applications. To support these systems, ICT is declared the leading enabler of connecting disconnected suppliers, manufacturers and transportation companies.

Specifically, the technologies that enable the real-time logistics requirements are mobile communications; global positioning system (GPS), geographical information system (GIS), general packet radio service (GPRS), as well as Internet-based services, which provide increased transparency and detailed data about shipment data and deliveries. GPS systems are space-based radio positioning systems that provide a 3D position, speed and time any time of the day to users equipped with the right equipment.

In order to keep track of vehicle positions, there are 5 main technologies:

- Automatic Vehicle Identification (AVI), which connects vehicles to antennas on traffic lanes and is mainly used among taxi companies to manage queues and in mining for tracking trains
- Automatic Vehicle Location (AVL), a common solution that uses GPS to determine location through frequent intervals, enabling drivers to be sent custom information according to the position (such as weather data, traffic, accidents)
- Electronic Distance Measurement Instruments (EDM) is used for applications such as route numbering, addressing traffic accidents, and calculating areas and volumes.
- License Plate Matching and Cellular Phone Tracking involves collecting the license plate numbers and arrival times at various checkpoints to calculate travel time. This can be done manually or automatically using technology such as video recognition
- Cellular Phone Tracking requires cellular telephone reporting and cellular geolocation to calculate time between two measurements and provide speed information. This method is not commercially widespread due to its low-accuracy and privacy issues, with public fear of monitoring telephone calls and track vehicles

The Automatic Vehicle Location (AVL), through the use of GPS, is the most commercially viable fleet management technology today. To understand how this technology works, below is brief background about
how the technology works, its benefits and disadvantages, and what is important to be aware of when using a GPS system.

4.1.2 The GPS

The GPS receiver/processor takes use of position and time measurements from GPS satellites, encoded in the transmitted signal. It consists of 32 satellites orbiting around the globe, developed by the Department of Defense in the United States. GPS is a satellite technology that through a constellation of satellites transmits precise microwave signals which can be picked up by GPS receivers to determine the current location, time and velocity.

The GPS helps to identify the location of an object, individual or other assets. The position is stored regularly and can be sent to a local central database or via Internet connection to computers, through the use of General Packet Radio Service (GPRS). This data can then be used by a customized software or web service to provide an interface with overview of the fleet, which can be supplied by different vendors.

Today roughly 75% of tracking devices are based on GPS receiver chips, integrating both GSM and GPS technologies. The GPRS-based GPS monitoring system communicates through the GSM modem.

The GPS system is built by 3 main segments: space, control and user segment. The space segment includes satellites orbiting around the globe. The control segment consists of 5 master control stations spread across the globe. The user segment includes the GPS receivers that decode signals from satellites to determine position, speed and time.

The services offered to GPS users are the civilian (SPS) with 100 meter accuracy and military (PPS with 20 meter accuracy. For the user, the communication consists of two parts. What is required first is the mobile access network (GSM) to connect the control center with the on-board devices. Then the GPS position must be collected, by using a GPS receiver.

GPS trackers can be classified into three categories based on how they store and send data: data loggers, data pushers and data pullers. These can be passive, active and hybrid. Passive systems send information only when the user connects the GPS tracking unit to a docking station. The active, real time-time system is based on a GPS-mounted wireless receiver that continuously downloads information without the user managing it. The real-time systems come with a software, which enables the user to track an object in real-time, and supervise the object through a computer.

4.1.3 Effects of implementing ICT

Companies must use an operational risk management approach to determine what the business needs are and to understand the potential risks of implementing the wrong technology. Some suggestions include:

- Begin early, before your competition.
- Choose the right suppliers and do not manage too much yourself without being a subject expert.
- Be aware the information architecture determines if the project becomes worth the investment (positive ROI).
- Perform a pilot test. This reduces the risk of incorrect design or costs, helping to reduce the time to ROI.

To get the most benefits of a new ICT solution, companies must also invest in business modeling to lay the ground for Internet-first integrations. Companies must view the whole supply chain as a network of interconnected businesses with flows of products and services. This should be connected and linked through Internet based solutions and applications. Through IT new possibilities emerge of interconnectedness.
between departments, new ways of storing, processing, distributing and sharing information internally and externally. This increases the need of removing barriers between different units, such as improved communication between marketing and distribution.

To support these changes of increased fluidity of data and product flows, companies are required to invest in new information and communication technology (ICT). The most important changes should be prioritized (ranging from 3-5), and likewise determine potential obstacles that may inhibit the changes. Following this, the organization must formulate the processes needed to execute the goals set for the change project. Companies should be aware ICT primarily affects the supply chain in three ways:

1. Increasing travel demand as a result of new offerings being developed.
2. Substitution of travel as activities will be done remotely, instead of traveling.
3. Modifying travel through logistics and ICT processes to enable new ways of carrying out these activities.

Position-based services further enable features such as web-based booking services, delivery notifications and receiving information from mobile telephones, GPS systems to provide location data – all to help the user manage logistical resources in an increasingly demand-driven freight distribution system. ICT helps human activities, increases operational or even personal efficiency, reduces time to execute activities, improves logistics efficiency, and increases transparency to stakeholders, increases adoption of improved business practices to meet service level agreements and increases flexibility in organizations to adopt to a dynamic environment.

A survey performed with users of tracking systems identified benefits such as increased productivity, lowered costs and improved fleet performance. They also mention effects of reduced overtime claims, lowered insurance premiums, fuel usage, communication costs and administration.

With benefits such as cutting costs on labor, better safety, improved fleet utility, less theft, better maintenance reminders, GPS is becoming the preferred and most widely used information system in logistics, with an especially large success within the transport industry. As I have seen, companies investing in ICT by using GPS have the potential to generate large savings, with the quickest return coming from labor and fuel costs, topics that today create headache for many C-level managers within transportation companies. Another advantage is an increased employee accountability as each driver can be better managed, resulting in fuel savings, less maintenance costs and improved safety, with quicker correction of faulty vehicles. Further benefits experienced by logistics service providers that implement GPS fleet management systems:

- Decreased accident rates and safer driving.
- Higher level of fleet availability (drivers can be taught how to drive in a more fuel efficient way. Helps tracking working hours of the staff, automating tracking of start/end times and improve service planning
- Fuel savings and environmental factors (ensure the right delivery temperature, refrigeration temperature along the route).
- Reduced overall transport operational costs (maintenance dates, oil change, time to identify issues, reduce downtime and risk of further damages).
- Improved responsibility and information flow (enable tracking of position, speed, heading).
- Better recovery of stolen vehicles (guarantee return of vehicle, send notifications).
- Increased customer satisfaction (It is evident modern logistics services require the use of real-time monitoring and communication with fleet vehicles to reach a high level of fleet operations and adapt quickly to ever-changing customer demands).
4.2 Supplier Evaluation Framework for Cooltra

To help answer the second research question, this part begins with an evaluation framework adapted for Cooltra and purchasers of fleet management solutions.

4.2.1 Evaluation framework for fleet management companies

Based on the above evaluation criteria for supplier, together with research fleet management, a new evaluation criteria framework was created, specialized for companies purchasing fleet management technologies. The framework is reduced to the ten most important criteria. The below 10 criteria were determined to be the most important for Cooltra, sorted from more to less. The weight was decided by the leadership team in Cooltra, following multiple discussions to mutually agree on what were important factors for the evaluation.

<table>
<thead>
<tr>
<th>Evaluation criteria for fleet management purchase</th>
<th>Weighted importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>10</td>
</tr>
<tr>
<td>Credibility</td>
<td>9</td>
</tr>
<tr>
<td>Financial situation</td>
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</tr>
<tr>
<td>Price</td>
<td>8</td>
</tr>
<tr>
<td>Historical performance</td>
<td>7</td>
</tr>
<tr>
<td>Quality</td>
<td>7</td>
</tr>
<tr>
<td>Backend</td>
<td>6</td>
</tr>
<tr>
<td>Frontend</td>
<td>5</td>
</tr>
<tr>
<td>Contract agreement</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4. A Cooltra-weighted supplier evaluation framework

**Flexibility**

Flexibility received the highest importance, 10. After multiple interviews with engineers and Chief Operations Officer, it was clear they need a vendor to provide flexibility of product design. This involves customization of the GPS, ERP (Enterprise Resource Planning) integrations, collaboration with developers, API offerings. A supplier with low flexibility typically had a standardized product that could not be adapted to customer needs. A supplier with high flexibility had resources to customize the solutions.

**Credibility**

Credibility was given the score 9, and for Cooltra this means risk management. Does the company have a solid reputation? Do they have a background in working with scooter rentals, i.e. Cooltra’s industry? Furthermore, how are they perceived as doing business with? As Cooltra’s COO put it – “There is significant operational work involved in installing and customizing each scooter, all 6000 of them”. Before deciding on such a strong partnership, it’s important that Cooltra knows the company has sound financials and a low risk of working with. As one of the interviewees said, “They [the supplier] must not leave us on the street!”

**Financial situation**

The third criteria is evaluating the supplier's financial situation. Is the company’s revenue growing, declining, any recent acquisitions that makes it especially compelling for Cooltra to collaborate? What is their profit margin, and the future outlook?
Price

The interviewees from Cooltra all agreed that price is not the most important decision criteria, and it was given the importance score of 8. Cooltra is seeking strategic relationship with vendors, and as one of the interviewees said “when taking decisions by the price, it’s not always the best idea”.

Historical performance

Cooltra wants to work with a supplier that has a proven success track record of fulfilling companies’ requirement similar to that of Cooltra’s. Does the company have experience working with companies like Cooltra, and with similar technologies? The significant investment in time and money required when installing GPS solutions for all scooters, means Cooltra must be comfortable they can live up to these demands.

Quality

Any issue with the GPS technologies means Cooltra’s service to their end customer will be affected, thus impacting Cooltra’s service levels and customer satisfaction. It’s critical for the equipment to have features such as being rain tolerant, enabling automatic updates, high quality connection, regular signal intervals and a high percentage uptime.

Backend

Back-end features means how the data is managed in the fleet management platform. What can Cooltra do with the data, how can they access it and in which formats? What are the existing connection possibilities, what kind of information can you receive automatically? Is the data structured into different groups, or is it sent together in one file? This was not as important as the above mentioned criteria, and was given the score of 5.

Frontend

Front end means how information is presented visually in the fleet management platform offered by the supplier. How does the app look today, how intuitive is it? To which extent does their existing solution fulfill the requirements of a fleet management platform that Cooltra will offer their customers?

Contact agreement

Contract agreement was given a weight of 5 and, indicates how Cooltra will purchase the GPS equipment from the supplier. What are the payment terms, leasing options, and timeline for this? Cooltra is interested in buying the equipment as a service, rather than purchasing everything up front. Are there any possibilities to update the product when there is a new release? Flexibility is key here, and the supplier should offer the possibility of updating terms and changes as required by Cooltra. As one of Cooltra’s interviewees mentioned in the interview “I don’t want to be in locked in with our supplier”.

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Figure 5. Evaluation criteria weight according to Cooltra, the higher score the higher importance.

4.3 Evaluation of Cooltra suppliers

In the below section, the vendor is analyzed according to each criteria proposed in the evaluation framework designed for fleet management procurement. The results are summarized in table and figure for each supplier, and an explanation on how the supplier performs according to each criteria.

4.3.1 Supplier 1

Introduction  Supplier 1 is a global leader in navigation, traffic and map products, GPS Sport Watches and fleet management solutions. The company was founded in the early 90’s with revenue of roughly $1 Billion and has 4,000 employees in 35 countries.

Evaluation score

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Weight</th>
<th>Score</th>
<th>Weighted Score</th>
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<td>Flexibility</td>
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<td>Credibility</td>
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<td>Quality</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>443</strong></td>
</tr>
</tbody>
</table>

Table 5. Score of supplier 1 according to Cooltra’s evaluation criteria
Supplier 1 has little flexibility for custom developments. Their business model is to be a large player in the market selling large volumes in a standardized package. Cooltra’s solution is requires specific features and integrations, for which Supplier 1 requires large investments to fulfill.

As a big player with many top reference suppliers, Supplier 1 has large credibility. It is present worldwide and has long experience of similar projects.

Large market share and revenue of roughly $1 Billion in 2016, with improving gross margin and cash flow from earlier years.

In relation to other vendors, a very high price of 12 EUR/device/month.

Good history, but almost solely in the Business-to-Customer (B2C) field, which have different needs than Cooltra.

Quality was good, with Europe-manufactured products, being rain proof, as well as providing automatic updates and consistent connection quality.

Supplier 1 offered a large toolset of managing the data on the platform. It offers connection with many varieties of information types and with possibilities of automatically dividing the data into different groups.

The application was very intuitive for the user and easy to use.

Supplier 1 had pre-determined agreement conditions that couldn’t be adapted to Cooltra’s needs.

Figure 6. Score of supplier 1 according to Cooltra's evaluation criteria
Summary

A good provider but not focused on large fleets, more into B2C where customization possibilities are low.

4.3.2 Supplier 2

Introduction

Supplier 2 is a company focused in the development, manufacturing and commercialization of location-based systems. It was founded in 1992 and has today over 22,000 customers in Spain with over 150,000 active vehicles. The company has wide experience in many different fields, providing solutions for trucks, car fleets, trailers, bikes, taxis, boats, rental cars, machine equipment, agricultural vehicles and others.

Evaluation score

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Weight</th>
<th>Score</th>
<th>Weighted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
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<td>Credibility</td>
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<tr>
<td>Backend</td>
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<td><strong>568</strong></td>
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Table 6. Score of supplier 2 according to Cooltra’s evaluation criteria

Figure 7. Score of supplier 2 according to Cooltra’s evaluation criteria
Supplier 2 is a specialist in API integrations, and has experience working with many different companies in various sectors (cars, buses, taxi fleets, animal transport etc.). This makes them more open to answer to Cooltra’s needs of custom development.

Supplier 2 is the market leader in Spain, with high customer satisfaction.

With the broad range of customers and long experience in the field, with consistent successful track record, Supplier 2 is seen as a low-risk supplier.

The price was 6 EUR/user/month, half of the price of supplier 1.

Good historical performance with over 2 billion kilometers being tracked by Supplier 2’s systems, with a 99% success factor.

Quality was deemed to be very high, with equipment being manufactured in Europe. Good test results on rain tolerance, automatic updates.

A high score due to broad integration possibilities.

Supplier 2 lacked some of the features on the frontend capabilities - it was not very intuitive to use and had a limited library of frameworks.

Supplier 2 is open for negotiations to adapt the contract to the use of Cooltra’s operations.

A wide portfolio of solutions, good customer attention and care, open to understand Cooltra’s challenges and goals of their solution.

Supplier 3 is a company specializing in development of telematics solutions for enterprises. Apart from controlling and operating mobile resources, the company helps its customers increase productivity and business performance. The company has been in operations since early 2000s, and has over 5,000 customers in Spain, and offers its services to any client globally through its servers in the Amazon Web Services (AWS) cloud.

### Evaluation score

<table>
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<th>Weight</th>
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<td>Price</td>
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<td>Historical performance</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td><strong>479</strong></td>
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*Table 7. Score of supplier 3 according to Cooltra’s evaluation criteria*
Figure 8. Score of supplier 3 according to Cooltra’s evaluation criteria

**Flexibility (7)** Although Supplier 3 offers flexibility in the integrations, much of this work would have to be done by Cooltra. The product is in a premature phase and does not offer functionality demanded by Cooltra.

**Credibility (7)** Supplier 3 is smaller than the other companies in this study, and is focused around applications that are different from Cooltra’s. The company has over 5,000 customers in Spain but its reference cases are different from the usage for Cooltra.

**Financial situation (8)** The company has solid finances and successfully completed multiple projects in various sectors such as security, automotive, hospitals and logistics.

**Price (8)** The price was fairly good, 7 EUR/unit/month.

**Historical performance (7)** Their experience is more focused on applications for route monitoring and optimization, and the organization has very engineering-focused approach. They do not have a lot of experience on user-friendly UI and designing end solutions.

**Quality (7)** Supplier 3 manufactures their products in China, and quality was not the same as other vendors.

**Backend (7)** Supplier 3 provides large flexibility of backed integrations, however these have to be developed by Cooltra.

**Frontend (7)** Similar to backend, the frontend can be customized but most of the work needs to be done by Cooltra.
Its contract is restrictive, with less financing capabilities and less room to customize agreement to create a tailor-made financing solutions for Cooltra.

A good supplier, but collaborating with them requires large time and money investment to develop the solution.

Supplier 4 is a provider of telematics and security solutions founded in Spain during the early 2000s. The company started out focusing on location-based services to identify robbed vehicles, and has lately emerged into providing more innovative solutions for fleet management on pay-per-use terms. They are present in over 30 countries, have over 60,000 clients in Spain and have partnerships with most insurance companies in Spain.

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>Weight</th>
<th>Score</th>
<th>Weighted Score</th>
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<tr>
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<td></td>
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<td><strong>446</strong></td>
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</table>

*Table 8. Score of supplier 4 according to Cooltra’s evaluation criteria*
Figure 9. Score of supplier 4 according to Cooltra’s evaluation criteria

Flexibility (5) Supplier 4 gives Cooltra limited accessibility to customize the solution. Modifications have to be done by the supplier, on behalf of Cooltra’s requirements.

Credibility (8) Supplier 4 boasts with a strong credibility being one of the largest players in the Spanish telematics market.

Financial situation (8) Their financial situation is strong, having done some major investments recently.

Price (8) Price was fairly good with 7 euros per unit per month, thus a score of 8 was given.

Historical performance (8) The company has done large-scale projects similar to the requirements of Cooltra, and has a rich historical performance in many different sectors in the Spanish market.

Quality (6) Quality was not very good, due to low water resistance and the large size of the GPS monitor.

Backend (5) The backend-functionalities are limited, with restrictive access to customization.

Frontend (5) The front-end functionalities are limited, and the supplier showed little support in demonstrating the user interface capabilities when Cooltra was testing out the various suppliers.

Contract agreement (7) Standard, some negotiation possibilities to adapt the contract according to Cooltra’s preferences.
Summary

A rigid back-end solution, but the company focuses on volume selling and not customized solution for different customers. As was evident by the little interest shown by the supplier towards Cooltra during the test phase, the company lacked the kind of customer service required by a strategic supplier supporting a critical part of Cooltra’s solution.

4.3.5 Final score

The supplier that fits the most requirements for Cooltra is Supplier 2, with the most score of 579. With the most flexibility, high credibility, stable financial situation, good price, and high quality. The less strong point is the supplier’s frontend capabilities which requires more work from Cooltra’s side in order to create the desired solution.

<table>
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<td>Supplier 3</td>
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<tr>
<td>Supplier 4</td>
<td>446</td>
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</tbody>
</table>

*Figure 10. List of supplier scores*
5 Conclusion

This section analyzes the collected data presented in Chapter 4. The results will be discussed along with the choice of methods, outlining possible influences of methodological biases and errors in data validity. Also, it discusses the study’s findings, in relation to what was already known about the subject, and the new understanding gained by the findings.

5.1 Discussion

5.1.1 Fleet management

The first research question is “How does ICT enable fleet management?”. As expressed by (Decide Software, 2016) ICT is increasingly embracing the third step of Supply Chain Management – “Supply Chain Execution”. Companies have historically been good at creating systems for managing Supply Chain Planning (demand planning, material resource), as well as Sourcing and Procurement (E-Procurement, Contract Management). However, the last part – Supply Chain Execution and fleet management has not received the same attention. With the more recent development within position tracking technologies, fleet managers can now achieve higher utilization and faster response to customer needs. This is thanks to technologies such as GPS-enabled AVL and AVI – which can keep track of the vehicles and report in case of any abnormalities. Our results confirm the integral part of ICT in enabling fleet management.

There are many different technologies available and each one comes with benefits and disadvantages. For Cooltra, it is important to have highly-accurate and updated data from the scooters, meaning AVL with GPS was the best option. This enables Cooltra to provide more services to their end-customers who need to know where their deliveries are and how the trip has been performed, in time and within safety limits. Thus, a better fleet management solution is directly tied to Cooltra’s business development unit as it provides a platform, onto which they may build further services. As noted by (Li, Kumar, & Lim, 2002) – much work is required within business modelling, to enable internal integration within companies.

At Cooltra, the key is to begin testing the new services and drive top-line growth through new revenue streams. Once the infrastructure is in place, the software development begins – where Cooltra must understand what services customers are willing to pay for. Having the GPS infrastructure installed in scooters offer large possibilities of creating new services for its end customers, and for this remains market research to understand what are the key features needed within the fleet platform. Once the fleet management solution is made available to its customers, Cooltra can also utilize the platform to improve internal processes. The company may track the distance a certain scooter has driven, to prepare the maintenance organization for a future inspection on the particular scooter. Evidently, this has key benefits both for Cooltra and its customers.

Other users of fleet management might find it sufficient with a more passive tracking solution, with less focus on GPS-enabled solution, and more on solutions like RFID, DMI and license plate matching. The nature of Cooltra’s requirements made this thesis very focused on GPS. However, other solutions may offer lowered costs – considering the GPS needs a SIM-card to connect to the platform which leads to monthly payments per device. According to quotes from various suppliers, this cost could amount up to almost 10 EUR per device per month.

Today’s barriers for technology adoption may change in the future. With the increased use of GPS-embedded smartphones, Cooltra may begin focusing on creating new solutions taking use of the smartphones riding along the motorbikes. Public opinions about cellular phone tracking may also change, enabling more companies to take use of cellular phone tracking. Furthermore, companies must comply with data regulation
laws (especially within European Union) to ensure drivers are not tracked without consent. As a result, we may see regional differences in what solutions are being adopted according to requirements of user data.

One of the hypotheses (as originally heard from Cooltra) of this thesis was that GPS equipment reduced the costs of insurance. Apart from expanding its B2B offerings and enabling new services, this was one of the primary reasons Cooltra was looking into integrating GPS on all scooters. The hypotheses was correct, with (Waiyaki, 2013) identifying how many insurance companies are offering rate reductions for safety equipment, generate massive savings on insurance premiums. What remains is a more thorough study comparing companies’ actual insurance costs before and after a fleet management solutions implementation.

Other propositions include fleet management leading to better tracking of staff (or big brother, as one of the interviewees said), improved customer care, and better incident reporting. As shown by (Vivaldini, Pires, & de Souza, 2012), fleet management systems enable real-time communication, providing information about events along the route. For Cooltra, this means their B2B customers don’t have to rely on the information provided by drivers to understand if the drive went well. Instead, fleet managers can look on their management portal to see which scooter has had an accident (i.e. sudden increase in g-force measured by accelerometer embedded in GPS), and if it followed its designated path to the destination. As a result, transparency is increased within the organization. The fleet managers has better understanding of top performers and can promote accordingly, leading to better talent retention and service quality.

5.1.2 A new supplier evaluation framework for fleet management

The second research question is “What framework can be used to evaluate vendors of positioning and tracking technology?” Research on supplier evaluation was heavily influenced by (Dickson, 1966) who surveyed 273 purchasing managers in different companies, and summarized his findings into 23 important criteria. The author found quality, delivery and history most important.

As there is limited research on framework available today for procurement of fleet management technologies, the method was to use an existing framework and adapt it according to the needs of the case company. A new supplier evaluation framework was thus developed which included the ten factors of flexibility, credibility, financial situation, price, historical performance, quality, backend, frontend and contract agreement At Cooltra, the management had a strategic view of suppliers considering the large time investment needed in implementing a GPS solution for thousands of scooters worldwide. Furthermore, quality was equally important as any breakdown would influence the experience of using Cooltra’s services. Cooltra’s B2B customers will be expecting their fleet management platform to provide data in an accurate manner to help ensure the deliveries are being made correctly.

Out of the four supplier, Supplier 2 scored highest during the evaluation with 568 points. Thus it was chosen as the final supplier for Cooltra, with the next step of beginning Proof of Concept (PoC). It is clear Cooltra was looking for a supplier who is “in it for the long run”. This shift in mindset of supplier supports theory from (Dey, Bhattacharya, & Ho, 2015), who suggest companies should make the move from focusing on strategic topics when evaluating suppliers. Rather than focusing on quality, delivery schedule and costs, companies should look for suppliers with high levels of organizational practices, risk management, environmental and social questions. This was also one of the reasons Cooltra decided for Supplier 2, as the supplier had completed earlier projects which were very customized to the customer’s needs and involved a long time of working together in order to come up with a new solution.

The three most important criteria for Cooltra was flexibility, credibility and financial situation. Flexibility was chosen as the most important factor primarily because integrating a supplier’s GPS tracker into Cooltra’s fleet across multiple countries, is a very time consuming operation. Furthermore, once the physical job is done, the
platform has to be developed. This means the supplier must collaborate with Cooltra to create a new solution adapted for them to fulfill the needs of Cooltra, the customers and the supplier.

To lower the risks before entering such venture, it is important to research the credibility for each supplier. This means investigating if they have completed such projects before and knowing they have the resources to fulfill Cooltra’s service level agreements (SLAs). Also, to ensure the supplier will still be in business by the end of the year – it’s essential that the company has sound finances. This can be a difficult criteria to determine as some companies may be private and do not have their balance sheets available for the public. For the generalizability of this framework, this criteria be open to cultural and regional differences. Cultures with low trust between parties may value sound finances and guaranteed payment higher than cultures with high trust, where such things may be “taken for granted”.

Some factors did not align with earlier research. For example, (Dickson, 1966) found that geographic location, management and organization were two of the most important factors. At Cooltra, these were not discussed and the discussion remains open to why. A possibility could be that Dickson’s research is based on smaller companies that are based in a city or just parts of the country. In such situation, having a local supplier who can come visit for the day makes perfect sense. For a geographically spread company like Cooltra, having a supplier with many different locations is of great value to support their business. Management and organization was not discussed – however this may have come up in many of the other criteria. An example is when an interviewee from Cooltra was complaining of bad customer service from one of the suppliers. One may argued he is giving negative feedback on the “management and organization”.

Some criteria in our evaluation framework did not exist in earlier research – such as backend and frontend software capabilities. These criteria stem from the IT organization at Cooltra who will build the fleet management platform to support its B2B offering. As these could not be found in the literature, they were purely expressed by Cooltra and their understanding of what makes a company good in this criteria. The need stems from Cooltra’s B2B fleet management platform which needs to connect with many parts of the organization.

With solid backend capabilities, the integration from GPS to Cooltra ERP system is easier to setup and the systems can speak with each other, enabling more automation. Without the integrations, manual data collection must be done – requiring time and investment. The fact that a company offering scooters has demands on how the fleet management platform should both work and look, tells a story. Companies like Cooltra are expanding into value-adding services to stay competitive in the business. With the software intelligence on top its scooters, fleet managers know they will be given insight into their fleet, leading to actions for improvements.

5.2 Summary
Fleet management is a solution for managing vehicle fleet, enabled by solutions such as the Global Positioning System (GPS). The ability to manage your fleet provides benefits such as increased threat prevention, improved driver accountability and reduced costs. Accordingly, there is a need for improved understanding of the technologies are available and how to select the right supplier. The immediate objective of this research project is to determine the fleet management technologies, and how to evaluate the suppliers according to the needs of purchasers within this industry. With this, an analysis can be made of today’s technologies as well as an evaluation framework customized for fleet management procurement.

Through interviews with key stakeholders in a fast growing scooter rental company and its suppliers, the analysis yields their explanations and provide new insights into what matters for companies within this industry. Results include requirements of suppliers being 1) credible, 2) flexible and open to changes
according to user demands and 3) a stable financial situation to ensure they stay as a long-term strategic partner. The stories add nuance to our understanding of the latest fleet management technologies and how to evaluate companies in this emerging industry. In using a largely untapped source of collecting demands and challenges from scooter rental companies operating both within a B2C and B2B environment, this project will contribute to future research on similar topics. The evaluation framework was based on the emerging technologies, and the growing need for companies to partner with suppliers who can help to innovate and develop their offerings to both businesses and consumers.

5.3 Contribution

5.3.1 Theoretical contribution

Prior to beginning the thesis, a pre study was performed. This proved to be very beneficial as it enabled to reduce the scope and focus on the right subject. The subject of choosing technology and suitable supplier was a highly prioritized matter for Cooltra – as it was a major bottleneck to release a better offering towards their B2B customers who are requesting capabilities of managing their fleets in real time.

The subject of how ICT affects fleet management for vehicle rental companies has not been extensively studied before, making this study a supplement to the existing theory of choosing a supplier of telematics for rental companies. Our study has contributed to reducing the gap in theory about supplier evaluation criteria for vehicle rental companies, by studying a company in the emerging field of vehicle sharing that is becoming increasingly popular in Europe and around the world. The thesis identified new factors to include in the supplier evaluation framework, such as backend and frontend features. This shows that even scooter-operating companies take a high interest in software and hardware development outside their traditional business. Further ahead, companies like Cooltra may be looking at how much “AI capabilities” their suppliers have – to help Cooltra create intelligent solutions for its customers.

Highlighting the global transformations of sustainability, increased environmental awareness among users and a future where people increasingly share resources – this study provides knowledge on how vehicle rental companies can choose the right technology and vendor to track their fleets. The thesis also provided new insights to the technologies available to implement fleet management solutions, the differences between them, as well as benefits and disadvantages of the different options. One of the findings include the suitability of Active Vehicle Location (AVL) solutions, which take use of GPS to provide the location on a map. In the future, companies may also take use of the already available GPS and accelerometer inside users’ phones to process more data and create further new solutions.

The evaluation framework that was developed according to Cooltra’s own experience and industry needs, and shed light on needs of this emerging industry. For example, what was not found in existing evaluation frameworks and which was unmistakably important for Cooltra, was the need for supplier’s customer service and front/backend capabilities. In this case, it translated into the extent to which the supplier reached out to their customers during the test phase and ensured everything was going smoothly, and answered any questions that may arise. One of the goals of the study was to determine how companies can evaluate vendors of fleet management solutions.

Another goal was to determine a suitable supplier, which this thesis successfully did when deciding on supplier 2. The literature study highlighted how suppliers generally act and think to develop skills and competencies. In the results, an adapted framework was presented according to Cooltra’s needs, which helped Cooltra select a strategic vendor for this critical solution. It is also believed that the framework can serve other vehicle rental companies around the world. Since the business models and technology use is similar whether it’s a scooter, car or truck, our framework can add value to many sectors. As a summary,
companies like Cooltra are looking for long-term strategic suppliers, who, as one of the interviewees stated “Won’t leave us on the street”. Companies like Cooltra are also prepared to pay a premium for a company that fulfills more requirements, but has a higher price. Other companies may have different purchasing department structures, where factors such as list price may have larger influence.

5.3.2 Empirical contribution

Companies like Cooltra are increasingly developing new software on top of their scooter offerings, which is why they need to know the backend and frontend capabilities of suppliers. Providing scooters is not Cooltra’s end goal – what is needed to stay competitive is a business intelligence solution that can provide advice and feedback on how a company’s fleet is operating. This can also help Cooltra stay ahead of the competition and avoid having to sell on price during tenders. As competitors release cheaper scooter services, Cooltra must focus on the total cost of ownership and highlight the savings generated by embedding fleet management solutions like theirs.

The fleet management platform plays a critical role in the future business development. Collecting data about scooters, and highlighting key numbers in a user-friendly manner is the next step for more value-adding services offered to Cooltra’s customers. A suggestion for the organization is to ensure sufficient focus on improving digital capabilities in the fleet management platform, to ensure the project gets the attention needed. This might include hiring more data scientists, or researchers in machine learning to understand how and what data should be captured to help its customers understand how its fleet is operating, and provide suggestions for further improvement.

With the work now completed of researching about suppliers and deciding which one fits the requirements, Cooltra can focus on creating its fleet management solution and offer new solutions to its customers. Apart from offering a portal for the fleet managers and gain new revenue streams, Cooltra will gain benefits of immediate accident reports, reduced amount of stolen scooters and ensure drivers are compliant to speed limits when operating. Also, with Cooltra embedding ICT solutions in their scooters, they will create new communication flows between themselves and their customers. Benefits of more regular customer interaction, being proactive on Scooter maintenance issues are factors that should be weighed when deciding to invest in ICT.

5.4 Limitations and further research

Throughout this thesis, four specific improvement areas can be highlighted.

Firstly, the theoretical implications from this study suggests that the subject need further research in order to be generalized to a larger segment. An improvement, and an interesting approach would be to interview multiple (5-10) companies that are looking to buy telematics equipment, ask what requirements they are looking for and create a supplier evaluation framework customized for them. In this way, the evaluation criteria could be based on more interviewees, and not focus as much on the management level when determining what is important for the company when choosing a supplier. Although one may argue that the Chief Operations Officer (COO) is aware of a company’s operational challenges, interviewing members of his team can add interesting perspectives to the study and uncover topics that might not be addressed on the management agenda.

Secondly, this thesis did not mention whether the insurance discounts cover the cost of implementing the solutions and the lowered cost as a result of this. A future study could do this by comparing the insurance cost of a vehicle fleet with and without telematics equipment installed (i.e. with/without insurance discounts), and compare it with the actual cost of installing telematics equipment. This is important as one of the main reason for Cooltra to look into this new technology, was to lower the total cost of ownership of their fleet.
The possibility of knowing beforehand, that other companies in their industry have successfully reduced costs by implementing a telematics solution and received insurance discount, would be of great value.

Thirdly, due to the method chosen for this study, interviews served as a critical way of collecting data from Cooltra and its suppliers. This limited the scope of the study and I believe other approaches could have been taken. It would be interesting to see a study that compared the result of many different companies by using methods such as questionnaires, which would increase the number of respondents. Of course, this would limit the depth of analysis for each case company, with few respondents per case company.

The fourth comment is that this study was done from a perspective of the purchaser of fleet management technologies. In order to help support the development of new solutions, a future study could analyze the demands from the customers (users of fleet management solutions). This could be even focused on some specific needs, such as backend and frontend demands for fleet management operators – to see what kind of solutions they need and what are the missing features in their current solutions. As I have seen during the study of suppliers, many do not have sufficient capabilities and bandwidth to support companies like Cooltra. Thus it would be great for the suppliers to have data on what datasets and connections companies generally need – and then develop solutions accordingly. In this way suppliers could enter the market with knowingly less risk, and feeling confident their product responds to needs of fleet management customers.
6 References


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University of Sheffield. (2014, 08 29). The University of Sheffield. Retrieved from Learning and Teaching Services - Interviews.


