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Mapping and Improving Administration Processes in an R&D Environment

A Case Study of the Internal Vehicles at Volvo Cars

Master's Thesis in the Master's Programme
Supply Chain Management

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ABSTRACT

Administrative processes exist in all kinds of companies. The administration processes are, however, seldom a prioritised area for improvement. The automotive industry is experience increased competition as an effect of the digitalisation and improved development processes. The car manufacturers need to develop new car models more rapidly. The development of cars is expensive therefore it becomes of the uttermost importance to improve all processes connected with the research and development.

This thesis aims to map and improve an administration process at Volvo Car Corporation's research and development department. A single case study can provide a deeper understanding of both the specific case and method used. The study included a literature study, several interviews of the participants of the process, observation of included activities, studying of internal documents, analysis of the collected data as well as mapping the process according to business process management.

The process was described by several process maps as well as the stakeholder of the process were identified. The analysis highlighted some areas of improvement. One area was the use of physical forms, which partly was an effect of the second identified improvement area, the need for physical signatures. Another area of improvement is the use of different IT system.

The thesis concludes that by reducing the use of physical documents, the approval process and final archiving activities can be reduced and less resource consuming. Furthermore, the administration process can become more efficient with an electronic approval system as well as with a further developed system integration. Finally, it can be concluded that process mapping is a useful method for companies to create understanding and to improve their internal processes.

Keywords: *administration, administration process, business process management, BPM, archiving, data archive*.

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Lastly, we would like to say thanks to our family and friends who always have believed and supported us during this master thesis as well as our time at Chalmers University of Technology.

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GLOSSARY

Development vehicle = A vehicle that is used in the process of developing new car models. The development vehicles are ordered through a separate process, excluded in the study. The development vehicles enter the processes in the process *Use of internal vehicles* and are thereafter included in the term internal vehicles.

Dismantler = A company which dismantle the vehicles and sells the parts as spare parts.

Disposal form = The form that needs to be filled out when a vehicle will be disposed of. It explains to whom the internal vehicle will be disposed of.

ERP system = Enterprise Resource Planning system = A business management software for core business processes.

Internal vehicle = A vehicle used internally at Volvo, used for testing, marketing purposes and internal transportation.

Marketing department = The department at Volvo that works with the promotion of cars at events.

Non-saleable vehicle = The vehicle is not in a condition to be sold to the car dealer and on the second-hand car market. These vehicles' values need to be written-down.

Order form = The form that is filled out when a need for a new internal vehicle is identified. This form needs to be signed by relevant people to be valid.

Order handler = The person responsible for ordering the internal vehicles from production.

R&D = Research and development = Activities performed to develop new products or to improve existing products.

Recycler = A company which shatters the vehicle into small pieces and recycles the small pieces into its former material.

Saleable vehicle = The vehicle is in a condition to be sold to the car dealer and then on the second-hand car market.

Special driving dispense = An internal vehicle used for projects, tests or developments needs to be registered with a special driving dispense, which allows the vehicles to be driven on public roads. It happens that an internal vehicle used for marketing is registered with this dispense as well.

Vehicle leader (VL) = The person responsible for the usage of the department's internal vehicles and corresponding vehicle engineer.

Vehicle leader meeting (VL-meeting) = A meeting every second week where the vehicle leaders discuss vehicle connected topics and orders of internal vehicles are approved.

Vehicle owner = The person at Volvo who is the legal owner of all Volvo's internal vehicles.

Vehicle System = An internal system for handling the internal vehicles. In the system, all vehicles are registered as objects with a specific identification number. To this identification number information regarding the vehicle is available.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1 INTRODUCTION

This chapter explains the background to the thesis as well as short description of the case company used in this study, Volvo Car Corporation. Next follows, the aim of the thesis and the research questions. After that is the scope and the delimitation presented. Lastly, an outline of the following chapters in the thesis is presented. The outline aims to provide the reader with a brief overview of the chapters included in this thesis.

1.1 Background

The automotive market of today can be described as a diverse technology landscape, with changing customer behaviour and with an increased demand for connectivity and digitalisation (KPMG 2017). This results in a dilemma called "lost in translation" where the automotive companies are in the borderlands between being a car manufacturer or a digitalisation innovator. This dilemma has created a business environment where the development of cars has accelerated significantly. Developing cars is costly (Shea 2010; Wilson 2015), indicating an increased cost for research and development (R&D) in the automotive industry. To stay competitive in the market, it is vital for companies to be aware of the changes in the customers' needs, the market condition and competitors' abilities to develop cars (Liker and Meier 2006). The cost of staying competitive and not lose market shares has increased.

Several processes are essential within a product development environment, e.g. the process concerning the product design, manufacturing and related administration processes (Karniel and Reich 2011). In the last decades, companies have engaged in improving their manufacturing processes, probably as an effect of some well-known principles such as Lean and Six Sigma (Keyte and Locher 2016). These principles initiated a trend where major firms around the world launched initiatives to identify and eliminate waste in their operations. As an effect, less attention was put on improving processes not directly connected to the manufacturing process. Examples of this can be found in numerous of offices where the companies still perform the activities the same way as decades ago, even though the overall trend is to digitalise and make processes more efficient. According to Keyte and Locher (2016), this evolvement has led to that it can be twice as much waste at an office level as on the shop floor. Office level refers to administrative processes, which are of importance for the product development. Waste in an important process is a highly inefficient use of resources and can adversely affect the company's ability to remain competitive and to generate revenue.

Even though the most well-known principles generally not are focused on administration processes, there is evidence that means to improve the administration processes exist. However, with some exhortations. Strategic Direction (2005) argues that the principles of Lean can have a substantial impact on the performance of product development, when the unique nature of product development is recognised, analysed and considered. Companies that included the office level in the product development when using the principles of Lean to improve the process exhibit more streamlined administration processes (ibid.). Thus, the companies eliminated waste in worker's everyday work. Improvement in offices and administrative work can increase the economic gain and competitiveness of the company (Keyte and Locher 2016).

To consider the uniqueness of the process is supported by Hameed et al. (2015), who insists that when making improvements in office related processes, the nature of the work needs to be understood and analysed. It can be said that it is not only necessary to understand and consider the context of the process but also the precise work that is performed. It is crucial for a company to realise the value of a process and recognises that all process, including the administration, needs to be efficient to be competitive on the market.

Volvo Car Corporation is a car manufacturer affected by the changing market conditions and the need for improving and developing cars rapidly. In the research and development of cars, Volvo uses so-called *internal vehicles*. The term internal vehicle includes the vehicles used in performing tests to increase the performance and the quality of existing car as well as in future cars, vehicles used in marketing events and for transportation. The term also includes so-called development vehicles, which are used in the pure purpose of developing new car models. Connected with the internal vehicles is an administration process. This administration process is related to accounting and named *Handling internal vehicles*.

1.2 Volvo Car Corporation

Volvo Car Corporation, also mentioned as Volvo or Volvo Cars in this report, is a part of Volvo Car Group which is owned by Zhejiang Geely Holding Group Ltd (Volvo 2018). The founders of Volvo, Gustaf Larsson and Assar Gabrielsson, started building cars in the 1920s because they thought that nobody was making safe enough cars for Swedish roads. In 1927 the first car with the Volvo brand was driven on public roads, and since then has Volvo continuously been developing cars with improved safety. In 1999 Volvo Group sold Volvo Car Corporation to Ford Motor Company. Ford implemented changes and affected the way Volvo was doing business. Later, in 2010 Ford sold Volvo Cars to the present owner.

Volvo develops and produces cars with the user, safety and environment in mind. Volvo's way of thinking when developing cars in a combination of being in a competitive market has resulted in a complex development process. The need for improving and developing cars rapidly has led to increased use of internal vehicles in tests to ensure that the quality of the cars goes in line with the internal requirements, tests to develop new technologies and innovative solutions as well as in the development of new car models.

As a result, Volvo’s internal vehicle fleet has grown in terms of numbers of vehicles in order to be able to develop and deliver cars to the customer at the same pace as the market requires. The R&D costs are high in the automotive industry, implying that value of the vehicle fleet is high, has increased and will continue to increase if the market trend remains. It is important to have processes that handle the highly valuable resources in a good and correct way, as the opposed would increase the risk of mistakes. Mistakes that could cost and reduce the speed of R&D and sales.

It is also necessary to have an efficient handling process. When large sums of money are handled internally, it is especially undesired to use resources in a non-efficient way, as resources are scarce and could be used elsewhere possibly creating value. Therefore, the handle and management of the R&D processes are vital for Volvo’s competitiveness. Moreover, internal vehicles also consider vehicles used in marketing events. The development of new car models and updates of

models result in an even larger vehicle fleet, due to the marketing department vehicle fleet needs to be changed every time a new car or update is released. This to successfully promote the new models and updates.¨

The current process, *Handling internal vehicles*, is not adapted to meet the new market condition, and the process needs to be improved for Volvo Cars to remain competitive and not lose market shares. Today the process is time-consuming and do not support the rapid development of vehicles.

1.3 Aim

This thesis aims to map and improve the current administration process of *Handling internal vehicles*. The administration processes vary between companies, this thesis focuses on a specific process at Volvo Car Corporation. By focusing on only one specific context, a more in-depth analysis can be made and thus increase the effectiveness and efficiency of the process even further.

In the process of *Handling internal vehicles*, many documents are created. To fulfil the aim of this thesis, it is crucial to analyse how to decrease the need for physical documents in this process. This could reduce the administrative work related to the process as well as less material resources are used, thus increasing the environmental sustainability of the company.

The process of *Handling internal vehicles* is divided into the subprocesses: *Ordering of internal vehicle*, *Use of internal vehicles* and *Disposal of internal vehicles*, see Figure 1. *Use of internal vehicles* can be divided into *Update value of internal vehicles* and *Handling external costs* connected to the internal vehicles.

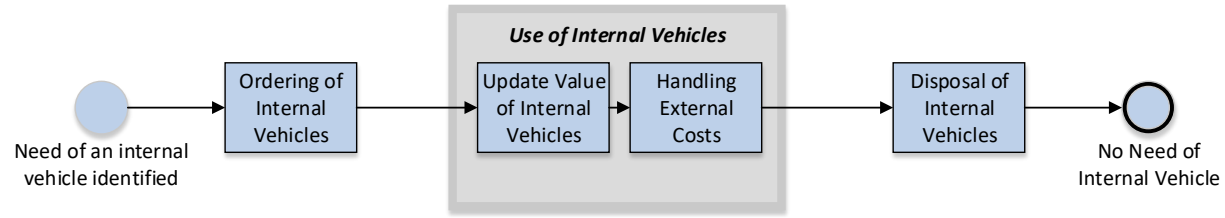

Figure 1. Overview of the subprocesses in Handling internal vehicles.

1.4 Research Questions

Volvo Cars have, during the recent years, had different owners, who have applied their policies. The different policies have generated different ways of doing things. The processes have been changed to meet the new situation but mainly with the focus on the fulfilment of policies and not with the performance of the whole process in mind. When the policies change, the process will often remain the same (Dumas et al. 2013). This statement together with lack of knowledge regarding the process indicates that there is a high possibility of activities in the process that could be considered worthless or even wrong. By not knowing the process in detail, not knowing who is involved or the activities performed, it is doubtful if the process is standardised and performed in the same way every time. According to Liker (2007) standardising processes is a way of improving the efficiency. To be able to find possible ways to improve the process a study of the current process is necessary, which leads to the first research question:

- *What does the current process of Handling internal vehicles look like?*

To create a better and more effective process, it is essential to consider the interests and needs of the different stakeholders. A stakeholder is a person or group who has an interest in the process due to taking part in it or are affected by the process or its outcome (Park and Allaby 2017). Also, the people or groups affecting the process can be considered stakeholders (Maylor 2010). It could be someone in the process, an internal stakeholder, or someone outside the organisation, an external stakeholder. When improving the process, it is crucial to understand what value the process generates to the stakeholders, since a process that does not generate any value for any stakeholder is useless. Based on this, the second research question is generated:

- *Who are the stakeholders in the process of Handling internal vehicles and what are the stakeholders' roles, interests and needs?*

When the stakeholders and their needs are identified it is possible to start considering different ways the needs can be met. The process should be both effective and efficient. Analysing the information gathered in the former questions are a good basis for designing an effective process is created. The last research question is as follow:

- *How should the process be designed to fulfil the needs of the stakeholders in a more efficient way?*

1.5 Scope and Delimitations

The thesis is a study of how administration processes can be improved by process mapping. A specific process at Volvo Car Corporations is used as a case. A generalisation from this case study could be difficult, but general learning could be used in other contexts too as well as support hypothesis. The chosen process is connected to the administration of internal vehicles performed by the controller. The process studied concerns the flow from the order of an internal vehicle till the disposal of the vehicle. Included in the study is the creation of the internal documents that are generated during the process flow. Regarding the external documents, only general activities are described, where strictly accounting activities as paying bills are considered outside the scope of the thesis. Activities that are rarely performed are not considered due to time limitations and as it would lead to highly specific cases as well as investigate each purpose behind the different alternatives chosen, e.g. rare types of disposal of internal vehicles.

The internal vehicles can be ordered in different ways at Volvo Cars. One ordering process that generates documents for the controller is the process *Ordering of internal vehicle*s. The other way concerns vehicle used for developing new models and are ordered in another process, not generating order documents for the controller in focus. These development vehicles will, however, generate documents and activities for the controller in the process of *Update value of internal vehicles* and are therefore included in the study and after the process also included in the definition of internal vehicles.

Volvo Cars is developing a new system that will replace the current vehicle system and other internal systems. This system aims to reduce the use of the different systems present today and make the processes leaner and task easier to perform. This new system could be used for *Handling internal vehicles*.

1.6 Report Outline

The report has been divided into seven chapters with corresponding subsections. The structure of the report and a brief description of each chapter is presented below.

Chapter 1 – Introduction
The introduction introduces the reader to the background of the thesis and provides an understanding of why the study is of interest. In this chapter the aim of the study, the research questions the report is to answer, and the scope and delimitations of the study are presented.

Chapter 2 – Theoretical Framework
This chapter concerns the theory which the thesis is based on. The literature presents a brief introduction to the subject with the purpose to provide a deeper understanding in order to fulfil the aim of the research. Since the thesis concerns how process mapping can help improve administration processes, a significant part of the literature study covers Business process management (BPM). The concept of Business process management is explained and how process mapping can be used to analyse and improve processes. The second part of the literature study covers the concept of archiving. This part includes different forms of archiving and important aspects of how to archive different kinds of information, including financial information.

Chapter 3 - Method
The following chapter is the method, where the process of the study is described and why particular methods were used. Firstly, the research strategy is presented, followed by the data collection, the processing of the data and a discussion regarding the quality of the data. The data collecting methods used are a literature review, interviews, internal documents and observation. The last three provided the information for the next chapter.

Chapter 4 – Empirical Findings
The fourth chapter presents the empirical findings. The empirical findings are divided into four parts; *Forms, Ordering of internal vehicles, Use of internal vehicles* and *Disposal of internal vehicles*. The first section describes the different forms used in the process. The last three parts of the empirical findings are presented mainly in flow charts, which describes the administrative processes connected to the internal vehicles at Volvo Cars. The process is also described in the text to give a deeper explanation of what happens and why.

Chapter 5 - Analysis
Chapter 5 is the analysis of the process *Handling internal vehicles*. This chapter aims to combine the theoretical framework and the empirical findings to help create a deeper understanding of the current process and fulfil the purpose of the study. The analysis starts with analysing the current subprocesses of *Handling internal vehicles* and is followed by an analysis of the stakeholders' interests and needs.

Chapter 6 - Recommendation
In the recommendation, a new design of the process *Handling internal vehicles* is suggested. The new design is based on the use of the IT system being developed at Volvo Cars. The chapter is divided after the subprocesses and following structure. Firstly, a brief recap of the motivation to

change the process, succeeded by the requirements of the system for the design to be applicable. Lastly, the new process is described supported by flow charts.

Chapter 7 – Conclusion
Last in the report is the Conclusion. This chapter summaries the report and the conclusion that can be drawn from the study. Here the answers to the research questions are restated, together with a short discussion of the result of the study and its applicability for other companies.

2 THEORETICAL FRAMEWORK

This chapter presents the theoretical framework for the study. The framework starts with a background to Business process management, followed by a detailed description of Business process management. Then information regarding archiving and different methods for storing information are covered. The chapter is concluded with a brief presentation of Swedish bookkeeping law.

2.1 Background to Business Process Management

There are several disciplines that focus on improving performance in and of the organisation which laid the foundation for Business process management (BPM). Some being Total quality management (TQM), Lean and Six Sigma (Harmon 2015; Dumas et al. 2013). TQM became popular in the 90s (Andersson, Eriksson and Torstensson 2006) and aimed to increase the performance of the organisation by focusing on customer, letting everyone be committed, base decisions on facts, continuous improvements, committed top management and by focusing on processes (Hellsten and Klefsjö 2000; Bergman and Klefsjö 2011). Lean management has its origin in the 50s automotive industry in Japan, but it was first in the 90s it was labelled as Lean by Womack et al. (1990) in *The Machine That Changed the World* (Liker et al. 2008; Andersson et al. 2006). Lean is about continuously striving to find and eliminate waste by having a pull system and is driven by what creates value for the customer (NIST 2000). Six Sigma also has its origin in the manufacturing industry, from the mid-80s, but focuses on minimising defects and thus reducing variation in the products by continuous improvements (Andersson et al. 2006) (e.g. the quality of a blue shirt and matching blazer can be defined as having the same blue colour independent on times used and washed). Six Sigma has evolved from Statistical process control (SPC) (Hammer 2015) and is therefore highly based upon measuring outputs.

According to Hammer (2015), Business process management (BPM) is partly based on SPC and partly Business process reengineering (BPR). SPC is presented as having two limitations. Firstly, it considers all processes, which in a large company is numerous, thus creating many different improving projects. Secondly, it focuses on eliminating variation and keeping the level of performance stable, which does not necessarily mean the performance level is good. The limitations of BPR is the lack of metrics as well as more of a onetime happening (Hammer 2015) and BPR was by some, including Michael Hammer, advocated as needed to be radical in the redesign (Dumas et al. 2013). Hammer (2015), however, writes that BPR laid the foundation to BPM by the way it defined and focused on processes. A process is "an end-to-end work across an enterprise that creates customer value" (Hammer 2015, p. 4), similar to Bergman and Klefsjö's definition (2011). BPR focuses on the design of the process rather than the execution. It is also believed that empirical studies are showing that process-oriented organisations seem to perform better than non-process-oriented organisations, giving focus on process credibility (Kholbacher 2010).

Parallel to the evolvement of disciplines and process thinking were the development of technologies and IT systems (Dumas et al. 2013). One type of system that was developed was Enterprise resource planning (ERP) systems. ERP systems could store data in a centralised database, which stakeholders could access. Another type of system that was developed was the Workflow management systems (WfMSs), which aimed to automate processes and reduce human involvement (van der Aalst, La Rosa and Santoro 2016) by distributing work activities to actors

according to a process model. By changing the process model, the WfMSs could quickly implement the new way of execution. WfMSs started distributing work between persons but emerged into communication with other systems, such as ERP systems. When doing the distribution of work and becoming better integrated with the other systems, WfMSs transformed into Business process management systems (BPMSs) (Dumas et al. 2013).

2.2 Business Process Management

Business process management (BPM) has several definitions, but a common focus is on overall performance (reach strategic goals, improve business operations, add value etcetera) by having a broader view, focusing on the processes (Jeston and Nelis 2008; Trkman 2010; vom Brocke, Mathiassen and Rosemann 2014; Dumas et al. 2013; Hammer 2015). A process is "a network of interrelated activities that are repeated in time, whose objective is to create value to external or internal customers" (Bergman and Klefsjö 2011, p. 42). BPM is about managing and improving the processes. An organisation can gain a competitive advantage by having better processes and better ways of execution (Dumas et al. 2013), applicable to processes creating value for external as well as internal customers.

Firstly, the definition of a process is presented in detail, before describing alternative methods to gather information about a process in Business process management. The following section relates to ways of analysing the processes, and at the end, the procedure of redesigning a process is presented.

2.2.1 Definition of Process

A process consists of different activities or work repeated over time (Bergman and Klefsjö 2011) that follows a logical sequence (Becker and Kahn 2003). It can also include chains of events and decisions (Dumas et al. 2013). An event is something that happens automatically without having a duration. An example of an event is the arrival of supplies. Activities are, on the other hand, when something is done, thus having a duration when being performed. In the example of the arrival of supplies the activity could be inspecting the goods. If the inspection is one simple unit of work, it could be called a task, and if there are several steps, it is an activity. Decisions mean that after some activities or events a decision regarding which way to go needs to be made, affecting which future activities will happen in the process. The events, activities and decisions require and involve actors and objects in the process to produce a valuable outcome (Dumas et al. 2013). The work performed in the activities is done on the objects (Becker and Kahn 2003). The process can deliver value to the customer, meaning the outcome is positive, or no value is created in the process and thus a negative outcome. Dumas et al. (2013) define the customer as the actor who consumes the output, and according to Becker and Kahn (2003), the interface to the customer is an important feature. The parts in a business process and the relations between are shown in Figure 2.

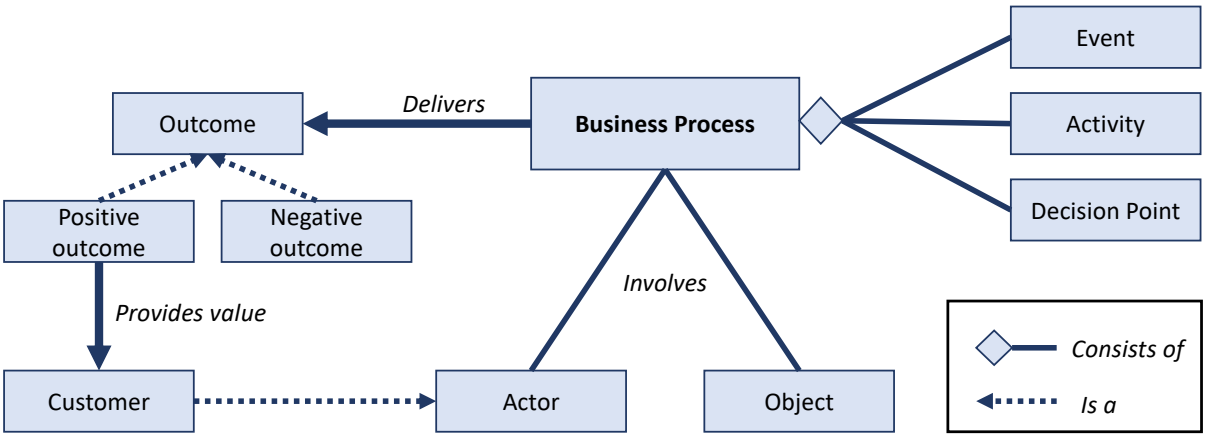

Figure 2. Overview of what is included in a business process (adopted form Dumas et al. 2013).

2.2.2 Process Discovery

According to Kohlbacher (2010), knowing which business processes are performed within the organisation and how the processes relate to each other is a prerequisite for managing the organisation after processes. Understand the operation of the process is important to be able to model a representative business process, so is possessing the capability to model it (Dumas et al. 2013). These two requirements are rarely unified in the same person, indicating the need for involving multiple stakeholders to create a correct model. Dumas et al. (2013) differentiate between people with high modelling skills and low process knowledge, so-called *process analysts*, and people with low modelling skills and high process knowledge, so-called *domain experts*. The domain experts provide the process analysts with information and knowledge concerning the process.

In Business process management there are different ways of discovering the information needed for creating the model. Some information can be found in what can be called *evidence-based discovery,* and other information requires *interview-based discovery* (Dumas et al. 2013). The different methods have strengths and limitation, see Table 1, and the alternatives should be combined for the best result.

Table 1. Overview of the two ways to collect data regarding strengths (adopted from Dumas et al. 2013).

Aspect	Evidence	Interview
Objectivity	High	Medium-high
Richness	Medium	High
Time Consumption	Low-medium	Medium
Feedback	Low	High

Evidence-based discovery means information discovered through analysing documents, observation or the automatic process (ibid.). When analysing documents, it is important to remember that the content might not be the reality of how the process works and only be partially trustworthy. The document can, however, be useful as a way of becoming familiar with the process before talking to the domain experts. If using observation as a method, one follows the process for one specific case and observe how the process is really working. When trying to understand the

whole process, it is appropriate for the observer to be passive rather than active. Using observation requires the observer to have access to the people working in the process, which could require approval from managers. It is essential to have in mind that people might act differently due to knowing being under observation (Wikström and Bendix 2000). Automatic process discovery uses event logs in information systems to provide a view of the process because each event could be recorded and connected with a specific case, a specific activity and a precise time (Dumas et al. 2013). Relying on logged data instead of data collected manually leads to a more accurate representation of the reality (van der Aalst et al. 2016). Form this data reconstruction of the process could be made, but one should consider that some errors could exist in the system (e.g. system crash and information not stored correctly).

The other way to gather information presented by Dumas et al. (2013) is interview-based discovery and consists of interviewing the domain experts regarding the execution of the process. Interviews generally have some challenges (ibid). One challenge being *fragmented process knowledge*, meaning that rarely one person possesses knowledge regarding the whole process, but multiple domain experts are responsible for different parts of the process. Thus, leaving the process analyst to have several different interviews and puzzle the separate and sometimes conflicting information together. Another challenge is that domain experts often *think of processes on a case level*, meaning the process is described in regard to a specific case and not from a general perspective. A third challenge is the domain expert's *lack of familiar with business process modelling languages*, putting a need for the process analysts to explain the model in a natural language.

Interviews often require iteration, due to the process analyst creates a draft of the model which is discussed with the domain experts and improved until accepted. Dumas et al. (2013) believe that domain experts provide more critical information in a free-form interview rather than a structured. Interviews are labour-intensive but have the potential to provide details. However, it is common that interviews focus on "the normal way of working", thus leaving exceptions and when things go wrong out of the conversation. To avoid this pitfall, the interviewer should ask specific questions on the subject.

2.2.3 Qualitative Process Analysis

After the process has been discovered, understood and modelled by a process map, it needs to be analysed. This can be done in different ways where the evolvement from other principles is noticeable. Two useful approaches are; analysing which step in the process that adds value in creating the outcome, so-called value-added analysis, and analysing the root cause of a problem (Dumas et al. 2013). The main aim of both approaches is to identify and eliminate waste.

Eliminating waste is one of the core ideas in the lean philosophy (Slack, Brandon-Jones and Johnston 2013). In lean, the cause of waste can be divided into three categories; muda, mura and muri. Muda refers to activities that do not add value and are generally caused by poor communication of requirements or inefficient use of resources. Communicating and sharing information increase the performance of an organisation (Yu, Yan and Cheng 2001; Rafaeli and Ravid 2003). Mura means lack of consistency and performing task differently. Lastly, muri is when unreasonable requirements are forming the process.

The value-added analysis focuses mainly on muda, but enables to find both mura and muri, as the first part of the value-added analysis is to have the process divided into steps. This is done by the creation of the process map. After splitting the process into steps, it is essential to know who the customer of the process is and what outcome the customer wishes. When having this information; the steps and the outcome, it is possible to start analysing each step regarding the value it adds (Dumas et al. 2013). The step is considered *value-adding (VA)* when it directly contributes to the outcome. This definition is similar to what is defined as primary activities in Porters value chain (Becker and Kahn 2003), with the exception that Porters value is directly connected with the manufactured product or service of the company and not the outcome of a process.

In the process, there can be steps that are necessary even if not directly increase the value of the outcome. An example of that type of step is a task or activity that do not add value to the customer directly but increases the possibility for the company to deliver value in the future, like creating a knowledge base. This type of step adds value to the organisation and goes under what is called *business value-adding (BVA)* steps (Dumas et al. 2013). In regard to Porters value chain, this could be considered as supporting activities, due to needed to perform the value-adding activities (Becker and Kahn 2003).

Steps can also be classified depending on the context and subjectivity. Dumas et al. (2013) have the approach that steps forced by laws and departments, such as accounting, are business value-adding. There is a last category of steps, a category for steps that do not fall under the two previous types and do not add any value, so-called *non-value adding (NVA)* steps or *waste*.

The second part of the value-added analysis is to eliminate the waste, mainly done by trying to minimise or remove all NVA steps. When eliminating steps, one need to consider if the workload is increasing for someone else or if it is a control step being removed, what risk lies with less control (Dumas et al. 2013). BVA steps might be considered for removal, but one should first consider the role the step has in reaching the business goal or requirements and make a trade-off. Automation can be one way of elimination (Dumas et al. 2013), which would reduce the risk of human error. The human error or human factor refers to mistakes and accidence happening due to human involvement (mänskliga faktorn n.d.).

When looking at the process trying to eliminate waste, it is advantageous to know why the performance of the process is as it is. Analysing this can be done by different root cause analysis techniques, which aims to identify and understand the root cause or causes of the problems (Conger 2015; Dumas et al. 2013). One technique is a *cause-effect diagram, a*lso known as *Ishikawa diagram* and *Fishbone diagram*. The diagram can be used as a way of finding out what factors are causing the issue (Dumas et al. 2013). The diagram consists of the mainline pointing to the issue in need of analysing. To the mainline, generally, six different lines representing categories of factors point, the categories being: machine, method, material, man, measurement and milieu. On those category branches, the factors are displayed as primary and secondary factors.

2.2.4 Process Redesign

The reason why organisations redesign processes is because the business processes create and deliver a service or product to the customer, something that adds value, and if one wishes to increase the quality of the service or product improving the process creating or delivering the value

can be a good way, some argue the best way (Harmon 2015; Dumas et al. 2013). In short, redesigning is about improving the quality by re-organising the process. For a process to be considered better, it needs to better contribute to fulfilling the strategic goals of the organisation (van der Aalst et al. 2016). Even processes that were well designed from the beginning should be considered for a redesign due to the evolvement of the world as well as the organic evolvement of business processes.

A change in the market can put different needs on the process, or a process might have been designed to suit a matter, e.g. particular need from accounting, but when that matter changes, e.g. no longer needed, the process remains the same. The latter is containing steps that are no longer needed. One could believe that if this occurs, the people affected or perform the process should highlight the occasion. The people are, however, generally occupied with carrying out the day-to-day tasks and lack the overall insight into how the process is organised (Dumas et al. 2013). It is common that people know only their own activities or perhaps also one up- or downstream activity, not the whole process.

When gathering information on the process, ideas and directions regarding the design might arise. From this, the redesign might be approached in a rather creative manner and not in a systematic way, which could lead to some options/solutions are missed. To avoid that Dumas et al. (2013) present a framework to use when redesigning a process. It contains seven elements (p. 256):

- the *customer*s of the process
- the *business process operation* view, which relates to how a process is implemented
- the *business process behaviour* view, which relates to the what, in which order and how the execution of a business process is
- the *organisation* and the participants in the business process
- the *information* used or produced in the process
- the *technology* used in the process, and
- the *external environment* of the process.

A redesign can be looked upon on three levels of abstraction. At the highest level are methodologies, then techniques and at the lowest but most concrete level are tools (Dumas et al. 2013). A methodology can be seen as problem-solving methods controlled by principles and philosophy. A technique is defined by Dumas et al. (2013, p. 260) “as a set of precisely described procedures for achieving a standard task”, examples being Ishikawa diagram and flowcharting. Whereas a tool is a software program used to support technique(s).

A methodology can be revolutionary or evolutionary (Dumas et al. 2013). Revolutionary means that the outcome is radically different from the previous process, which can be connected with what some BPM promoter advocated in the early days of BPM. While evolutionary concerns a rather incremental approach to the changes. Methodologies can also be separated by the starting point of the redesign (ibid.). It could be starting from scratch, implying that nothing will remain from the existing model. This is a good way of eliminating the inefficiency of organic evolution. It is also possible to have the existing process as a basis, which is considered easier than starting from scratch. Or one could use blueprint or reference model as a basis and adjust it according to the situation. The easiness of using existing as a basis is likely the reason why it is the most

common approach, whereas reference model is the second used and newest (Dumas et al. 2013). When starting from scratch and using the revolutionary approach, there is a higher risk, but it can bring higher benefits if successful, due to the possibility of eliminating all inefficiency.

2.3 Archiving

Storing specific information for a long time, so-called archiving, have existed for centuries (Olson 2010). The main reason for archiving is to protect and maintain artefacts of important information for future needs, these artefacts can also be mentioned as data objects. To be able to archive information an archive is necessary, meaning the place where these artefacts can be stored for long periods of time. In other words, an archive is created with the purpose to store specific information or objects for future reference and to be available if someone might need them in the future. It is common that each archive has a predetermined purpose for storing the specific objects (ibid.).

When archiving it is vital to have a policy that expresses what to store, when and for how long (Olson 2010). The policy should preferably include selection criteria to make it easier for the person who is responsible for the archiving activity to archive the correct information. It is essential that this policy incorporates present rules and law from the government into account since it could be provisions of law for what and how long data objects should be achieved. To success in database archiving it is recommended to have good document management methodology since it is crucial for the result of the archiving process (Wilkinson et al. 1998).

Several companies think that saving documents on server files storages or on the computer hard drive is adequate and that this process is enough for document management. According to Winterberg (2011) is this a false assumption. Further, the author states that storing data and scanned document on a server is a crucial factor to run a paperless office, but it is not a document management system. Document management has some requirements to be effective, such as the access to information should be controlled, the document formats must be consistent and have processes for workflow. It is about to managing data in a productive way, and the task of documents can vary depending on the context (Robertson et al. 1998).

Hameed et al. (2015) state that a main factor to always focus on is efficiency, in the meaning of speed and cost. The management of work, often expressed as “office work”, has become more common to improve (ibid.). A common task for an office worker is to save information on paper in an ordered manner and store them for future needs, earlier expressed as archiving. A complex process and structure are necessary to have control over the information and find the right information when needed. This process is likely to be time-consuming, resulting in a high cost (Hameed et al. 2015). To overcome these issues many companies have entered the world of digitalisation with an archiving system to save electronic copies. Through digitalisation activities and processes can be performed simultaneously in a short time, compared with manual labour. To realise this benefit, it is required to identify and analyse the work nature and from that design and create the system. Generally, this analysis ends up in a web-based system with a smooth and user-friendly design which will increase the efficiency and thus make the business competitive (Hameed et al. 2015).

2.3.1 The Lifeline of Data Objects

All data objects that will end up as archived will pass some similar phases (Olson 2010). These phases express the stages of normal usage in a so-called data lifeline, see Figure 3. The author explains the lifeline in five different phases.

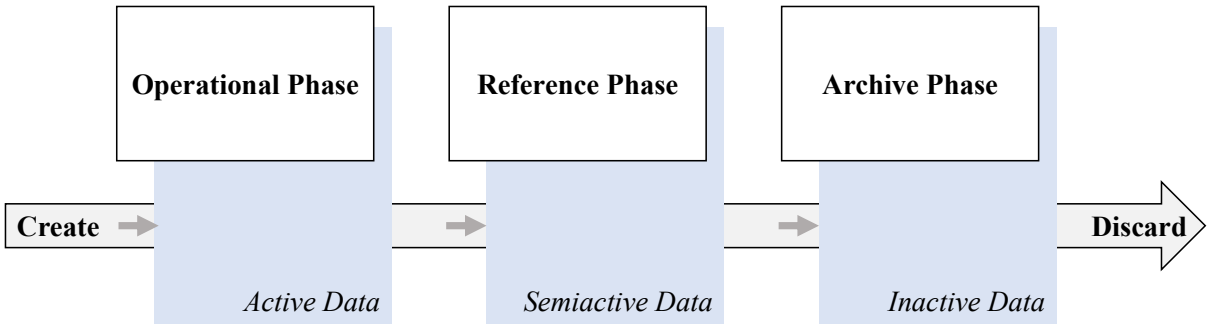

Figure 3. An illustration over the data lifeline (adopted from Olson 2010).

The first phase is creating the data, which occurs at a specific point in time. The information or data may have existed before, but it is first after recorded and written down it could be considered created according to Olson (2010). Some data is more time consuming to create than other, but a common denominator for all data is that it must be created for it to be ready for the next phase.

When data has been created, it automatically enters the operational phase, meaning the data will be used in the daily work (Olson 2010). In some cases, the data is created to be used by other data objects, for example, an invoice is created from a purchase order. The data objects that will be used in create additional data several times will remain in the operational phase. The data will also remain in the operational phase if the data is creating value for the company's everyday business. Moving the data to the next phase too early can cause a negative impact on the enterprise, as the data is more complicated to reach. The time the data spends in the operational phase varies according to the purpose of the data (ibid.). Data objects that will be in this phase for a shorter time often correlates to data that never will be changed after creation. The opposite is true for the data that can be changed or records an object that will persist for years, and these kinds of data will last longer in this phase.

The third phase, the reference phase, refers to when the data is hovering between the operational phase and the archive phase, meaning the data needs to be available on a timely basis (Olson 2010). Data enters this stage when it has no potential to participate in the daily transactions or to be used to create new data, meaning that the data does not have the characteristic explained in the operational stage. The length of time the data spends in the reference stage depends on the probability of need for access. It is common that a company decides to keep data objects in the reference phase for some predetermined period of time since the data will be used in end-of-year reports or as accounting or bookkeeping records.

A data object enters the archive phase when it no longer will be a part of the operational transaction, nor is expected to be referred to again, but still needs to have the possibility to be accessed (Olson 2010). Even though archiving data is to save data for future needs, the access is limited in comparison to the reference stage. The line between being in the reference or in the archive phase

is narrow, and it can be hard to decide when it should be move from the reference to the archive phase. This is also company specific since different companies have different specification or rules for the different phases, both according to the length and type of data.

The last event in a data objects lifeline is the step when the data will be removed from the archive, in other words, no opportunity to reach the data again (Olson 2010). Since the data object could be in both physical form or digital, it will be removed in different ways. A digital data object will be deleted from the database and cannot be revived, while a physical copy will be destroyed, shredded or thrown away.

2.4 Forms of Data Archiving

Data can be archived in different shapes such as paper documents, emails and/or computer files (Olson 2010). The shape of the data objects affects the complexity of the archiving process since different data objects require different types of archiving. Physical documents can be archived in binders or file drawers while the most common way to archive data is to use computers to store it electronically, sometimes by cloud computing. The easiest way to have a structured data archiving process is to store the data objects associated with a unique document number (Wilkinsonal 1998). The authorised people should preferably have knowledge about the document number to easier access the data.

2.4.1 Physical Documents

The digitalisation has resulted in more digital documents, but still, companies use and archive physical documents (Olson 2010). These physical documents could, for example, be order forms, blueprints and application forms. One reason why a document can be physical is the need for it to be signed by an authorised person, and a digital signature is not approved for legal reasons or company policies. Even though there is a need of a physical signature, the document could in some cases be scanned in order to be stored as a computer file. In other cases, the document needs to be the physical piece of paper since it is required by regulations (ibid.).

Archiving physical documents could result in some issues, such as that the printing ink may fade with time, which could result in vital informant gets lost and demolish the actual agreement (Olson 2010). The archive of the documents also requires actual space to be saved, which is a drawback with physical documents since saving papers for years will result in a huge archive storage area (Hameed et al. 2015).

2.4.2 Electronic Files

It is common to archive data in terms of electronic files, by so-called file archiving (Olson 2010). There is a lot of alternatives of software available on the market to support electronic achieving. The electronic files, generally programs and UNIX-files, are not archived on the computer hard drive, it is archived in a data warehouse, in other words, the data is moved from the frontline disk to an operational storage system. A data warehouse storage system does not have an understanding of the content in the files, it does simply manage the raw data (bytes) (Olson 2010). Usually, it is only authorised actors who can access the stored files to secure that the information is used properly which makes it easier for companies to ensure that the necessary information reaches the right people.

2.4.3 Text Documents

In companies, text documents as Word, Excel and PDFs, are often used in the daily work (Olson 2010). The reason why it is common to use text documents is that the documents are easy to create and handle. Further, most people have experience of text editing software and can use it to read others work. Some of these text documents will contain important company-specific information or agreements, which is required to be archived for long periods of time. An advantage of using text documents is that it is easy to open, read, change and display the information that is included in the document. An important function that the archiving system of text documents need is to have a function that converts the document stored to new and updated formats in order to be readable in the future (Olson 2010).

2.4.4 Emails

The process of archiving emails in a correct way could be complex, and there is a lot of alternatives for handling storage of emails available on the market (Olson 2010). At first sight, it seems that it is relatively simple to save emails; save the date, sender, receiver and the text of each email. But it has been proven that it is much more complicated than that. For example, all the attachments that are included in the emails need to be saved. To be able to open the attachment later, the company also need to ensure to have the correct programs available so that it is possible to open, read and present the content of the attachment.

It could also be essential to have some selection criteria to ensure that the correct emails are archived (Olson 2010). For example, an email chain could be long and could, therefore, contain multiple copies of the same information. Therefore, is it essential to have a system that will handle the archiving process of the emails. The system would preferably identify and eliminate all but the last email the chain. Otherwise, the size of the archive would start to grow exponentially.

2.4.5 Cloud Computing

A type of database archiving is the concept of cloud computing, a technology for using the internet and central remote server to maintain data and applications. The concept makes it possible for a remote user to use an application without having to install it on the local client and instead solely rely on the program installed on the server it is connected to via the cloud. This technology makes data storing more efficient and enables data storage to be further centralised. The technology makes it possible for many parties to reach the same data from different places and computers at the same time.

Quddusi (2014) further express that cloud computing makes it possible for people to use the software only when required and that the software does not need to be installed on the computer, which is a cheaper alternative since you only pay for what you use. It will also be easier to share and collaborate documents and data with others, and also to manage authorisation questions and review access for the potential user.

2.5 Swedish Bookkeeping Law

The information in this subchapter is gathered from the Swedish Accounting Standards Board, which issues rules and information concerning bookkeeping (Bokföringsnämnden 2017). According to Swedish Law, financial information need to be saved in at least seven years after existing financial year has ended. Financial information can be transferred from one media to another, for example, a paper invoice from suppliers can be scanned and transferred to the electronic state. Nevertheless, the original cannot be destroyed until four years after existing financial years has ended. In the case of the paper invoice from the supplier, the paper invoice could be thrown away after four years as long as the electronic copy is saved for the seven years. It could also be an electronic document that is transferred in to physical. One copy needs to be saved for seven years, while the original needs four years. If the financial information is received in both an electronic and physical form, the company can choose which to save to fit the organisation.

It should be emphasised that the years presented are the minimum time the information needs to be saved. Organisations should consider its environment, possibilities for disputes etcetera, and choose a suitable time period to save the information.

3 METHOD

This chapter presents the structure of the study and the methods used to fulfil the aim of the thesis. The study was divided into three steps, see Figure 4. The first step was to understand the context of the thesis focus. This was done by conducting a literature review, understanding the process to be studied and formulating the aim and research question of the thesis. The literature review resulted in the construction of a theoretical framework while understanding the case, aim and research question was the foundation for the collection of data. Based on the theoretical framework and the collected data the processes were mapped, which was the base for the analysis. The study resulted in a proposal for a new process and this report.

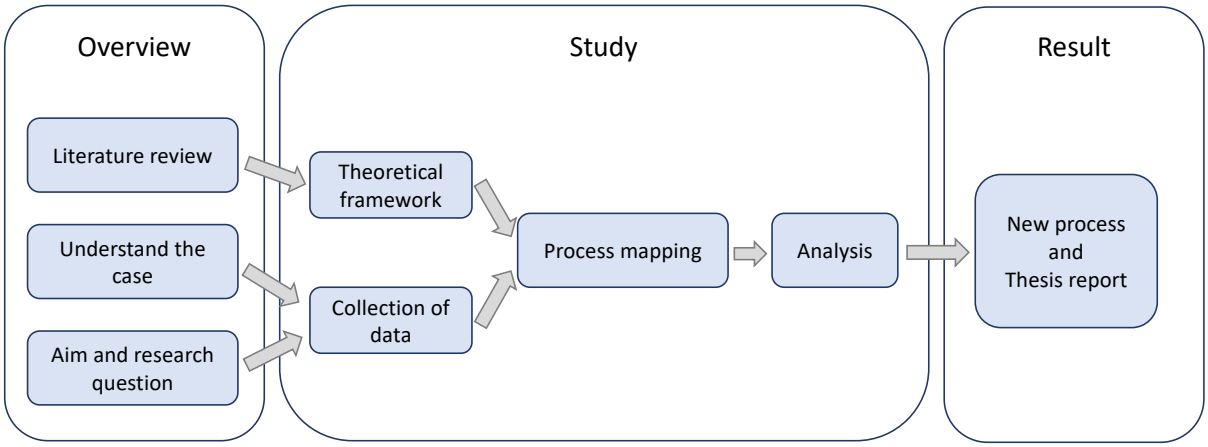

Figure 4. The structure of the work performed.

3.1 Research Strategy

There are several strategies to use when conducting research. When the purpose of the research is to understand a complex and real-world situation, a case study is a suitable strategy (Yin 2014). The focus of a case study is on one instance of a certain phenomenon and serves to provide a deeper understanding of the relationships, processes or events happening in the instance (Denscombe 2003). This thesis aims at understanding how administration processes can be improved at one specific company and therefore a case study approach was considered suitable.

One of the strengths of the case study approach is that it supports the use of different methods (Denscombe 2003). By using different methods for gathering data a better understanding of the situation can be created (Patel and Davidson 2011). Methods can be divided into two types: quantitative research methods and qualitative research methods.

Quantitative research methods observe, record and collect numerical data (Duignan 2016a; Bryman and Bell 2003). The collected data is then statistically processed and analysed (Patel and Davidson 2011). Quantitative studies are deductive as their purpose are to test the theory, which is done by comparing the collected data of reality with the theory (Wallén 1996). Contrary to focusing on the numerical data, quantitative studies emphasise on the words and are inductive (Bryman and Bell 2003). Inductive means that the purpose of the study is to create a new theory from collected data. Some methods used for collecting qualitative data are interviews, observations and questionnaires (Duignan 2016b).

According to Bryman and Bell (2003), quantitative research and qualitative research can be combined although their differences. Patel and Davidson (2011) have the view of the methods as two ends of a spectrum. Depending on the purpose of the study, the quantitative and qualitative methods can be combined, see Figure 5.

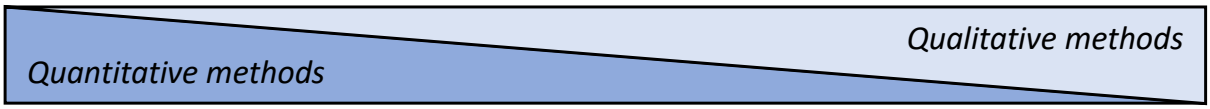

Figure 5. Combining qualitative research with quantitative research depending on the aim of the study

This study uses the theory of Business process management to improve an administration process at Volvo Cars. It could be seen as testing if that specific theory covers administration processes in an R&D environment. However, to be able to answer the research questions mainly qualitative methods of gathering data will be used.

3.2 Data Collection

To be able to answer the research question in this thesis, data regarding the current situation was needed to be collected as well as literature. The connection between the collected data and the research questions can be seen in Figure 6. Data can be classified according to its source, either as primary or secondary (Krishnaswamy and Satyaprasad 2010). Data collected from a primary source means the data is collected from its original source and has not been previously collected. Secondary data is data that has been collected by someone and used for a purpose. It is information that already exists, which makes it less time consuming to access. Dumas et al. (2013) discuss two methods of gathering data in BPM, interview-based discovery and evidence-based discovery. The first collects data purely from primary sources, while the latter uses both primary sources as observation and secondary sources as existing documents. In this study, primary and secondary sources are used as well as a combination of the two discovery methods to combine the different strengths.

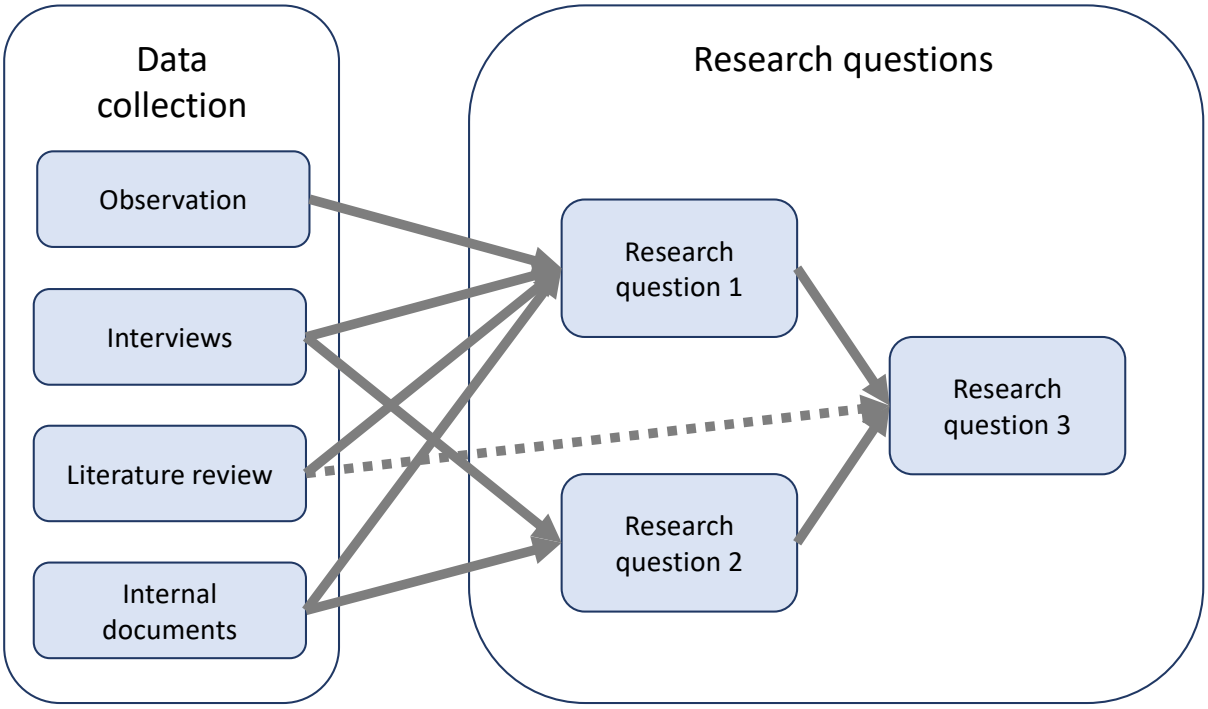

Figure 6. The connection between the different methods for collecting data and the research questions.

To answer the first research question, information regarding the existing process was needed to be gathered. Volvo Cars did have illustration and description over some procedures included in the study, but the documents did not provide the whole process, and not all information was accurate and up to date. Therefore, the data needed to be collected directly from the source. This was done by performing interviews with employees at Volvo Cars and observing parts of the process. The internal documents of procedures were, however, used to create a better overview and be used for details in the case of correct. Information was also accessed from internal system and documents to create statistics regarding situations. The literature also provided information regarding how to map the process.

The interviews and the internal documents were also used to answer research question two. Based on the answer to research question one and two, research question three could be approached with the support of the literature.

3.2.1 Literature Review

The literature collected creates the theoretical framework for this study, presented in *Chapter 2 Theoretical framework*, and is based on secondary data, since it is already collected and available on databases, files and other documents. The theoretical framework creates a basic understanding of the subject studied and provided an approach to improve the process. The literature is needed to create credibility to the analysis and the result.

The literature is based on relevant books, articles and web pages. One book was mainly used as a basis for Business process management. Using only one source could reduce the credibility. However, the trustworthiness of the book was considered high due to the authors' credibility and knowledge in the subject and its usage as literature in university courses regarding BPM. Although

additional information was added to create a broader view. The web pages used was considered trustworthy in regard to the information presented.

The articles and books were found using databases as Summon, handled by Chalmers library, Scopus, Web of Science and Google Scholar. Both Scopus and Web of Science are databases accessed through Chalmers library webpage. The literature found is connected with processes, Business process management, archiving, document handling and administration.

3.2.2 Interviews

Interviews were the primary source of data in this study, due to the information was in the persons working within the subprocesses. An interview can be structured, semi-structured and unstructured (Bryman and Bell 2003). A structured interview is generally used in quantitative research and follows the structure set prior, as it aims at maximising the reliability of the research. Meaning, if several interviews are performed the questions and order cannot differ for the result from the interviews to be valid for comparison. An unstructured interview, on the other hand, is an interview with almost no structure. The method is characterised by asking questions regarding a subject but allowing the interviewee to speak freely and share information (Gillham 2000). A semi-structured interview keeps the flexibility of the unstructured method, at the same time as allowing for more specified and prepared questions and areas to be answered.

The interviews performed during the study of this thesis is presented in Table 2 together with the topic of the interview. To prepare the interviewees, the purpose and topic of the interview were presented prior to the interview. In the beginning, unstructured interviews were used, as the primary purpose of the interview was to gather a context and overview of the process to be studied. Thereafter, the interviews became more semi-structured, due to the need for more specific information and with the possibility to follow up with questions on subjects mentioned.

Table 2. A summary of the interviews performed.

Role	The topic of the interview	Date
Vehicle leader (1)	Overview: Ordering of internal vehicles and Disposal of internal vehicles	2018-02-05
Disposal vehicle engineer	Overview: Ordering of internal vehicles and Disposal of internal vehicles	2018-02-05
Controller for development vehicles	The process of development vehicles	2018-02-09
Order Handler	Place the order of the internal vehicle	2018-02-14
Controller	Update value of vehicles and Creating invoice	2018-02-14
Vehicle leader (1)	Ordering of internal vehicles	2018-02-14
Administrator of the vehicle leader meeting	Vehicle leader meeting	2018-02-19
Vehicle leader (2)	Ordering of internal vehicles	2018-02-21
Controller	Follow up: Update value of vehicles	2018-02-22
Disposal vehicle engineer	Disposal of internal vehicles	2018-02-27
Controller	Update value of vehicles	2018-02-27
Vehicle leader (1)	Validation: Ordering of internal vehicles and Disposal of internal vehicles	2018-03-21
Disposal vehicle engineer	Validation: Ordering of internal vehicles and Disposal of internal vehicles	2018-03-21
Controller	Validation: Update value of vehicles	2018-04-09
Former controller for internal vehicles	Validation: Update value of vehicles	2018-04-09
Vehicle Owner	Organisation history and Ordering of internal vehicles	2018-04-27
Digitalisation Engineer	System integration	2018-05-07
Disposal vehicle engineer	Recommendation: the new process	2018-05-14
Controller	Recommendation: the new process	2018-05-15
Vehicle leader (1)	Recommendation: the new process	2018-05-18
Disposal vehicle engineer	Recommendation: the new process	2018-05-18

Interviews were conducted mainly with the participants of the processes, while some interviewees were chosen to understand the context of the study better. The controller for development vehicle was interviewed to understand the process of development vehicles as well as one interview concerned the possibilities with system integration. The first interviews were recommendations based on the supervisor at Volvo Cars awareness regarding peoples' area of expertise and network. From those interviews, other people of interest were identified and recommended. This method of finding people by letting other people with knowledge recommend suitable candidates is called snowballing sampling (Everitt 2002). When using this method, it is important to remember what is of interest for the study and staying critical to the source.

The questionnaires for the interviews is found in Appendix I, II, III and IV. The interviews were conducted in the interviewees' native language to assure the quality of the answers. Therefore the interview questions presented in the appendix are in Swedish. The appendix regarding the interviews with the vehicle leaders and the disposal vehicle engineer consist of questions connected to both *Ordering of internal vehicles* and *Disposal of internal vehicles* as well as follow up questions related to their primary area of knowledge.

It was essential to find suitable people to interview, due to it being the primary source of data for the study. Convenience sampling is another way of choosing whom to interview and means that the people that cooperate and are easy to access will be chosen (Everitt 2002). People at Volvo were cooperating, however, convenience sampling was generally used in regard of follow up questions as it could be with shorter notice.

All interviews when collecting the data of the current process was recorded after granted by the interviewees. This was helpful as the interviews contained much information and following questions were needed. By recording the interviewer can focus on what is said instead of focus on taking notes but. According to Bryman and Bell (2003), it is not only important what is said, but also how it is said. Recording the interview was a good way to secure both the information and the pronunciation. The drawback with recording is that it requires more work afterwards (Wallén 1996). All interviews were transcribed to have easy access to the information afterwards. This is one of the reasons why interviews can be considered time-consuming. Bryman and Bell (2003) suggest that one should first listening to the interview once or twice and then only transcribe the parts of interest. However, in the beginning, knowing what was of interest or not was difficult. There are also other challenges with interviews presented by Dumas et al. (2013), see *2.2.2 Process discovery*.

One of the mentioned challenges is the lack of familiarisation with business process modelling language. Therefore, the validation of the process was conducted face to face, where the process was described using natural language. By going through the process maps together with the domain experts, misunderstandings were brought to light and was corrected. The validation interviews were not recorded as errors of the process was corrected on the map directly or commented to fix later.

When mapping the processes, areas where collected data was not enough emerged and required additional information. This data was generally collected by using email or internal Skype and was collected from previous interviewee as well as the marketing departments vehicle leader and the workshop. In the case the information needed concerned the controller, the questions were also asked during a supervisor meeting as the supervisor was the controller. These supervision meeting together with some other meetings are not included in the interview table above, however, some meetings lead to receiving relevant internal documents and increased understanding the context of the study.

3.2.3 Internal Documents

Additional to interviews and literature, internal documents and information from the vehicle system were collected. The internal documents were illustrations and maps of processes, description of procedures, the protocol from the vehicle meeting and the meeting were some of the

internal vehicles were ordered prior to the reorganisation, the order and disposal forms, accounting records and invoices. The information gathered was used to complement the interviews and observation and to provide statistical background.

The illustrations of processes and description of procedures were found on Volvo Cars Business Management System, whereas process maps were received as email due to under updates and construction. As mentioned, not all information accessed was correct but was used to create an overview. The different forms where provided from interviewees and the accounting record were provided by the controller. The invoices were collected from the archive and searched for in binders.

The protocols of meetings where the order of internal vehicles was discussed were saved on a database. Today the decisions take place at the vehicle leader meeting. Volvo Cars has reorganised its divisions two times recently, and the database is organised after divisions in the company. These changes affected what meeting protocols needed to be investigated, and the location in the database archive. Due to the difficulties in finding records going back later than three years, that time period was chosen. This can be seen as a type of convenience sampling. From the protocols information regarding the number of orders, the number of vehicles ordered, what purpose the internal vehicle would fulfil and if the order was approved were extracted. The extracted information was transformed into diagrams.

Apart from collecting information of orders, data relating to disposal was extracted from the vehicle system. The numbers of the disposed internal vehicles were collected for the three disposal alternatives; sold to an authorised car dealer, scrapped by a dismantler and scrapped by a recycler. As the information was more accessible a slightly longer time period was chosen, to provide a better understanding.

3.2.4 Observations

In the evidence-based discovery method, observation is used to collect understanding of how a process works in reality (Dumas et al. 2013). The observer can have a passive role or an interactive role in the observation, whereas Dumas et al. (2013) advocates for a passive role when trying to understand a process. An interactive observation can, however, provide better knowledge regarding the motivation behind actions but risks affecting the process and thus the result. Both types of observation were used in this study.

One observation was of the vehicle leading meeting. The authors participated in a meeting and chose the passive role, as the purpose was to create knowledge of the process and how it works. It sometimes became interactive as the participants explained the activities happening, which created a deeper understanding.

Most interactive observations were done together with the controller, as part of the interviews. The activities performed by the controller includes several different steps and observing the step while discussing what was done helped the learning. The authors also participated in the sorting of the documents for archiving.

3.3 Processing Data

The aim of the thesis was to map and improve the process of *Handling internal vehicles*. To be able to improve the current process, it needed to be analysed. The data was collected to create an understanding of the process and then needed processing. Processes can be complex and challenging to explain by word. Visual material is a way of communicating ideas (Clark 2010) or in this case data collected of the current process. More specifically, process mapping can be used as a way to it visualise the different steps in the process (Heher and Chen 2017; Damelio 2011) and is, therefore, part of the aim. It is crucial that the material is visualised clear and can be read easily.

Turning data into visual materials can help the writer to understand the area in a new way, and it is essential to know what function the visual materials are supposed to fill (Clark 2010). The purpose of understanding the current process was to create an improved process. Therefore all understanding of the process was desirable as it could help the creation of the new process. Heher and Chen (2017) highlight the importance of having a clear and reasonable scope of the process that is being mapped.

There are several ways processes can be mapped. This thesis used the theory of Business process management to map and improve the process. BPM was chosen as it is a method focusing on improving the process and the overall performance, not just mapping a process. As the study aims to improve the process, it was considered appropriate to follow an approach with the same purpose.

The maps or the so-called flowcharts over the process follow the modelling used in BPM and is considered one of the techniques to use when redesigning a process, see below. The tool used was Microsoft Visio. Based on the BMP theory the collected data was analysed qualitatively, with the main focus on value-adding analysis and root cause analysis. The root cause analysis was done by Ishikawa diagram of what added time to the process, which is another tool to use when redesigning processes. The framework presented by Dumas et al. (2013) was also used as support for the redesign. More information regarding Business process management can be found in *2.2 Business Process Management*.

3.3.1 Process Mapping

The process mapping is based on the modelling language BPMN, Business process model and notation. The language is based upon the use of symbol with different corresponding meaning, see Figure 7. Circles represent the start and the end of the process, while activities are represented by rounded rectangles and the flow illustrating the sequence of the activities by arrows with a full arrow-head (Dumas et al. 2013). Regular rectangles were used to visualise subprocesses. In the process there are also so-called gateways where decisions regarding the following flow are decided, these are depicted as diamonds, and the gateways can be a split, a parallel or a join gateway (ibid). A split gateway is represented by a diamond with an '**X**' in it and depicts when a choice regarding which flow of activities to follow. On the arrows leaving the diamond the requirements for that flow is stated. A parallel gateway is illustrated with a '**+**' inside the diamond and means all flows leaving the gateway will be followed parallel to each other. The join gateway has either an '**X**' or a '+' inside the diamond, corresponding to the gate where the flow was separated and shows where the flows come together and continuous follow the same sequence.

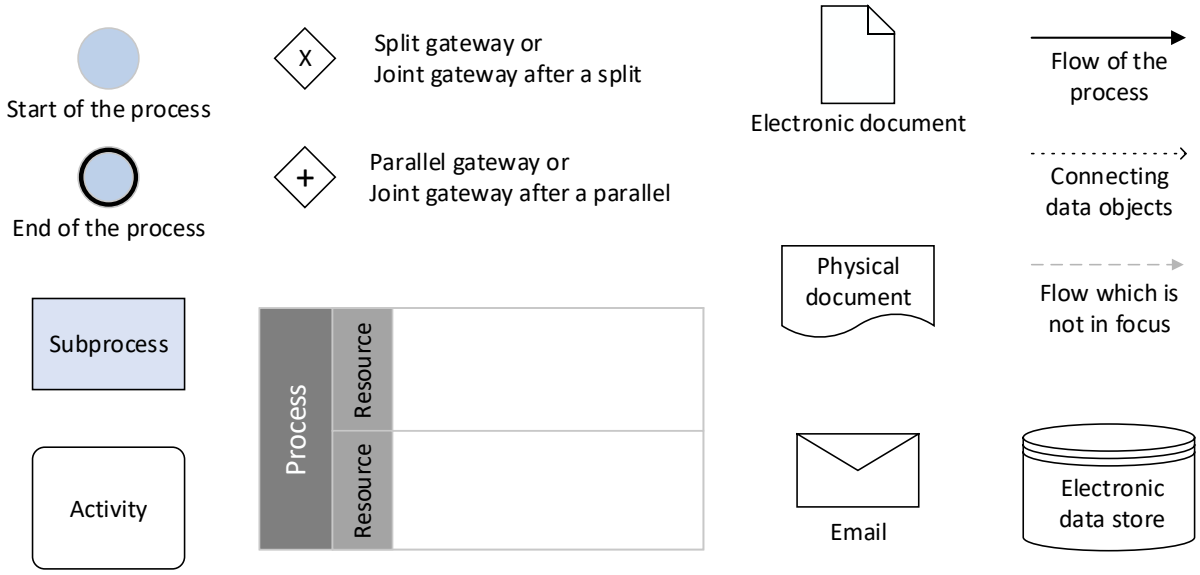

Figure 7. The different symbols used in the process mapping based on BPMN.

Connected with the flow there can be different data objects used in the activities or the data objects can be outputs from the activity. Example of data objects are physical documents and electronic document, which requires a place for storage, so-called data store. The data objects and are connected with the flow by dotted lines. How the data object, data store and the symbols from the flow is depicted can be seen in the figure. The figure also shows the usage of lanes to indicate which resource is performing the activity in the process.

3.4 Quality of data

The quality of data was of importance, as the data was the foundation of the thesis. If the quality of the data collected is low, the usefulness of the result of the study is reduced. The quality could be assessed upon two aspects; reliability and validity. To be able to reach high validity, high reliability is necessary.

3.4.1 Reliability

Reliability is the consistency in the measures used (Bryman and Bell 2003). This means, that the same study performed in the exact same way again, by the same or another researcher, would generate a similar result. One of the measurements used to collect data was interviews of a semi-structured or unstructured nature, indicating a risk of different answers as the questions could vary. However, the interviews were recorded, allowing the answer to be fully transcribed.

Data was collected from meeting protocols and extracting the information from the meeting protocols did sometimes require interpretation and thereby a possibility to the deviation between the statistics presented and reality. The purpose of the vehicle could be such area, as the category was only divided into three alternatives. Interpretations are connected with the person interpreting and could vary. Although, it is believed that it is a low risk for the errors or different interpretations to have a significant outcome on the result.

Numerical data were collected for the externally disposed of vehicles. There exist other alternatives of external disposal than the three presented, which are excluded from this study. Moreover, as not all externally disposed of internal vehicles are included the percentage becomes misleading. Someone else could choose to include the excluded alternatives to provide a correct distribution. The reason for excluding the alternatives from the study was due to the rareness of occurring, indicating the numbers should be relatively representative assuming correct disposed of in the system.

3.4.2 Validity

Validity concerns the measures used to measure the subject of interest (Bryman and Bell 2003). In other words, do the methods used for collecting data gather data that are of use in fulfilling the aim of the study. In quantitative studies, validity could be divided into internal and external validity, but are generally called credibility and transferability in qualitative studies (Bryman and Bell 2003). Credibility, internal validity, is how well the data or study reflects the reality and transferability, external validity, is how well the result of the study could be generalised.

To ensure the credibility of the interviews, respondent validation was used. Respondent validation is based on the researcher provides the interviewees with information of the data collected to receive feedback if the information was understood correctly (Bryman and Bell 2003). This was done by having meetings with the interviewees, where the process maps were presented and gone through together.

Another method to ensure credibility is data triangulation and is based on that information from different sources are compared and together becomes the validated information (Denscombe 2003). To perform the triangulation, internal documents were used, and interviews were performed with different participants in the process where some had similar positions too. Some of the activities studied do only affect the controller. There is only one controller and to increase the credibility, the former controller was included in the respondent validation.

4 EMPIRICAL FINDINGS

The process *Handling internal vehicles* can be divided into the subprocesses: *Ordering of internal vehicles*, *Use of internal vehicles* and *Disposal of internal vehicles*, see Figure 8. *Ordering of internal vehicles* refers to the process where the internal vehicles are ordered from the production line. The next subprocess, *Use of internal vehicles*, is when the value of internal vehicles are updated, both internal vehicle from production and internal development vehicle, and when the external costs are handled. Lastly, is the *Disposal of internal vehicles*, which is when the vehicle is sold, and the invoice created. This chapter aims to answer the first research question and provide a detailed description of the activities performed. To understand the subprocesses information regarding the two forms used is first presented.

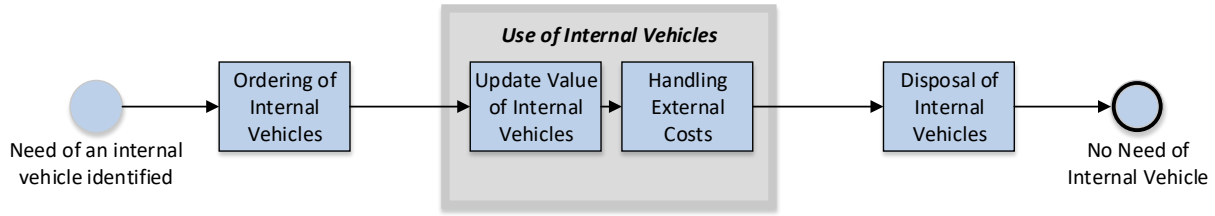

Figure 8. An overview of the process Handling internal vehicles and its subprocesses.

4.1 Forms

During the life of an internal vehicle, two different forms are needed. The first form is a necessity in the ordering process, while the second form is needed in the disposal process. The disposal form occurs in two different shapes since the marketing department uses a specific disposal form that differs from the standard disposal form.

4.1.1 Ordering of Internal Vehicles

The order form of internal vehicles is filled out after a need for a new vehicle is identified, and no existing vehicle matching the specification could be found or used. The order form is accessed from a database. It has been identified that it is common to save the order form on the personal computer with personal information pre-enrolled to facilitate the filling out process. This reduces the time it takes to fill out the form since the same personal information needs to be entered every time.

The order form is both digital and physical. The digital copy is used in the vehicle leader meeting agenda, and the physical copy is signed during the whole ordering process. The vehicle leader meeting (VL-meeting) is a meeting occurring every second week, where vehicle connected topics and ways of managing the fleet are discussed, and orders are approved. When the ordering process is fulfilled, the digital copy is stored in the database while the physical order form is archived in a binder.

The organisation has experienced some changes, both through new structures in divisions and different owners of Volvo. During these changes, additional information that needed to be filled out has been added to the form, but nothing removed. It emerged during interviews that some participants in the ordering process did not know when a specific signature was needed.

It is possible to order more than one vehicle on the same order form. A prerequisite for using the same order form is that the vehicles it concerns are similar and that all identification numbers of the internal vehicles are stated on the form. Later the controller, however, needs one order form for each vehicle and must, therefore, copy the order form into the same number of copies as the number of vehicles stated on the form. Then the controller writes one identification number on each copy and sorts the order form according to the identification number. In the end, the forms are placed and archived in binders.

Information Needed to be Filled Out

The form consists of two pages, where the person who needs the vehicles is responsible for filling out the first parts of the order form. This person is most often a vehicle engineer or a project leader and is responsible for filling out: *Information concerning the vehicle, Information concerning cost and General information*, see Table 3.

Table 3. Information presented on the order form.

Information concerning the vehicle
Specification of vehicle:
Type: _____
Model: _____
Equipment: _____
Area of usage:
Type of test: _____
Function/ division:
For which test or event: _____
Consequences if the vehicle is not going to be ordered : _____
Will the vehicle be used in a test which destroys the vehicle?:
Yes [ ]
No [ ]
I do not know [ ]
Time for usage:
From: _____
To: _____
User division: _____
At which VL-Meeting has the vehicle been discussed?:
At meeting: _____

Information concerning costs	
Cost centres:	
Cost centre for project: _____	
Cost centre for vehicle: _____	
Amount (cost of vehicle): _____	
Approval:	
Manager:	*Division Financial:*
Signature: _____	*Si gnature: _____*
Printed name: _____	*P rinted name: _____*
Date: _____	*D ate: _____*
Personal Volvo ID: _____	*P ersonal Volvo ID: _____*

General Information
Vehicle engineer:
Name: _____
Division: _____
Phone number: _____
Vehicle leader:
Name: _____
Division: _____
Phone number: _____
Vehicle identification number: _____
Manufacturing week: _____
Signature to confirm no existing vehicle available: _____
Fits vehicle into the limits of the division regarding:
Budget [ ]
Number of vehicles [ ]
Is the vehicle sellable after usage?:
Yes [ ]
No [ ]

Approval Signatures
Head of finance for R&D:
Signature: _____
Date: _____
Chairman of the meeting:
Signature: _____
Date: _____

Notes from the order placer
Date when the order is placed: _____
Signature: _____

Notes from controller
Documentation number for write-down: _____
Signature: _____

All information regarding the cost centre needs to be filled out, but depending on the division and if the internal vehicle will be saleable or not after the usage, different signature are needed. A vehicle that is not saleable after usage needs all the information concerning the cost and the approval from the manager as well as the finance of the division. This applies to vehicles from all divisions. However, when R&D orders internal vehicle not saleable after usage the head of finance for R&D needs to sign as well. In the order form, this is supposed to happen at the meeting, but the head of finance for R&D does not participate. Therefore, in the cases when the sign is needed, the vehicle owner makes sure it is signed before the meeting. If the vehicle is saleable, the signature

from finance is not needed, and in the case that it is R&D ordering the saleable vehicle, no signature is necessary as the vehicle owner's signature is equivalent to the manager's.

If the order is approved at the vehicle leader meeting, the order form is signed by the chairman of the meeting, who is also the vehicle owner at Volvo Cars. The vehicle owner is the owner of all internal vehicles at Volvo and has the same legal responsibilities as any car owner. After the meeting, the form goes to the order handler if the order has not already been placed. When the order handler has placed the order the order handler signs the form.

It is rear that the possibility to add attachment is used as well as the consequence if not ordered, if the vehicle fits within the limits of division's vehicle or budget and the signature of the controller is hardly ever entered.

4.1.2 Disposal of Internal Vehicles

An internal vehicle is disposed of when the vehicle is no longer needed. A vehicle can be disposed of externally in three different ways: sell to the authorised car dealer for the vehicle to be sold on the second-hand market, scrapping by sending the vehicle to the dismantler for the vehicle to be dismantled and the parts to be sold as spare parts or scrapping by sending the vehicle to the recycler for the vehicle to be shattered and the material reused.

To dispose of an internal vehicle extremally the first step is to fill out a disposal form. The disposal can appear in two different shapes, either it is a physical form, or it is digital and filled out on a computer. The design and information needed to be filled out in these two forms are the same. The digital form is used for all departments at Volvo except marketing. The digital form is emailed from the vehicle engineer or project leader to the internal workshop if the vehicle is going to be sold to the car dealer, otherwise, if the vehicle will be scrapped it is printed out and given in physical shape to the recycler or the dismantler.

It is the marketing department who uses the physical disposal form when selling to the car dealer. The physical form is made out of carbon paper, which automatically gives four copies of the disposal form. The original of the form is saved at the marketing department, while the three other copies are used in the disposal process. One copy is saved at the car dealer, one form is archived by the controller, and the last copy is given back to the marketing department and archived there. In the end, the marketing department will have two of these four copies, where one is unsigned, and one is signed by both the car dealer and the controller.

Information Needed to be Filled Out

The disposal form is most often filled out by a vehicle engineer or a disposal vehicle engineer, also mentioned as disposal engineer. There is a lot of information that could be filled out on the form, but it is uncommon that all information is filled out. The most critical areas of information to fill out are: *General information about the issuer, A. identification, Receivers* and *B. Condition of the vehicle.* The information that needs to be filled out in these areas can be seen in Table 4. It is always needed to enter the name of the receiver even though the date and signature are not always necessary.

Table 4. Information presented on the disposal form.

General information about the issuer
Division number: _____
Name: _____
Telephone number: _____
Department: _____
Signature: _____
A. Identification
Vehicle registration number: _____
Vehicle identification number: _____
Type of vehicle (code for model, colour, etc): _____
Chassi number: _____
Receivers
Receiver 1-3:
Print name: _____
Signature: _____
Date:
B. Condition of the vehicle
Total driving distance:
Vehicle: _____
Engine: _____
Is the vehicle re-build?:
No [ ] / Yes [ ] (if yes - fill out information D)
Is the vehicle crashed?:
No [ ] / Yes [ ] (if yes - fill out information D)
Is the vehicle registered?:
No [ ] / Yes [ ]
Date for vehicle inspection: _____
Enter information about tiers: _____

C. Disposal
Scrapping [ ]:
Date: _____
Debit account: _____
Disposing (car dealer) [ ]
Temporary disposal [ ]
Change of ownership to: _____
D. Other Information
Information:
E. Collision
Collision-account: _____
Checklist
Not registered with special driving dispense [ ]
Manual of vehicle placed in vehicle [ ]
Is the vehicle service book correct [ ]
Keys [ ]
Number: _____
Remotes [ ]
Number: _____
Code of "locknut" [ ]
Code: _____
Radio and its code [ ]
Code:

In the cases of scrapping the vehicles, meaning selling it to either the dismantler or the recycler, the disposal form is signed. While in the case of selling the vehicle to the car dealer by using the digital copy, the car dealer does not sign the form. The car dealer just answers the email received from the workshop. In this email, the car dealer states the vehicles received. However, in the case of selling the marketing vehicles to the car dealer, the car dealer signs the physical form. A receiver often mentioned on the disposal form is the controller, who never signs the disposal form.

4.2 Ordering of Internal Vehicles

The process *Ordering of internal vehicles* starts when a need for a new internal vehicle is identified. The first task is to fill out the order form. When the form is filled out the digital copy is uploaded to the agenda for the VL-meeting. The participants at the VL-meeting are the vehicle leaders from concerned departments, the vehicle owner, the administrator and the controller. If the order is approved at the meeting, the order handler receives the form when the order needs to be placed. The order handler places the order of the vehicle specified on the form. The process ends when the order is placed, and the controller receives the forms. An overview of the process *Ordering of internal vehicles*, is presented in Figure 9, as well as the subprocesses in the process. The subprocesses are described separately for a deeper understanding.

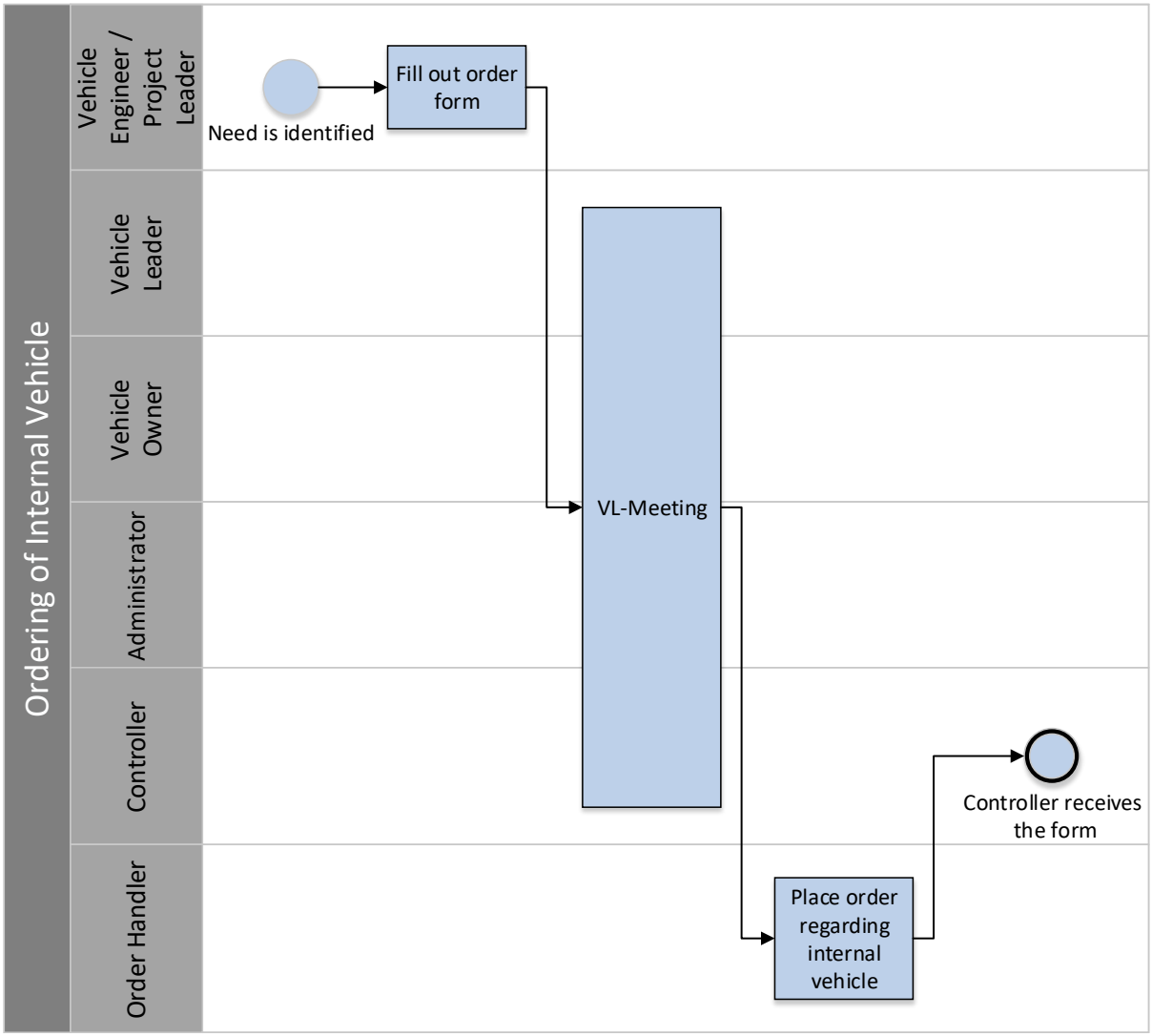

Figure 9. Overview of the process Ordering of internal vehicles. Fill out order form, VL-Meeting and Place order are the subprocesses within this process.

4.2.1 Fill Out Order Form

The template of the order form is reached from a database. The form is filled out on a computer by the project leader or the vehicle engineer. The order form is saved as a text document on the computer, but the form is also printed, see Figure 10. The reason why the order form needs to be printed is that the process requires signatures of approval.

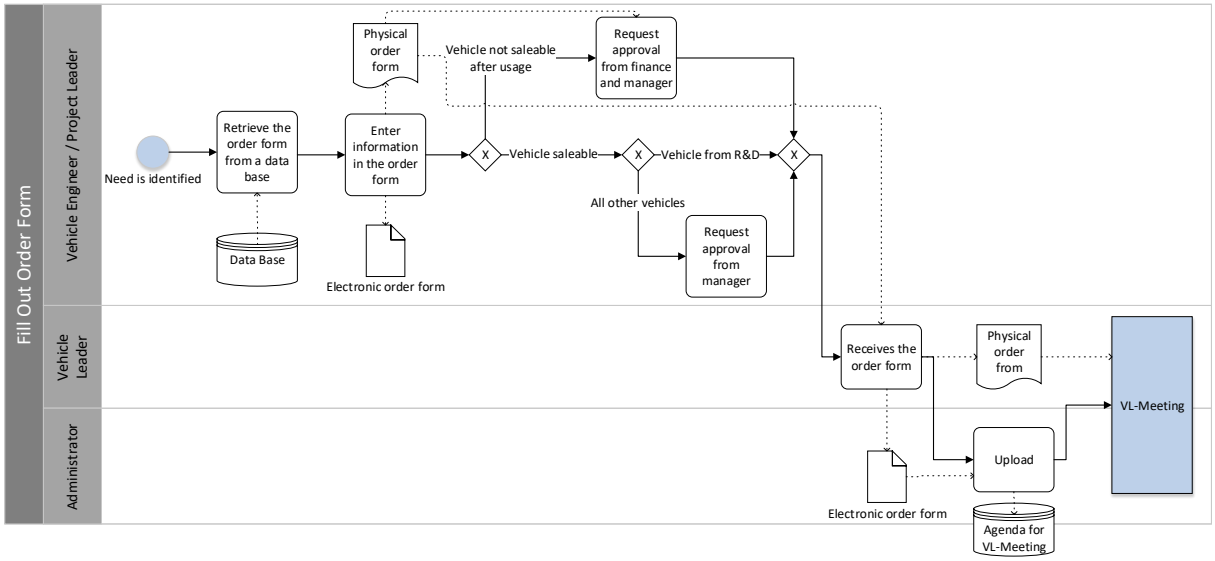

Figure 10. The subprocess Fill out order form.

If the vehicle is expected to be saleable after usage, and the vehicle is ordered from R&D, the order process is shorter. This due to that when the form is filled out by the vehicle engineer or the project leader the form can be given directly to the vehicle leader. The vehicle leader asks the vehicle engineer or project leader some questions regarding why the vehicle needs to be ordered. The questions are asked to ensure that the vehicle is needed, and no other existing vehicle can be used.

Moreover, if the vehicle is supposed to be saleable after usage, and the division who order is not R&D, the form needs to be signed by the division's manager. If the order is approved, the order form is provided to the vehicle leader who, as in the case of a saleable R&D vehicle, asks questions to ensure that the vehicle needs to be ordered.

When a vehicle is not saleable after usage, the order must be approved by both the division's finance and management. After the order is approved by the division, the order form is provided to the vehicle leader who asks questions regarding the order.

After the form is filled out by the vehicle engineer or project leader, both the digital and physical form are provided to the vehicle leader. The vehicle leader needs both the physical and the digital form. Sometimes it happens that the vehicle leader only receives the physical copy, and, in those cases, the vehicle leader asks for the electronic form. If the vehicle leader agrees that the vehicle is needed, the vehicle leader forwards the digital copy to the administrator before the vehicle leader meeting. The administrator receives the order form and uploads it to the agenda of the VL-meeting, which means it is saved in the database used for agendas and protocols.

4.2.2 Vehicle Leader Meeting

The vehicle leader brings the physical form to the meeting, where it is signed by the chairman, the vehicle owner. Before approving the order, the vehicle owner ensures there is a need for a new internal vehicle by asking questions to the vehicle leader regarding the purpose and the possibility to use another existing vehicle. For the vehicle leader to be able to answer these question, it is important that the vehicle leader has asked similar questions to the vehicle engineer or project

leader. At the meeting, other vehicle leaders could participate in the discussion and increase the possibility of using already existing internal vehicles.

At the meeting, two outcomes exist. The first is that an order is not approved, which generally is caused by the possibility to use another existing vehicle. When this occurs, the order process ends. The other alternative is that the order is approved, and in that case, the vehicle owner signs the form. At the end of the meeting, the administrator uploads a protocol of the meeting, including decisions regarding the orders to the database.

As shown in Figure 11, the vehicle could have been manufactured before the meeting, so-called factory damaged vehicles. These are vehicles that were ordered by a customer but have for example been destroyed when manufactured or been subjected to production errors that have a negative impact on the vehicle. Damaged vehicles can also be vehicles that cannot be sold on a specific market. These vehicles can be used as internal vehicles and are therefore discussed during the meeting, to investigate in if this vehicle can substitute the ordering a new one.

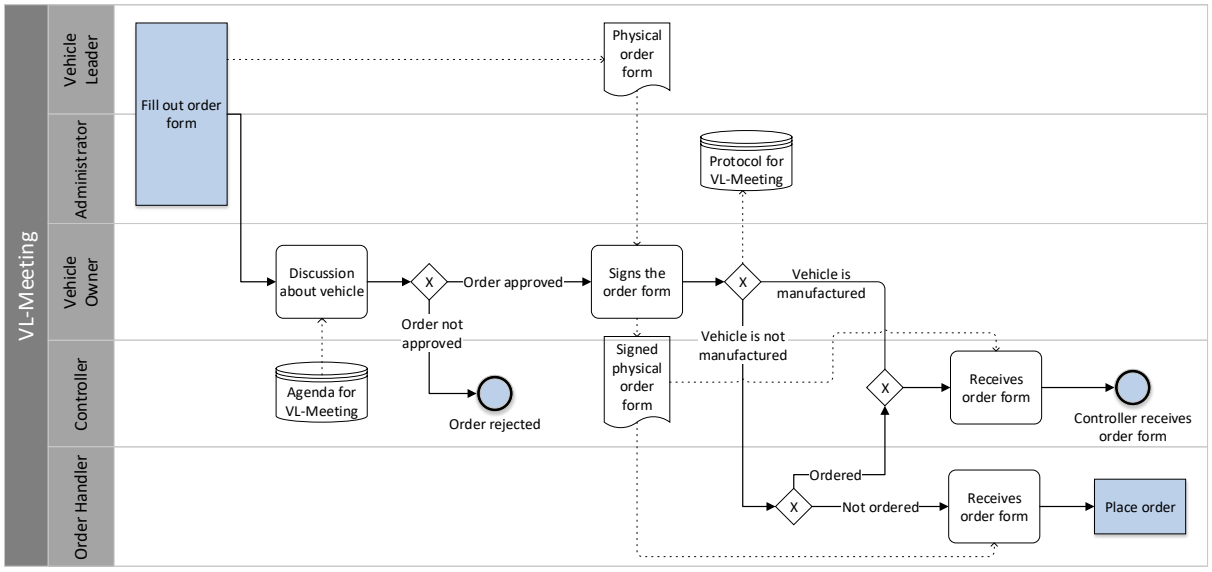

Figure 11. The subprocess Vehicle leader meeting (VL-meeting).

If the vehicle is not manufactured before the meeting, the vehicle should be ordered. The form concerning the vehicle is then given to the order handler, who place the order. However, some vehicles could already have been ordered. The main reason why some orders are placed before the vehicle owner has approved them is that these vehicles are needed for marketing purpose, which will be accepted since the vehicles need to be brand new. In this case, the form is signed by the vehicle owner at the meeting, and the form is then given directly to the controller.

4.2.3 Place Order

To be able to place an order the order form needs to be signed by the vehicle owner. Therefore, the order handler controls that the vehicle owner signature is entered on the form before placing the order. Then the specification of the vehicle is looked up in the vehicle system, see Figure 12. The specification is needed to place a correct order with specific options and fittings.

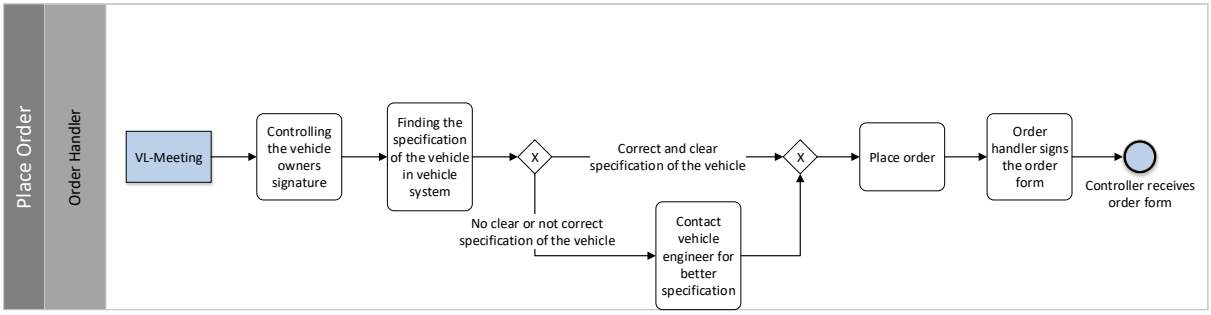

Figure 12. The subprocess Place order.

When the specification is checked up, two different outcomes can occur. The first one is that the specification is explicit and the order can be placed. The second alternative is that the specification is unclear, and in these cases, the order handler contacts the vehicle engineer for clarifying information. When the order handler is sure about the specification, the order is placed. The order handler then signs the form and places in the controller's post-box.

4.2.4 Statistics

In the protocol of the meetings where orders are approved, information regarding the decision about the vehicle as well as the order forms can be found. Based on that, information about the approvals at the meetings are presented here.

Figure 13 demonstrates the number of forms brought to a meeting and the number of vehicles approved during the meeting. Overall, it seems that more than one vehicle is stated on each form since almost all approved decisions concern more vehicles than the number of forms. All orders of internal vehicle discussed at meetings during the investigated time period was approved. The figure also shows that to some meetings no order forms were brought, and therefore no orders were placed.

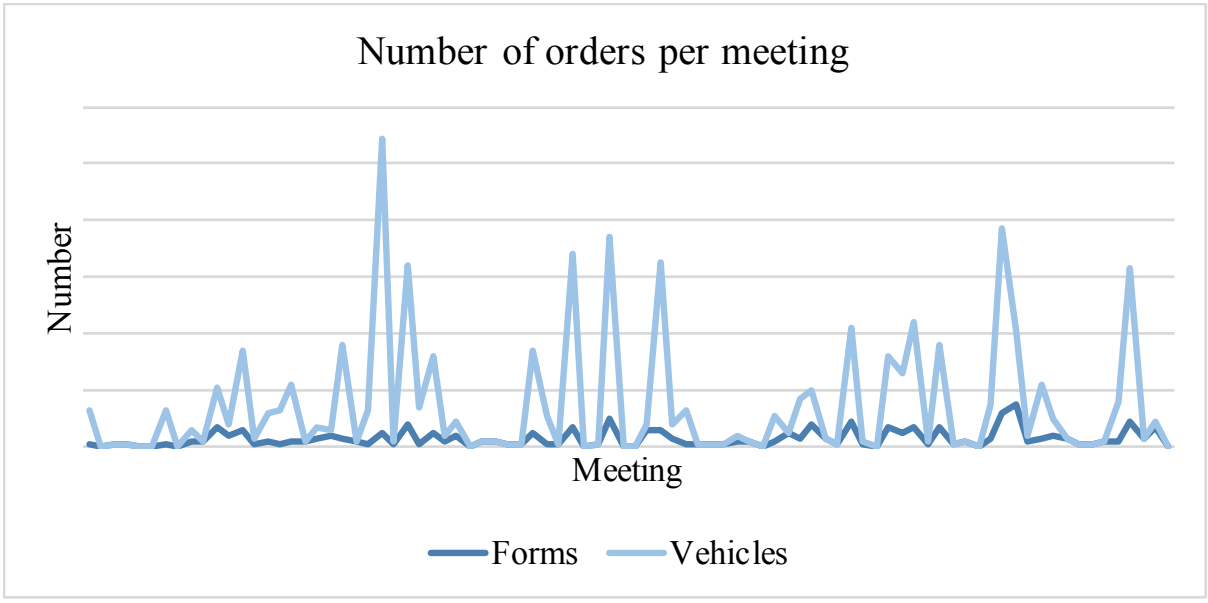

Figure 13.The number of orders per meeting.

Most of the vehicles ordered at the meetings seem to be ordered for marketing purposes, see Figure 14. The marketing department needs new vehicles every time a new car is released to exchange the fleet of marketing vehicles. This to always have the latest version of the vehicles since the new models of vehicles need to be the ones that are displayed during the marketing events. Of the tree years studied, 74 per cent of the vehicles ordered were ordered from the marketing department while 22 per cent were ordered for test purpose and finding improvements.

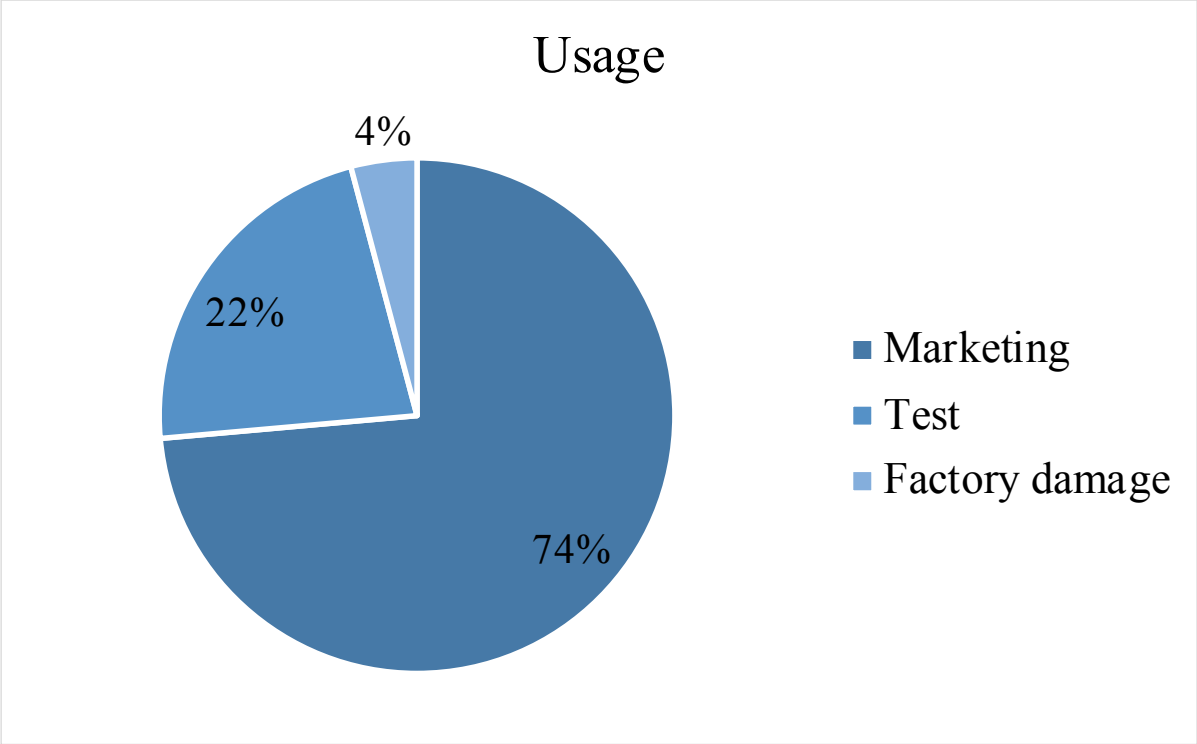

Figure 14. The usage of the internal vehicles ordered.

Four times a year some parts of the vehicles are changed. As an effect, every quarter a number of vehicles are ordered from production with the purpose of investigating if the new parts in the vehicles can be manufactured and assembled in the current production facilities and machinery. This allows the production to learn how to use the new parts and R&D to see if the parts fulfil the criteria. These vehicles are ordered as internal vehicles and are included in the statistics above.

The last 4 per cent are orders of factory damage vehicles. In case of factory damage, the vehicle leader for manufacturing needs to fill out the order form regarding the damaged vehicle. This form is then brought to the meeting, to discuss if this vehicle can be used internally in some way or if it can be sold to the second-hand market. The reason why the order form needs to be filled out for damaged factory vehicles is that someone needs to carry the cost of the vehicle. By ordering it as an internal vehicle at Volvo, the cost centre is defined and it also enters the process of *Handling internal vehicles* and is handled like any other internal vehicle, e.g. the discussion at the VL-meeting.

When ordering an internal vehicle, information regarding if the vehicle is saleable after usage or not needs to be filled out. If the vehicle is saleable after usage, the expenses for the ordered vehicle can be recovered when the vehicle is sold to the car dealer, and less information regarding the cost needs to be entered on the form, see the description of form in *4.1.1 Ordering of internal vehicles*. Figure 15 shows that 92 per cent of all ordered internal vehicles are ordered with the aim that the vehicle is saleable after usage. Nevertheless, something can happen or the plan for the vehicle can change during the time of usage, which could result in a different outcome than believed when the vehicle was ordered.

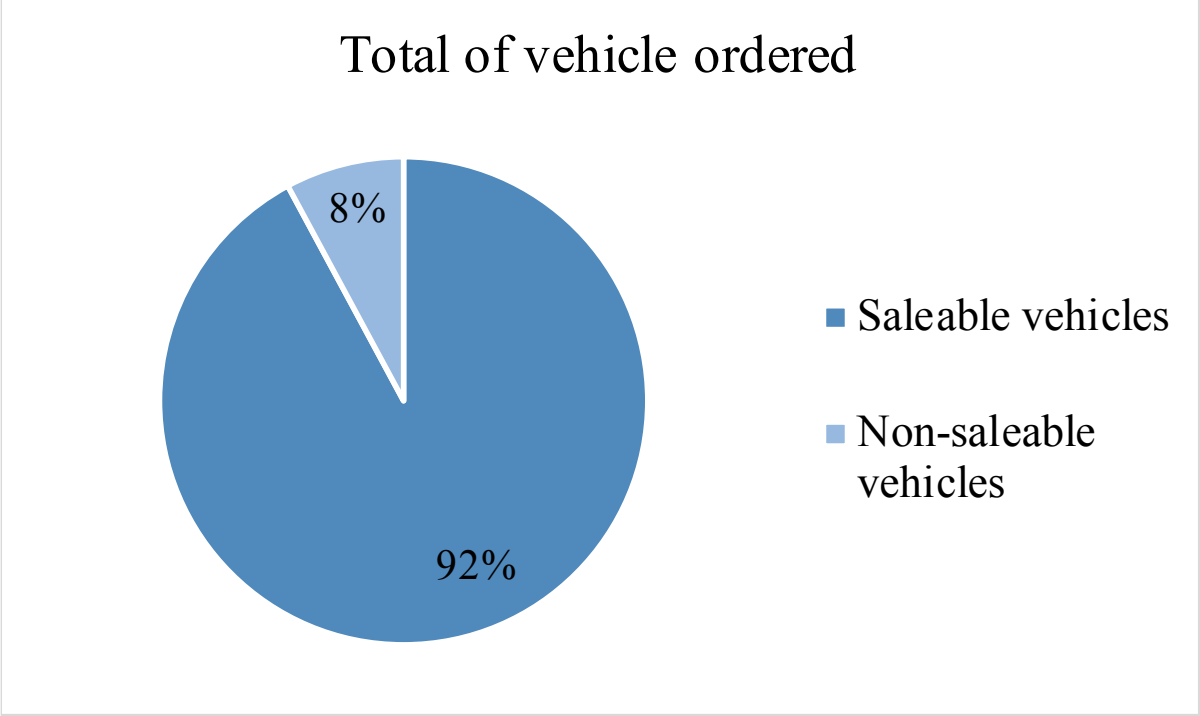

Figure 15. The internal vehicle ordered categorised after saleable or not.

4.3 Use of Internal Vehicles

The vehicles can start to be used after being delivered from production. During the usage of the vehicles, some work is required by the controller regarding updating the value of the vehicles. *Update value of internal vehicles* is divided into factory complete vehicles from production and factory complete development vehicles. Moreover, the value of an internal vehicle can also be updated if the vehicle is exposed to a test that changes the internal vehicle from saleable to non-saleable. In that case, the controller will receive an email with the instruction to perform a write-down, see process description in *4.3.1 Update value of vehicles from production – Write-down*. When using the internal vehicles several external costs appear, most of these costs are connected to that the vehicles are driven on public roads. These costs and the work it requires will also be presented.

4.3.1 Update Value of Vehicles from Production

One of the alternatives for updating the value of vehicles is the *Update value of vehicles from production* and concerns the vehicle ordered from production according to the process *Ordering of internal vehicles*. When an ordered vehicle is manufactured, the controller receives emails regarding the factory complete vehicles from production, which is the starting point for this process. The process for update the value of the factory complete vehicles from production consists of the subprocesses: *Handling emails, Quittance, Update ERP system, Identifying the vehicle* and *Write-down*, see Figure 16, and aims to update the vehicle system and ERP system with the correct value of the vehicles. The process ends with archiving the documents. The figure illustrates what kind of programs that are needed to perform the work required in each subprocess as well as the sequence of the subprocesses. All the activities are performed by the controller.

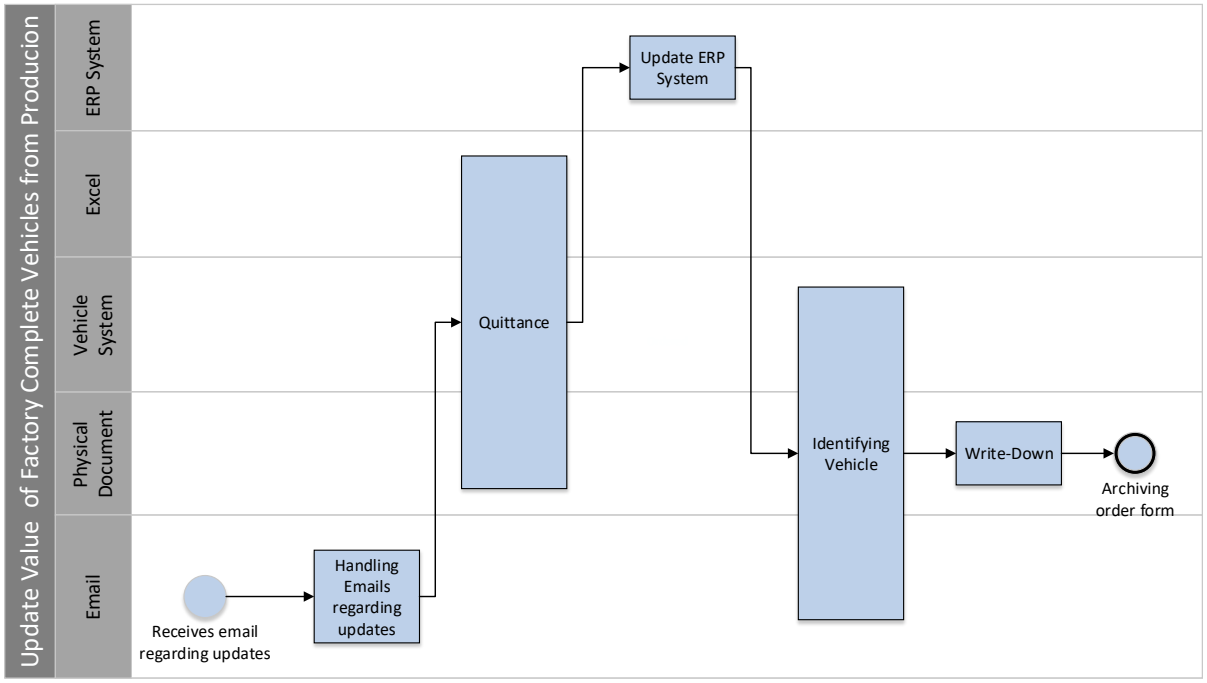

Figure 16. Overview of the process for Update value of vehicles from production. Handling emails, Quittance, Update ERP and Identifying vehicle are the subprocesses within this process.

Handling E-mails Regarding Updates

Every morning the controller receives two emails regarding updates in the vehicle system, see Figure 17. These emails give information about what happened or did not happen, during the last 24 hours. One of the emails, the Update email, can contain information about the value of the factory complete vehicles. The Updates email can also be empty, which means that no factory complete vehicles were entered into the system.

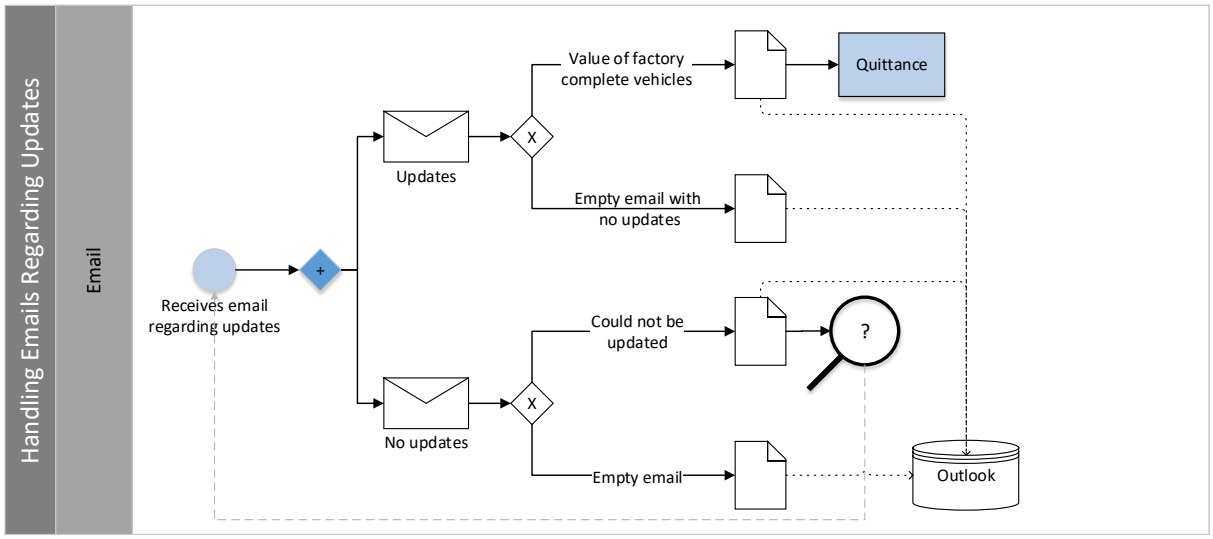

Figure 17. The subprocess Handling emails regarding updates that concerns factory complete vehicles from production.

The other email indicates that no updates occurred in the system, and it could be two reasons behind that. The first reason is that everything was updated successfully, and in that case the No updates email is empty. The second reason is that problem when updating the system with vehicles. When this occurs the No updates email includes information about a mismatch. When the No update email contains a mismatch, the controller needs to investigate why the vehicle could not be updated in the system.

All emails are saved in Outlook. The Updates email with factory completed vehicles from production is also printed, as well as saved as an electronic copy later. The reason why the controller saves all emails is that the emails could be used as proof of what occurred that date.

Quittance

After the Updates email is printed out, the controller opens the vehicle system and takes a snapshot of the current inventory value presented in the vehicle system. This snapshot is pasted into a new page in an excel file that contains information of this month's activities connected to the inventory value shown in the vehicle system, see Figure 18. The difference between the new and old inventory value is then calculated in Excel. This is done by manually copy the value from the entered snapshot and collect previously calculated value from an old page in the excel file. This difference between the new and old value is compared with the value stated in the Updates email with factory complete vehicles. These two values should be the same. If the values differ, the controller needs to investigate what is wrong. The reason why it is the controller who performs this check is that that the controller is the only person who has authority to perform changes in regard to value in the vehicle system.

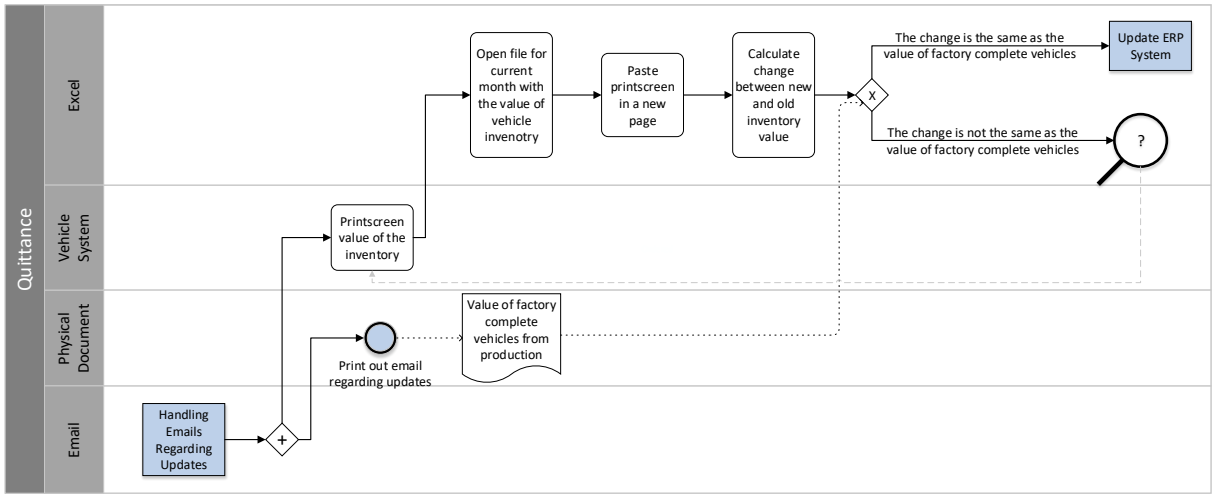

Figure 18. The subprocess Quittance.

Update ERP System

If the calculated value is the same as the value stated on the email regarding factory complete vehicles from production, the controller opens the ERP system to debit the account for internal vehicles and credit a suspense account with the same amount. The suspense account is an account where the value of the vehicles is entered from another system and serves as a security step to ensure the correct value is transferred to the internal vehicle inventory account.

The transaction in the ERP system creates a documentation number. The email with the updates of factory completed vehicles is then named after this documentation number together with the date, see Figure 19. The email document is then uploaded as an attachment to the booking just completed in the ERP system. Before the process ends, the controller performs a security check, to ensure that the value of internal vehicles in the ERP system is the same as in the vehicle system.

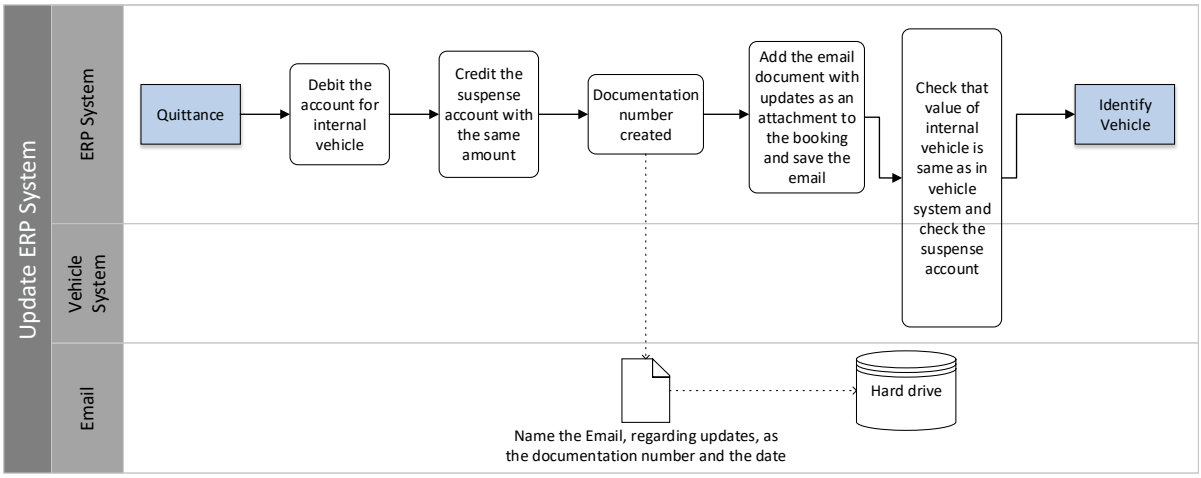

Figure 19. The subprocess Update ERP system.

Identify Vehicle

When the ERP system is updated, the controller takes the printed copy of the email with the value of factory complete vehicles from production and tries to identify these vehicles in the vehicle

system by searching on a specific number, see Figure 20. When a vehicle is found, the controller notes the identification number and the vehicle engineer connected to the vehicle. This information is found in the vehicle system. Based on the identification number noted on the printed email, the controller searches for corresponding identification number on the order forms that the controller received at the VL-meeting or from the order handler. When the right form is found, it is separated from the pile of forms.

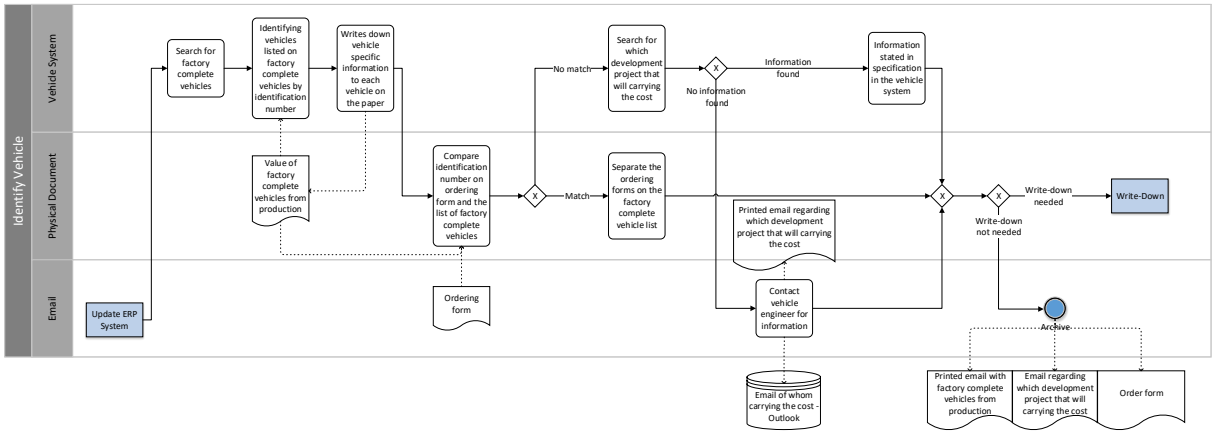

Figure 20. The subprocess Identify vehicle.

Sometimes there is not a match between the forms and the identification number, and this indicates that the vehicle does not have any order form and that the vehicle is a development vehicle. The reason why a development vehicle does not have an order form is that these vehicles are ordered production in another process. These vehicles need, however, to have their values changed, and therefore do the development vehicles enter this process. The controller needs to get information of which project account that should carry the cost for the vehicle. This information can, in best cases, be found in the vehicle system. When the specification does not contain this information, the controller contacts the vehicle engineer to receive this information. The vehicle engineer answers the controller by email, and this email is then printed and stored in Outlook.

After the controller has all information required, the controller investigates if the vehicle needs to be written down. When a vehicle does not need to be written-down, the controller archives the printed Updates email with factory complete vehicles from production, the email regarding which project that will carry the cost and the order form. If a write-down is needed, the process continues to the next subprocess.

Write-Down

Some of the vehicles stated in the emails need to have their value adjusted, i.e. written-down. This is due to the vehicle is not saleable after usage, and someone needs to carry the cost. When a vehicle needs to be written-down, the controller searches for the vehicle in the vehicle system. After the vehicle is found in the system, the controller takes a snapshot of the vehicle's value and this snapshot is pasted into a new excel document. When more than one vehicle needs to be written-down, the same excel document can be used. The amount to write-down is then calculated. The value of the vehicle is written-down to a specific predetermined value and changed in the vehicle system, see Figure 21.

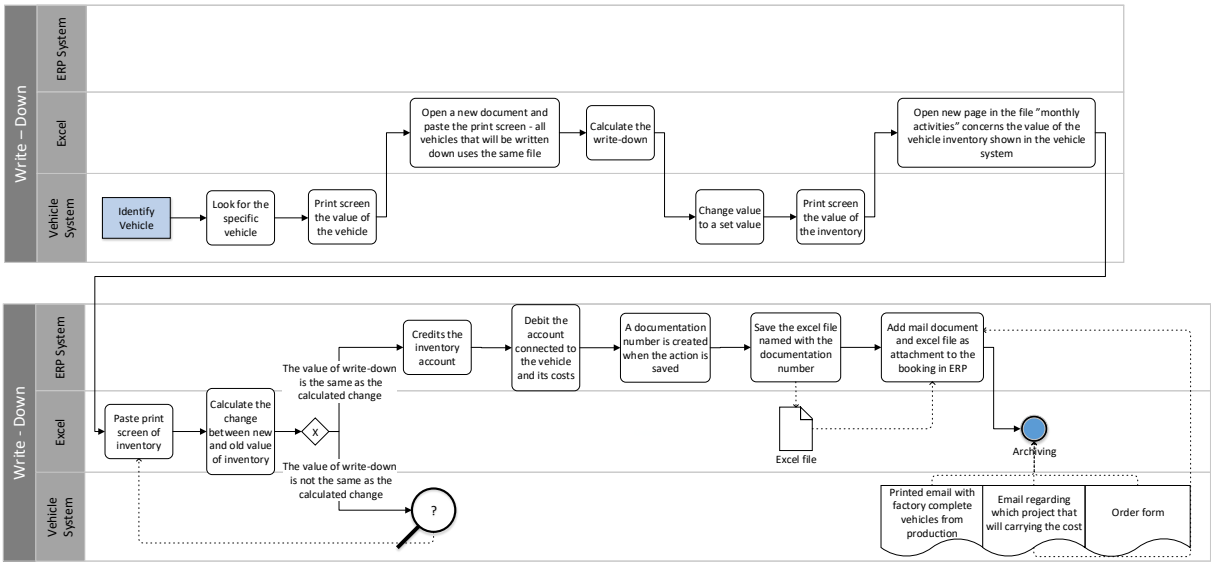

Figure 21.The subprocess Write-down.

When all values are changed, a snapshot of the value of the inventory in the vehicle system is taken. The excel file that concerns the month's value of the vehicle inventory in the vehicle system is opened. A new page in this document is created, where the snapshot is pasted. The difference between the new and old inventory value is then calculated. After the calculations, two things can happen. The first alternative is that the value is not the same as the calculated change, and when this happens, the controller needs to investigate what is wrong. The second alternative is that the value is the same as the calculated write-down, which is an indication that the work can proceed. The controller opens the ERP system and credits the inventory account and debits the account that is carrying the cost of the vehicle. When the controller saves these actions in the ERP system, a documentation number is created. The previous used excel file for calculating the write-down is renamed with this documentation number. This file and the email regarding which project will carry the cost, are uploaded as attachments to the booking in the ERP system.

Archiving

The process ends with archiving the physical order form, printed email of factory complete vehicles from production and printed email concerning development vehicles cost-centre. If an order form of internal vehicle concerns multiple vehicles, the form needs to be copied so the same number of order forms exists as vehicles on the form. This is due to all vehicle needs to have an own place in the binders. The documents are sorted and stored in binders. All order forms are sorted according to the identification number of the vehicle it concerns.

4.3.2 Update Value of Developments Vehicles

The development vehicles, which are used in developing new models, are ordered in another system and has an own meeting where it is discussed if the development vehicle will be ordered or not. The development vehicles enter the process of internal vehicles when the value of the vehicles needs to be updated in the systems. The process for updating the value of development vehicles is generally performed once a month with the aim to set a predefined value to each vehicle and to ensure that both the ERP and the vehicle system is updated. All development vehicles are

entered in the vehicle system with the value zero, however, it is decided from accounting that the vehicles should have a specific value. The process begins with extracting lists of factory complete development vehicles from the ERP system, followed by the subprocesses *Update vehicle system*, *Quittance* and ends with *Update ERP system*, see Figure 22. All the activities are performed by the controller.

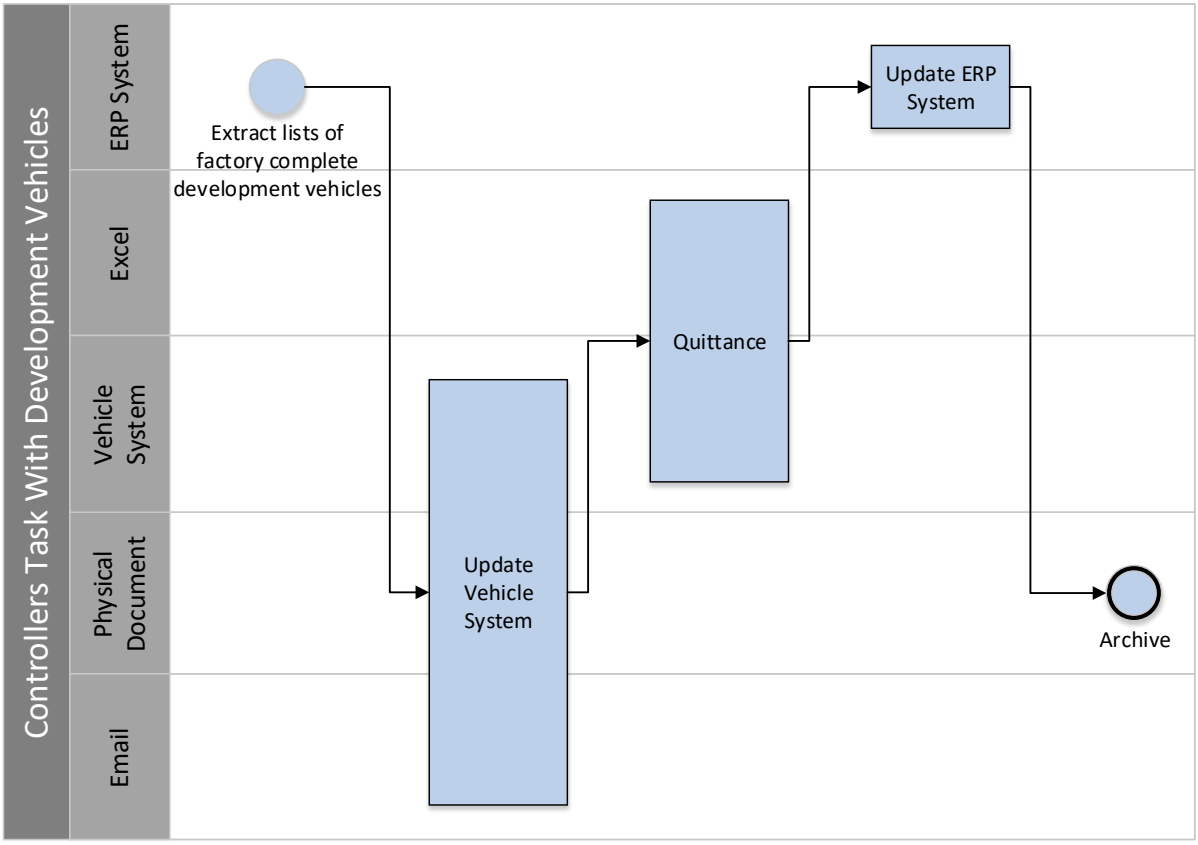

Figure 22. Overview of the process Update value of development vehicles. Update vehicle system, Quittance and Update ERP system are the subprocesses within this process.

Update Vehicle System

This subprocess starts with the printing of two lists from the ERP system. Each list contains information of all factory complete development vehicles from a specific plant during the last two months. The vehicles stated on this list will be searched for in the vehicle system, in order to update the value of the vehicle. A vehicle that can be updated directly is updated by adding invoice name, invoice date and the value is changed to the predetermined value, see Figure 23. After the vehicle has been updated, it is marked on its list. Sometimes the vehicle cannot be updated, due to the wrong status in the vehicle system. The controller needs to inform the vehicle engineer about the situation and must, therefore, postpone the update until next time. A note is made on the list in connection to the vehicle. As the lists overlap in time, some vehicles are already updated. In that case, these vehicles are marked off on the list. The total value of all updated vehicles is entered on the list as well as the date. This list is then scanned in order to be used as a digital copy later on.

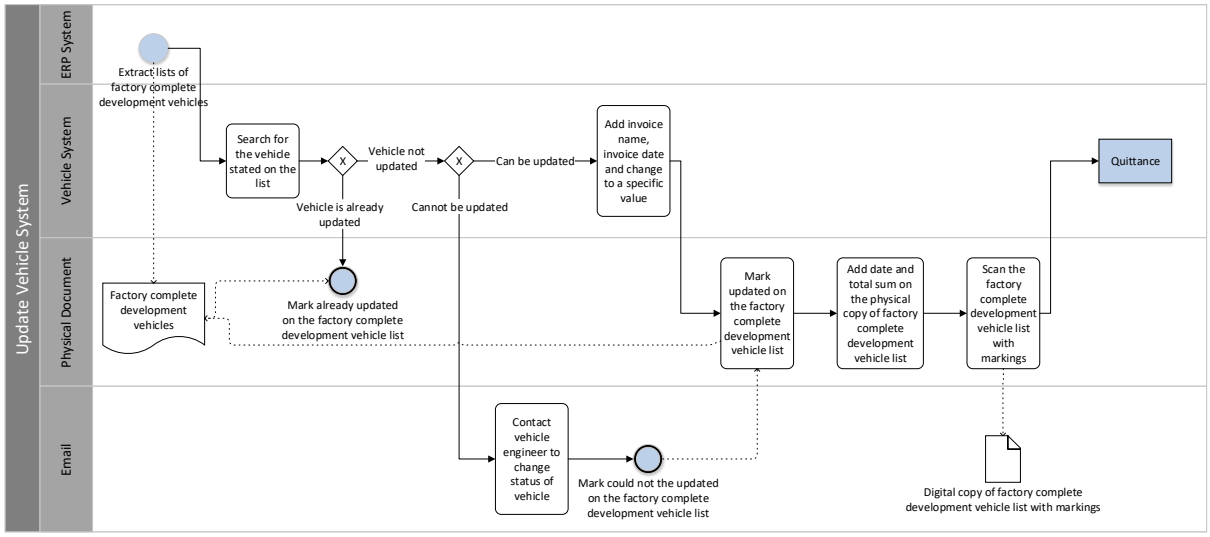

Figure 23. The subprocess Update vehicle system.

Quittance

Next step is to perform the quittance. The controller takes a snapshot of the inventory value in the vehicle system, see Figure 24. An excel file with information about this month's activities that concerns the value of the vehicle's inventory in the vehicle system is opened. In this file, the snapshot is pasted on a new page.

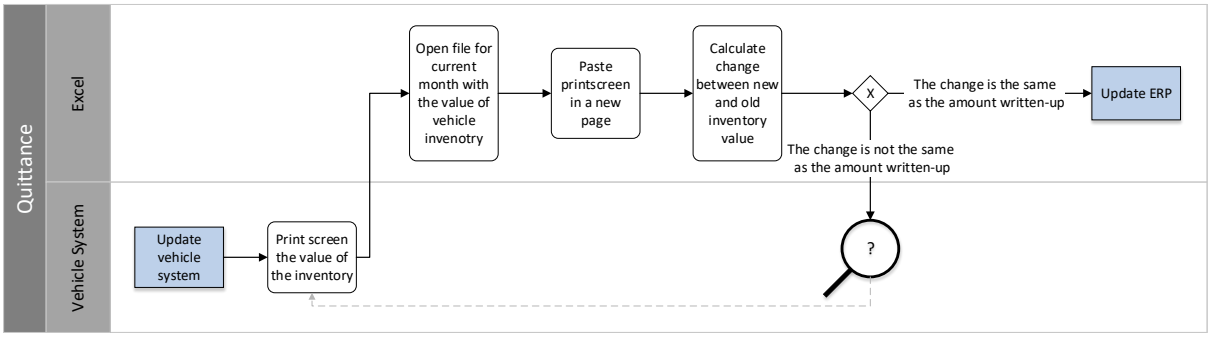

Figure 24. The subprocess Quittance.

The difference between the new and old value is calculated in Excel. This is done by manually copy the value from the entered snapshot and collect previously computed value from an old page in the same excel file and thereafter calculate the difference. When the difference is calculated this value will be compared with the value stated on the extracted list over factory complete development vehicles. At this point, two alternatives can occur. The first one is that these values are the same, which indicates that the controller can proceed to next step. The second alternative is that these two numbers differ. When this occurs, the controller needs to investigate why the numbers vary.

Update ERP System

When the quittance is finalised, the controller opens the ERP system and debits the inventory account and credits a fictional account, to ensure that the inventory account is equivalent to the value in the vehicle system. This action creates a documentation number which the scanned document, the list of factory complete development vehicles with markings, receives and is then stored on the hard drive, see Figure 25. This document is also added as an attachment to the booking in the ERP system. The documents of the printed with lists from the ERP system with notes written on them are also stored in binders as physical copies.

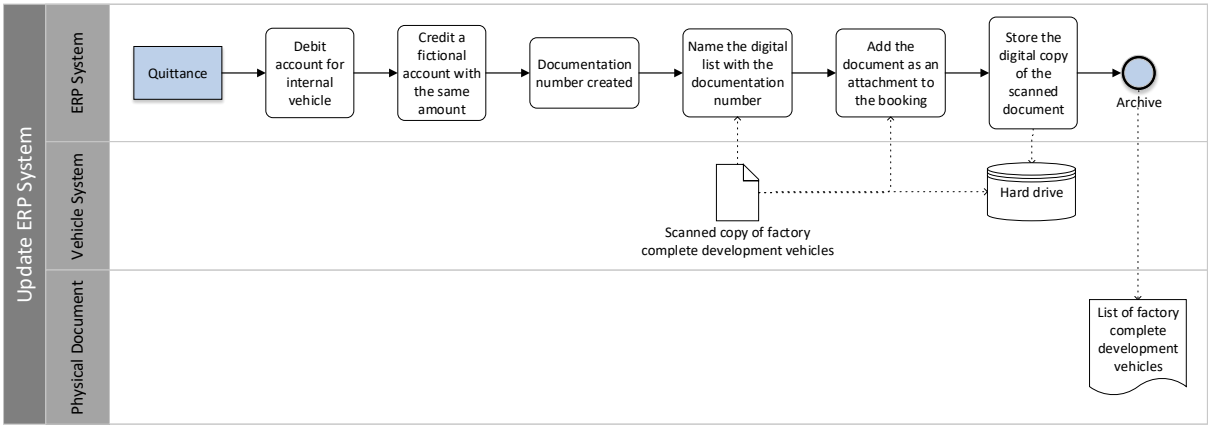

Figure 25. The subprocess Update ERP system.

4.3.3 Handling External Costs

During the usage of the internal vehicles, some additional costs are generated. The controller is responsible for handling the external costs. The invoice is generally sent to Volvo as a physical copy, which needs to be paid and archived. The invoice is archived in a dedicated binder, first in the office area and then later on in archiving facilities.

Some of the external costs generated are insurances, deductibles, vehicle inspections, repairs and turnpikes. Another large source of invoices is the Transportstyrelsen, e.g. congestion charges. When the invoices arrive at Volvo, the invoices are divided up according to which invoice that should be paid by Volvo and which should be paid by the employees. The reason why an employee can be responsible for paying the invoices is that employees can use the internal vehicles for private purposes.

After the invoices are sorted, the controller receives the ones that will be paid by Volvo. These invoices will, in turn, be sorted again according to the type of invoice. Three alternatives exist. Firstly, invoices that are from known partners are sent to an external organisation that scans and enters the invoices into Volvos ERP system, together with the scanned invoices, as well as archives the physical invoices. Before the controller sends the original invoice to the organisation a physical copy is made, and some information regarding the invoice is saved in an excel file to be used in follow up if the invoice is entered and paid. When the controller notices that the invoice is paid in the ERP system, the copy is discarded.

The second alternative concerns the invoices from known parties but with variations in the bankgiro number. These invoices are scanned by the controller and uploaded to a web-based accounting system. Information regarding the invoice is also entered into the accounting system. From the accounting system, the invoices are collected and entered into the ERP system, together with the scanned invoices, by another division within Volvo. The scanned invoices are also stored on the hard drive, and the originals are archived in the binders.

In the final alternative, the invoices are from rare sources and unknown bankgiro numbers. The invoices can sometimes be scanned by the controller, but it is not a requirement. The information on the invoice is entered into the web-based accounting system, and if the controller scanned the invoice, it is uploaded. From the accounting system, the invoice and information are collected by another internal division. That division ensures the invoice is paid and when done, a confirmation appears in the ERP system. The original invoices are archived in the binders and if scanned, also on the hard drive.

4.4 Disposal of Internal Vehicles

When the test or purpose of the internal vehicle has come to an end, the next step for the vehicle needs to be decided. The alternatives are either to be disposed of internally or externally. The internal disposal is internal use and the external alternatives are: sell to an authorised car dealer or scrapping by dismantler or recycler, see Figure 26. The alternative is most often decided by the disposal vehicle engineer. The decision is mainly based on two factors; the condition of the vehicle and the need for using the vehicle in another test. It is common that when the vehicle is ordered the outcome of the vehicle is known, for example, if the vehicle is going to be re-used, sold or scrapped. The use of external disposal is followed by creating an invoice.

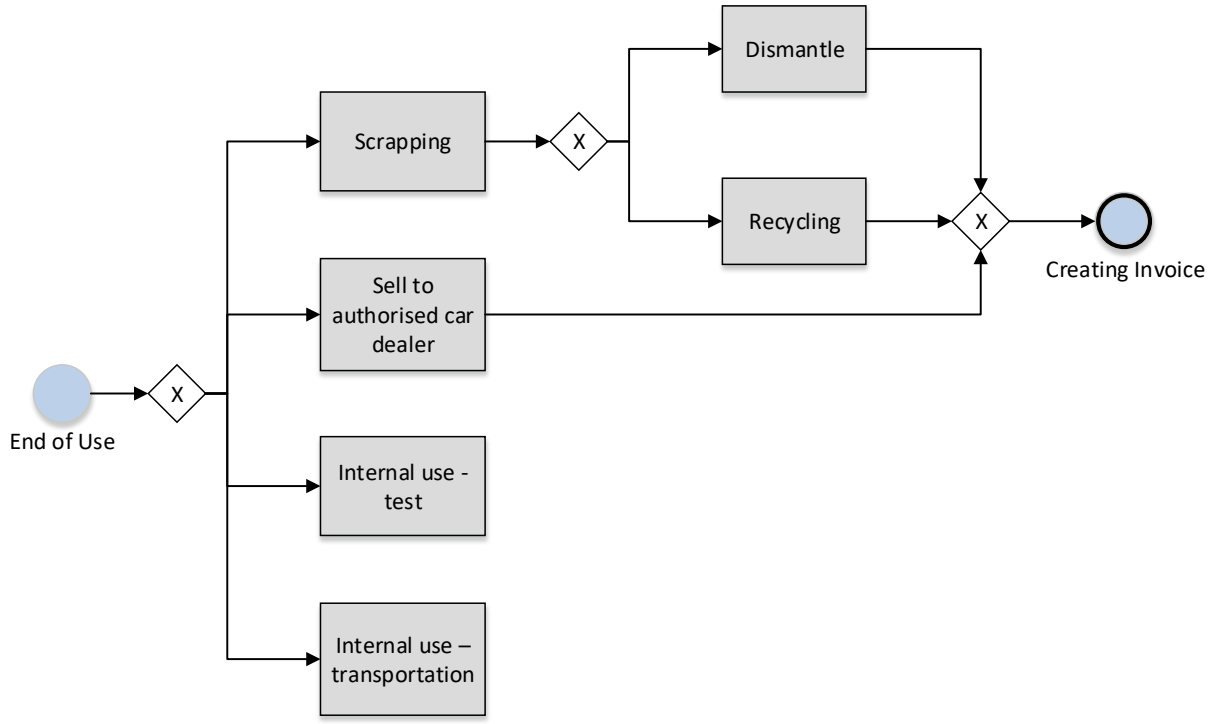

Figure 26. The four alternatives in the process of Disposal of internal vehicles.

A vehicle that can be used internally, due to an existing need, should be as it maximises the use of the vehicle and thus lowering the cost. Moreover, when an internal vehicle is ordered from the production it reduces the capacity available for customer orders, thus directly impacting the customers. According to the vehicle owner, the vehicle should be disposed of as soon as no need is identified, preferable to the car dealer or otherwise to the dismantler or recycler. It does, however, happen that vehicles are saved for assumed future needs.

4.4.1 Internal Use within Projects and for Transportation

When it is decided that the vehicle will be used internally, for transportation or test, it will later end up at the starting point of the disposal process "end of use", see Figure 27. A vehicle that will be used for a test within the same user division does not require any special actions. However, when a vehicle will be used for tests in another division, some administrative work needs to be carried out.

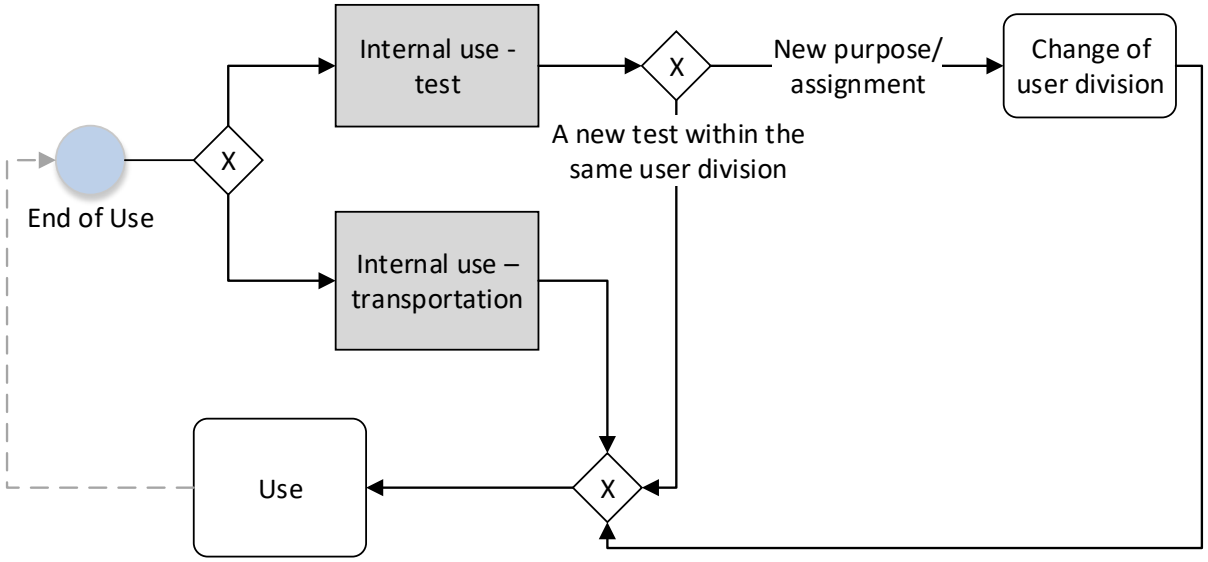

Figure 27. If the car is used internally and, in another test, it will end up in the same decision-making process again.

The administrative work is to do some changes in the vehicle system. Firstly, the former vehicle engineer transfers the vehicle in the vehicle system to the new user division. When that action is performed the receiver of the vehicle, the new vehicle engineer, needs to accept the change in the vehicle system, see Figure 28.

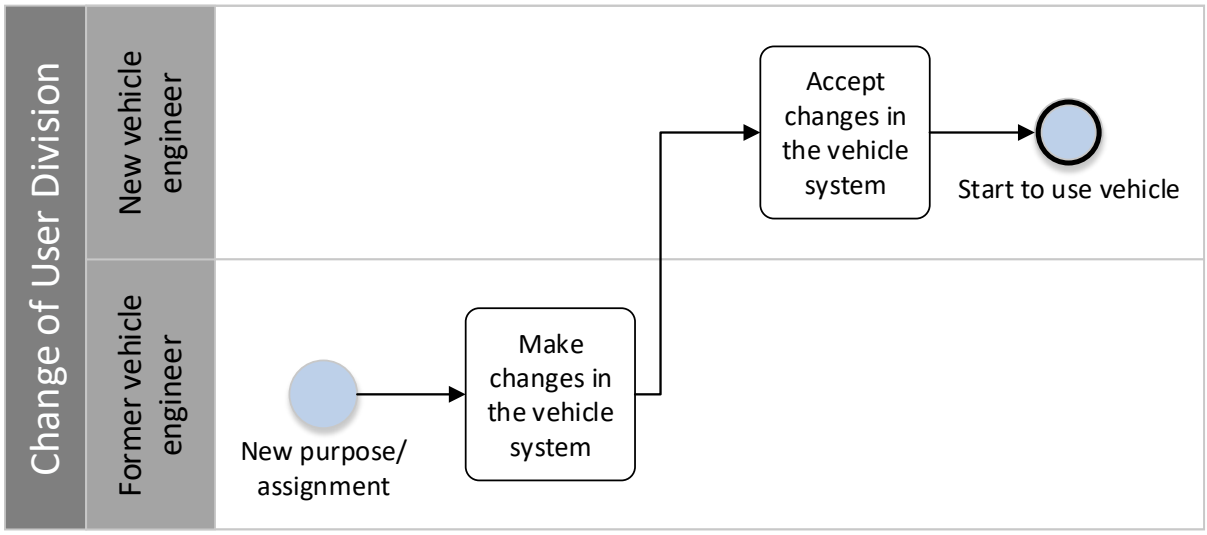

Figure 28. Change of user division in the vehicle system.

4.4.2 Sell to the Authorised Car Dealer

When a vehicle is in good condition after the tests or when purposes are fulfilled the vehicle can be sold to an authorised car dealer, who can sell it on the second-hand market. The process of selling the vehicle to the car dealer can exist in two ways, by using a digital form or a physical form. The physical form is used when selling marketing vehicles while a digital form is used for all other internal vehicles.

First of all, the vehicle engineer fills out the disposal form. In the case of selling the marketing vehicles, three copies of the physical form are delivered to the workshop together with the vehicle, while the original is archived at the marketing department, see Figure 29. In the other case, when the form is digital, and the vehicles are not from the marketing department, the form is sent by email to the workshop, see Figure 30. The workshop needs the form to know where to assign the expenses of the changes.

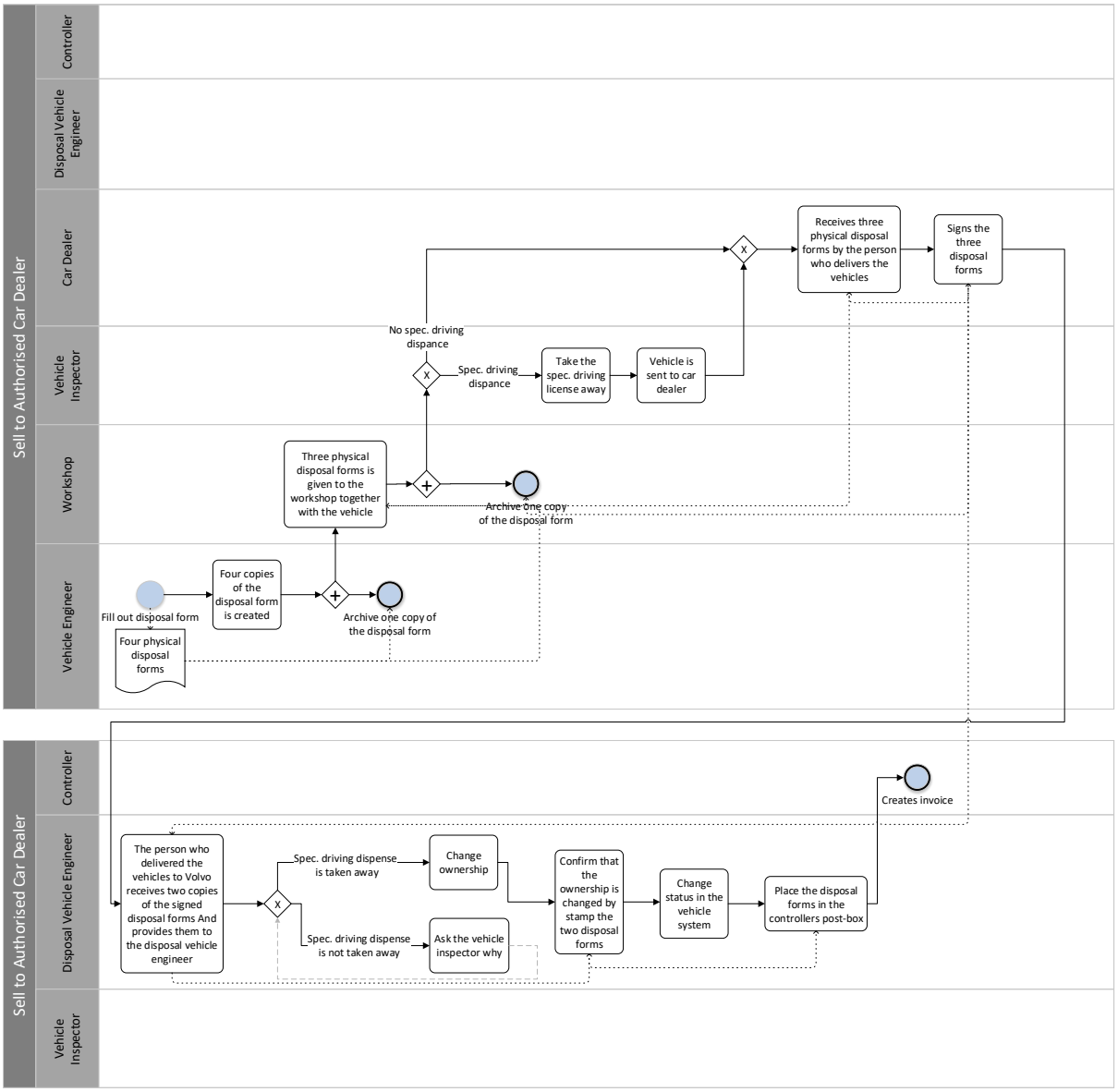

Figure 29. The process used when a marketing vehicle is sold to an authorised car dealer. A physical form is used.

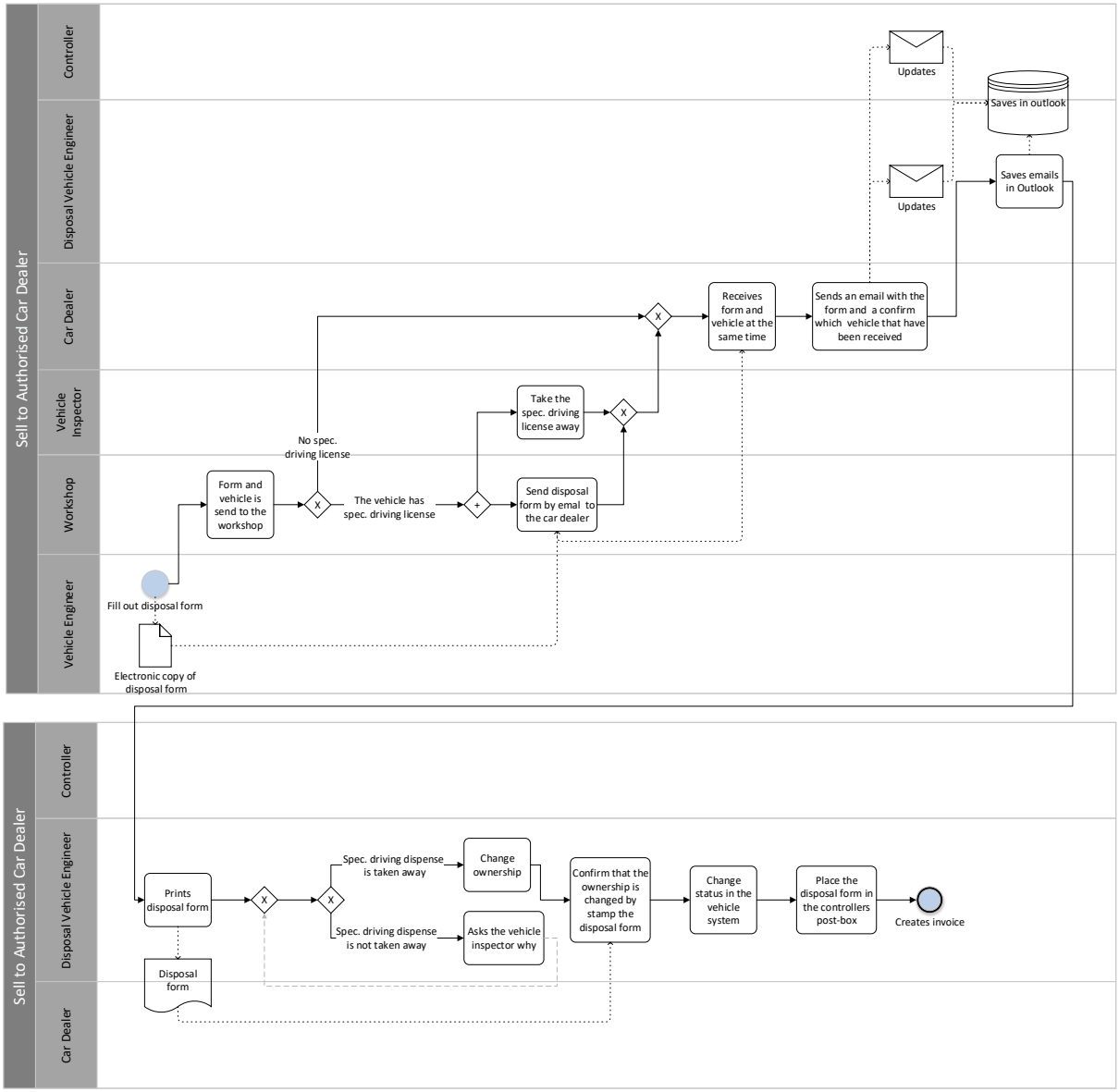

Figure 30. The process Sell to authorised car dealer, which is used for all internal vehicles except marketing vehicles. A digital form is used.

Volvo has two different internal workshops, one workshop that takes care of the vehicles from the marketing department and one workshop concerning all the other internal vehicles. The reason behind two different workshops is that vehicles from marketing are, generally, in good condition after being used commercially and a simple inspection is needed to be performed on these vehicles. The other internal vehicles, not the ones from marketing, need to be fixed back to original condition before being sold to the car dealer and is therefore sent to the other workshop. This workshop is equipped to carry out major changes on the vehicle, which most vehicles used in tests require.

Both workshops need to control if the vehicle has a special driving dispense. The special driving dispenses permits test vehicles to be driven on public roads. A vehicle that has a special driving dispense needs to go through the vehicle inspector before delivered to the car dealer. It is the

vehicle inspector who changes the special driving dispense to an ordinary registration. The vehicle could either be driven to the vehicle inspector or the vehicle inspector could visit Volvo. The forms do not pass the vehicle inspector. In the case of the digital form, the form is sent by email from the workshop for internal vehicles to the car dealer. In the other case, the marketing vehicles, the three physical disposal forms are delivered to the car dealer together with the vehicles.

A vehicle with an ordinary dispense goes directly from the workshops to the car dealer. The movement of the vehicles between the workshop/ vehicle inspector and the car dealer can be carried out in two different ways. One way is that a representative from Volvo drives the vehicles to the car dealer. The second alternative is to use a transport provider.

In both cases, if the vehicle has a special driving dispense or not, the forms go directly from the workshops to the car dealer. In the case of a digital form, the form is sent by email from the workshop to the car dealer. When the car dealer receives the disposal forms, the car dealer does not sign the form, the form is just sent back in an email where it is stated which vehicles have been received and at what date. This email is sent to both the controller and the disposal vehicle engineer. The controller saves the email, while the disposal vehicle engineer prints the form. In the case of the physical form used by marketing, the person delivering the vehicle controls that the car dealer signs the form. The car dealer keeps one of the disposal forms while the other two are brought back to Volvo and delivered to the disposal engineer.

When the disposal vehicle engineer has received the forms, the disposal engineer controls that the special driving dispense is removed. Here two different alternatives can exist. The first is that the dispense is not taken away, and in those cases, the disposal vehicle engineer contacts the vehicle inspector and investigate why. The second alternative is that the driving dispense is taken away, which is an indication that the work can proceed. It is important that the special driving dispense is taken away before the vehicle is sold to a customer by the car dealer. It is the disposal vehicle engineer who is in charge of making sure that every vehicle that is sold is not registered with the special driving dispense.

When the disposal vehicle engineer is sure that the special driving dispense is taken away, the engineer change ownership from Volvo to the car dealer in *"*Bilregistret*"*. The status is also changed in the vehicle system to "for disposal". The disposal form is then stamped with "changed ownership" and placed in the controller's post-box.

4.4.3 Scrapping by Sending the Vehicle to the Recycler

When it is decided that the vehicle is going to be recycled the disposal vehicle engineer fills out the disposal form and a copy of transportation regarding which vehicles will be disposed of and collected by the transport provider. The recycler is informed that there are vehicles at Volvo that is ready to be recycled. The recycler is responsible for providing transportation, see Figure 31. When the transport provider arrives at Volvo, a representative from Volvo is responsible for helping the provider to load the right vehicles on to the truck. The transportation provider receives the disposal form and a copy of the transportation before the transportation provider leaves Volvo. The representative brings another copy of transportation to the disposal vehicle engineer.

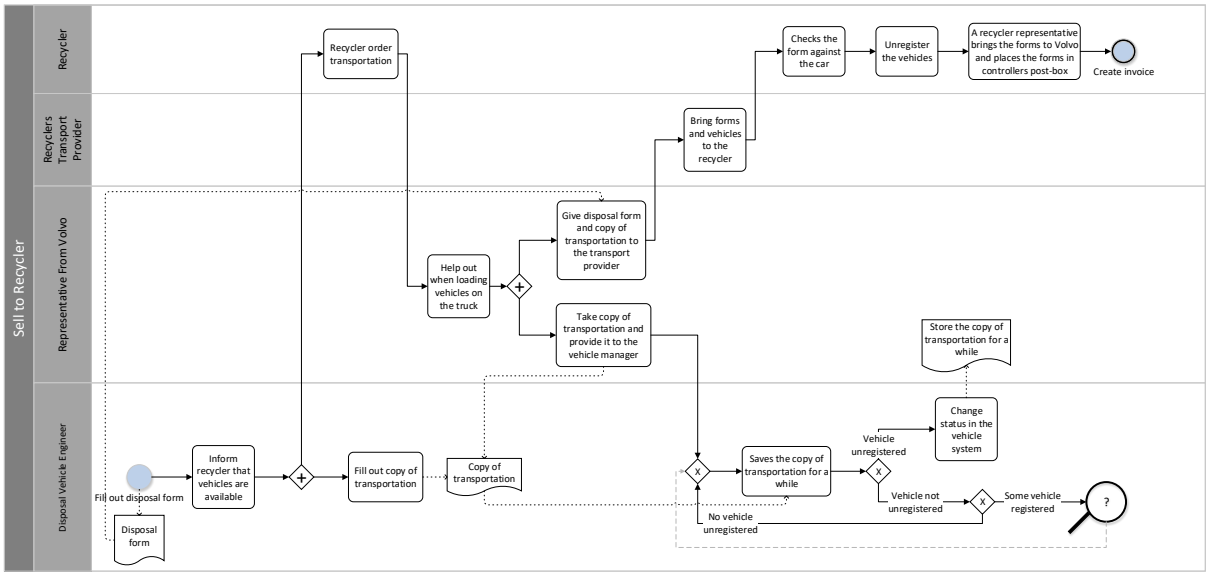

Figure 30. The process Sell to recycler.

When the recycler receives the vehicles and the forms, all vehicles are matched with an identification number on the form, to ensure that the recycler has received the right vehicles. The recycler signs the forms as confirmation of receiving the vehicles and then unregisters the vehicles from "Bilregistret". The recycler stores all the forms until a representative from the recycler brings them back to Volvo and placing the forms in the controller's post-box. The representative from the recycler generally visits Volvo once a month.

The copy of transportation is used to control that the recycler has unregistered the vehicles. The disposal vehicle engineer waits approximately one week before checking if the vehicles are unregistered since it can take a while for the status of the vehicles in "Bilregistret" to be updated. Sometimes it happens that none of the vehicles stated on the copy is unregistered and, in those cases, the disposal engineer needs wait one more week since it is a sign that the changes have not been completed. However, if one or some vehicles are unregistered, the disposal engineer needs to investigate what has happened. When the engineer is sure that a vehicle that was delivered to the recycler is unregistered, the status of the vehicle is changed to "for disposal" in the vehicle system. The copy of transportation is saved in the office for a while until discard.

4.4.4 Scrapping by Sending the Vehicle to the Dismantler

The second alternative for scrapping is to dismantle the vehicle. This process starts with that the disposal vehicle engineer fills out the disposal form, orders transportation and fills out the copy of transportation. On this copy, it is stated which vehicles that will be disposed of by the dismantler. A representative from Volvo is responsible for the right vehicles being loaded on to the transportation provider's truck. Before the transportation provider leaves Volvo with the vehicles the transport provider signs the forms on behalf of the dismantler and receives a copy of the transportation as well as copies of the disposal forms. The other copy of the transportation is given to the disposal vehicle engineer. Then the disposal forms are placed in the accountant's post-box by the Volvo representative, see Figure 32.

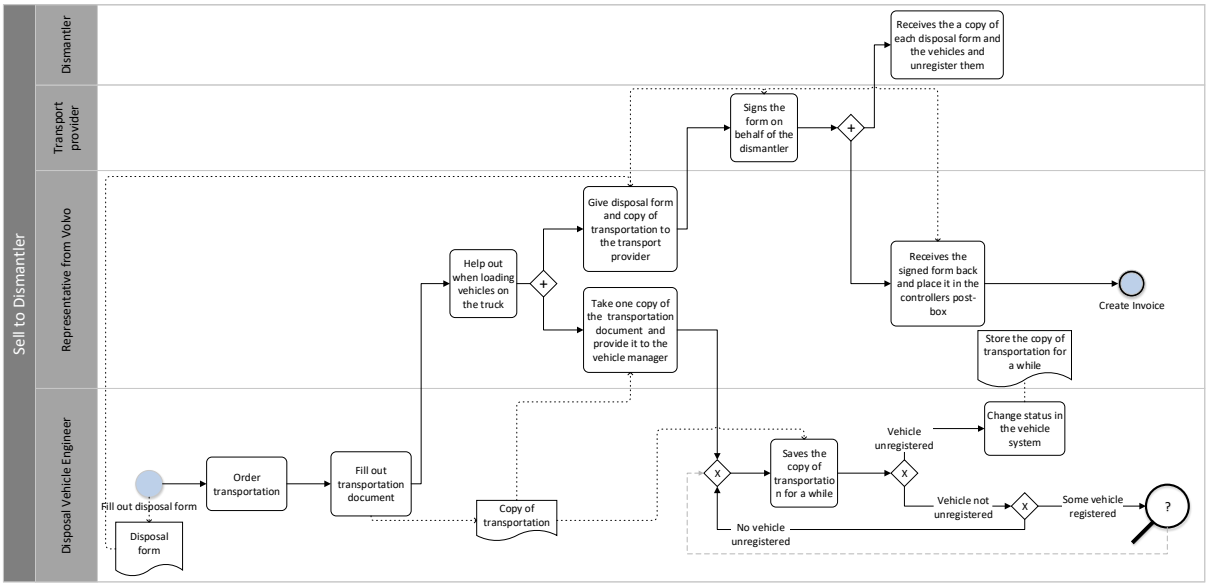

Figure 31. The process Sell to dismantler.

The dismantler is responsible for unregistering the vehicles in "Bilregistret". The disposal engineer waits approximately one week before controlling that the vehicles on the copy have been unregistered by the dismantler. If none of the vehicles on the copy are unregistered, the engineer waits one more week, but if just one or some of the vehicles are unregistered, the disposal engineer needs to investigate what has happened. When the vehicle engineer is sure that all the vehicles are unregistered, the statuses of the vehicles are changed to "for disposal" in the vehicle system. The copy of transportation is saved in the office for a short period until discard.

4.4.5 Creating Invoice

The controller's role in the disposal process concerns creating the invoices. This process begins when the disposal form is placed in the controller´s post-box. After the controller has received the forms, they are sorted according to receivers: *the car dealer, the recycler* and *the dismantler.* To create the invoices, all vehicles need have to the status as "for disposal" in the vehicle system. The process ends when the invoice is sent and the disposal forms are archived.

Creating Invoice to Car Dealer

The process of creating an invoice to the car dealer consists of four subprocesses, see Figure 33. When the controller receives a form in the post-box the status in the vehicle system can be updated, which is the first subprocess. The second is *Creating accounting records*, and the third is *Quittance*. The fourth and last subprocess is *Creating the invoice in the ERP system* and sending it. The different subprocesses are described below.

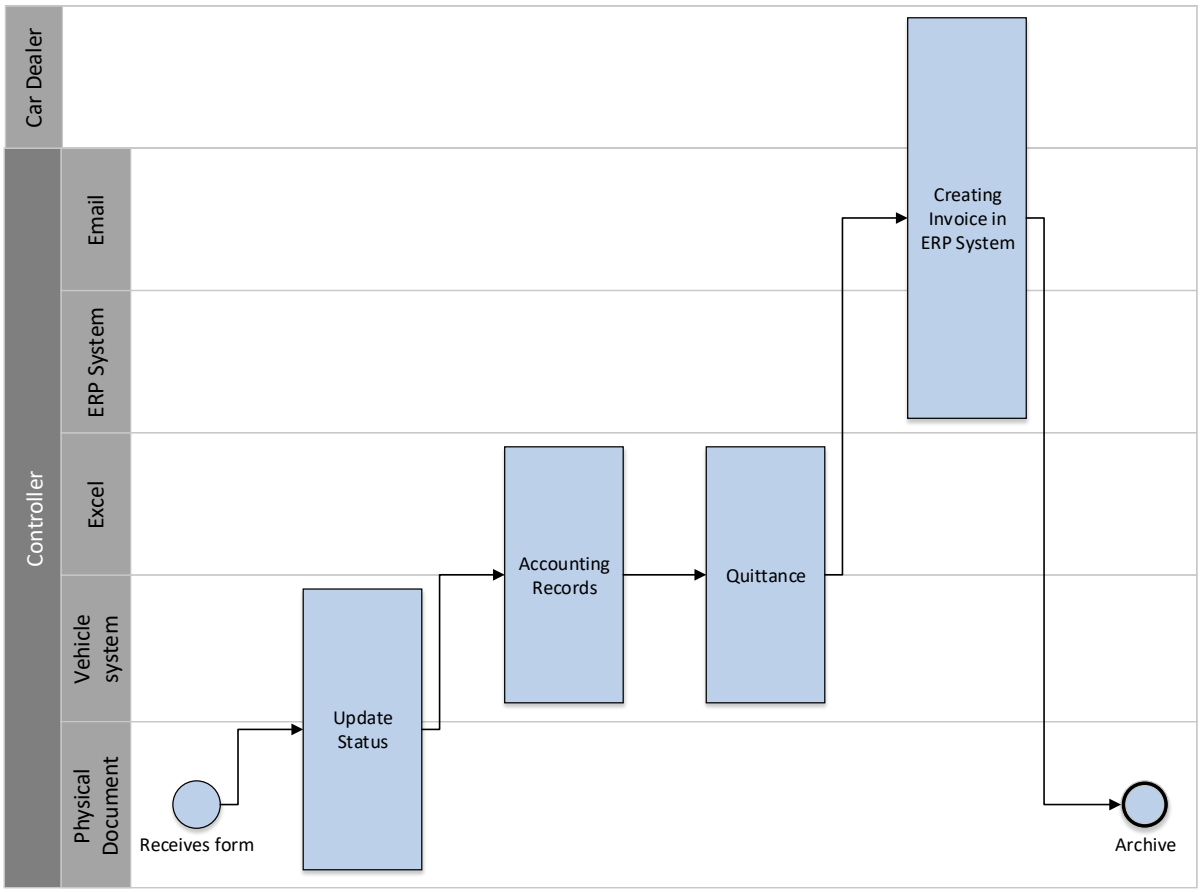

Figure 32. Overview of the process Creating an invoice to car dealer. Update status, Accounting records, Quittance and Creating invoice in the ERP system are subprocesses iwhtin this process.

Update Status

When the controller receives the disposal forms regarding vehicles that have been sold to a car dealer, it is necessary to control that the form is stamped with the confirmation of changed ownership, see Figure 34. When a form has been stamped with the confirmation, the process of creating an invoice can start. Otherwise, the controller needs to contact the disposal vehicle engineer to find out what is wrong.

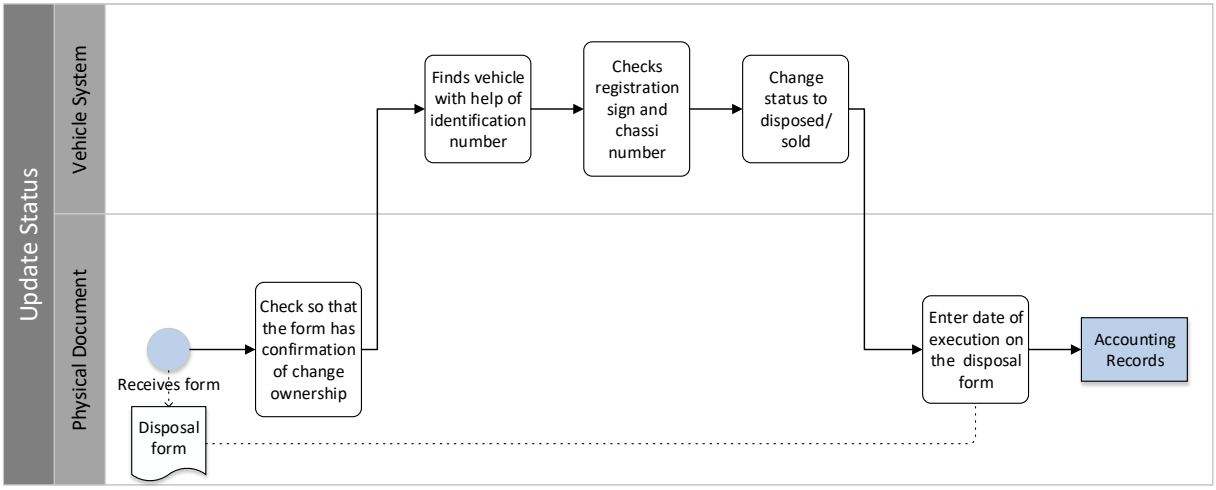

Figure 33. The subprocess Update status.

The next step is to find the vehicle in the vehicle system by searching on the identification number. When the vehicle is found, the controller controls so the registration sign and chassi number is the same as on the disposal form. If it matches, as it almost always does, the status of the vehicle in the vehicle system is changed to "disposed/sold" and the controller stamps the date of execution on the form. This process is repeated for the all the forms representing internal vehicles that have been delivered to the car dealer recently and needs to be invoiced.

Accounting Records

When the update is done, the value of the vehicles needs to be calculated, which is the amount to be invoiced. Firstly, two lists of information are gathered from the vehicle system. The information is copied and pasted into an excel document, where the information needed for the accounting record is rearranged. An old invoice is opened and used as a template, where the new rearranged information is pasted. The file is saved as a new document, see Figure 35. On the disposal form, some additional costs, e.g. winter tires, could be stated. These costs need to be included in the amount invoiced. The additional costs are however not in the accounting record but on the actual invoice. The excel file is then used to calculate the total sum to be stated on the invoice. The total sum is the sum of all the vehicles that are sold to the car dealer, excluding the additional cost. The accounting records are then stored on the hard drive.

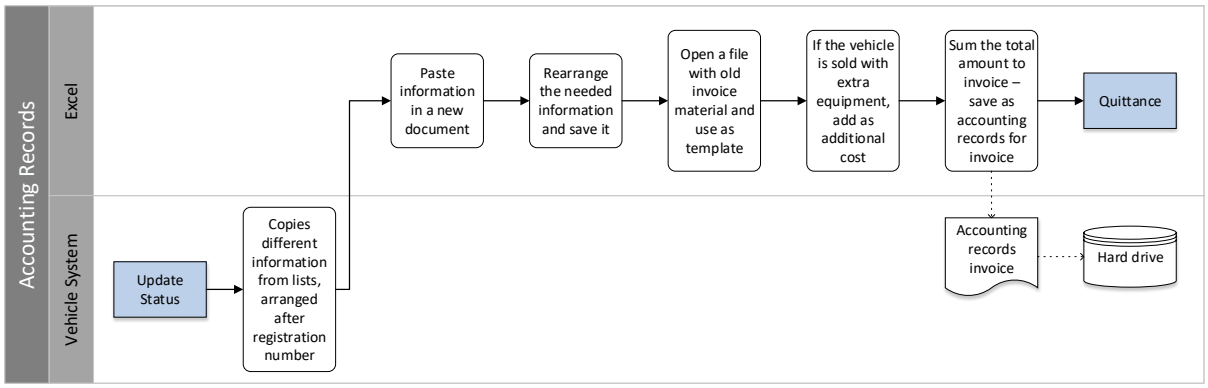

Figure 34. The subprocess Accounting records.

Quittance

When the accounting records for the invoice is created the process for making the quittance can start. A snapshot of the inventory value is pasted into a new page in an excel file with all the inventory activities performed during the same month. The difference between the new and old inventory value is calculated, see Figure 36. The quittance is made to ensure that the amount calculated on the record is the same as the value on the accounting record, with the additional cost excluded. If the sum on the record would differ from the quittance sum, the accountant needs to investigate what has occurred.

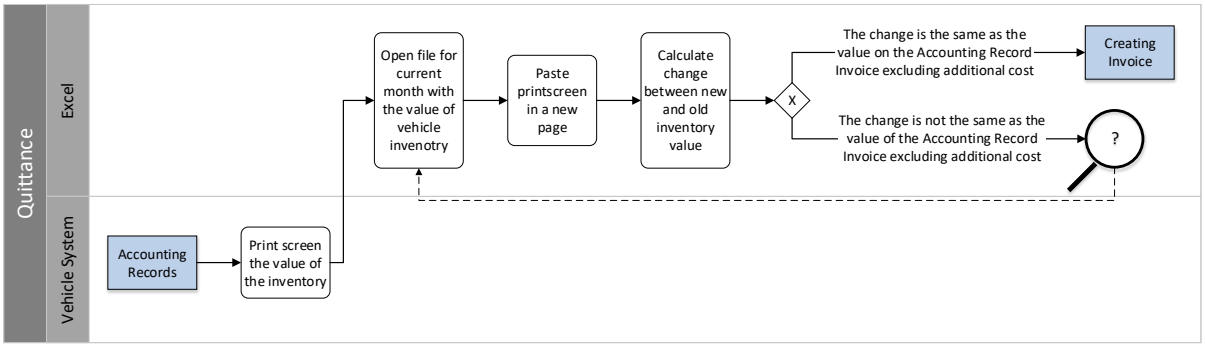

Figure 35. The subprocess Quittance.

Creating Invoice in ERP System

The last subprocess is to create the invoice based on the previously made accounting records, quittance and, if additional costs exist, the disposal form. The invoice is created in the ERP system, see Figure 37. In the creation of the invoice the receiver, the car dealer, and the sender, Volvo, is entered. Information regarding which account and profit centre that will be affected is also entered. The profit centres correspond to the receiver of the payment. The amount billed on the invoice is the total amount of all the vehicles as well as administration cost and possible additional cost.

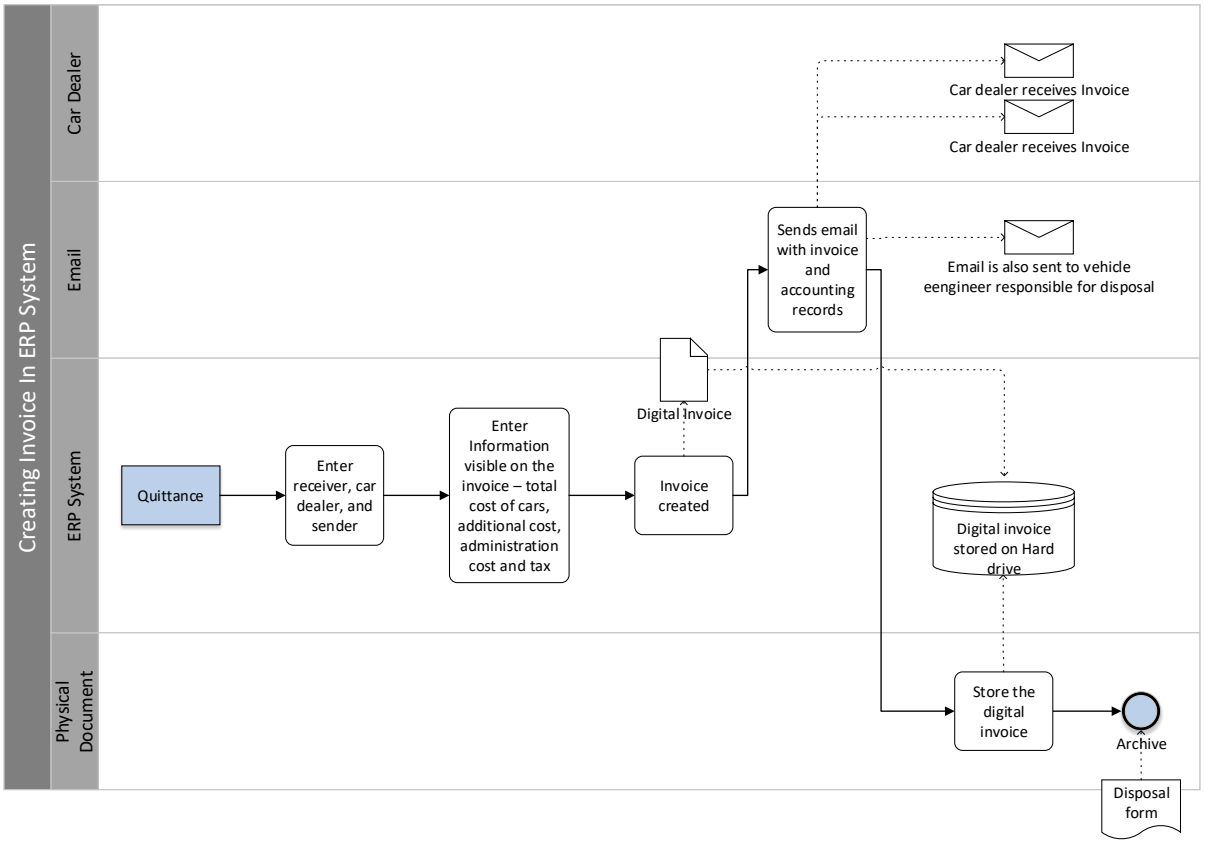

Figure 36. The subprocess Creating invoice in ERP system.

When all information is entered, the invoice is saved on the hard drive. The invoice and the accounting record are then emailed to two persons at the car dealer and to the disposal vehicle engineer. The disposal form, used at the beginning of the process to know which vehicle that is sold to the car dealer and possible additional costs, is sorted according to the identification number and archived in the binders behind corresponding order form.

Creating Invoice to Dismantler and Recycler

Since the processes for creating invoices to the dismantler and the recycler is similar, the processes are described together. The difference between the processes is that recycler sets the price of the recycled vehicles while Volvo sets the price for vehicles being dismantled. The subprocesses are: C*hange status of vehicle, Quittance, Creating accounting records, Change value accounts* and *Creating invoice*, see Figure 38.

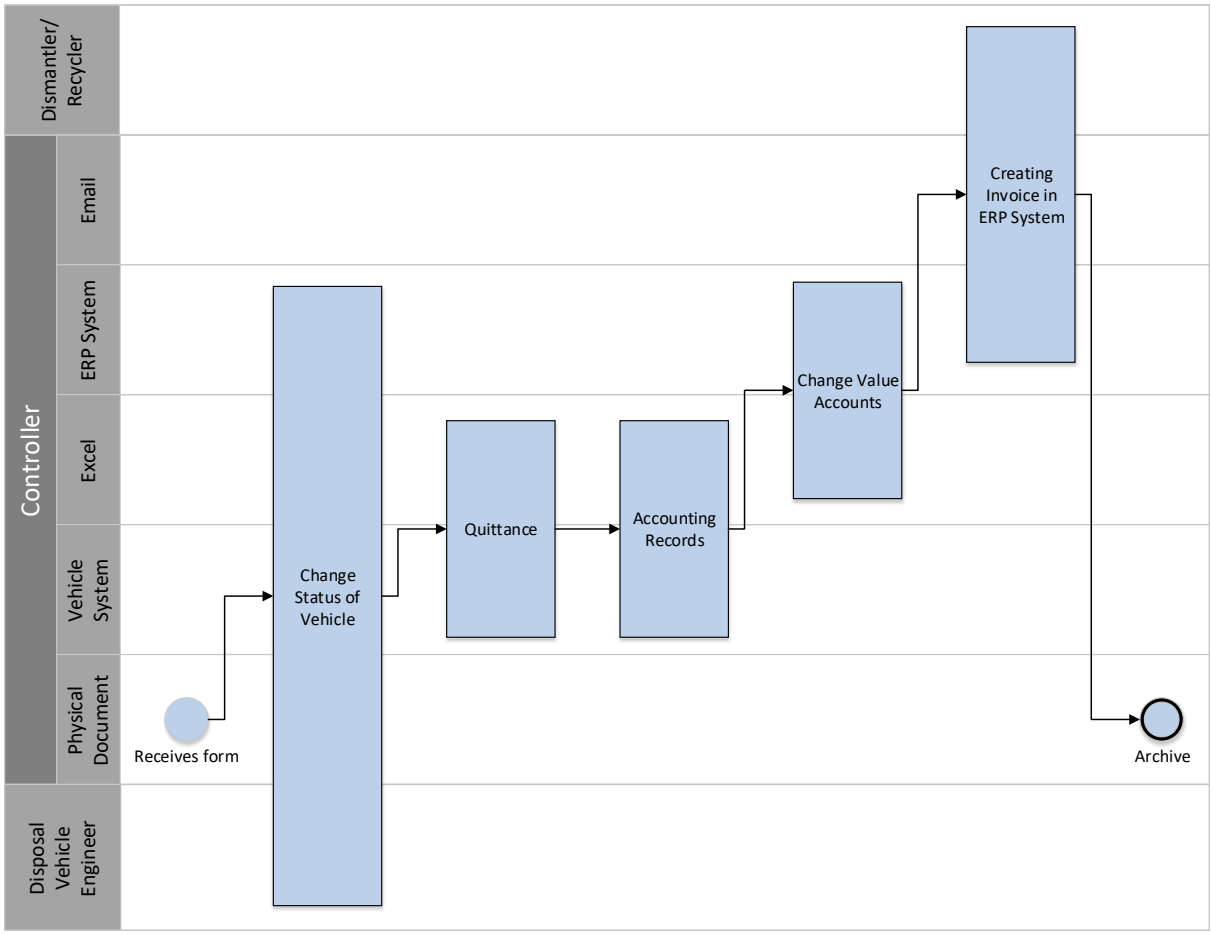

Figure 37. Overview of the process Creating invoice to dismantler and recycler. Change status of vehicle, Quittance, Accounting records, Change value accounts, Creating Invoice in ERP system are subprocesses within this process.

Change Status of Vehicle

The first step when creating the invoice is that the controller tries to find the vehicle in the vehicle system. This is done by searching on an identification number stated on the disposal form. To confirm that it is the right vehicle, the controller also checks that the registration sign and chassi number is the same as on the disposal form. To dispose a vehicle to the dismantler or the recycler the value of the vehicle must be lower than a predetermined value. For vehicles with a value below the limit, the status in the vehicle system can be changed to "disposed", see Figure 39.

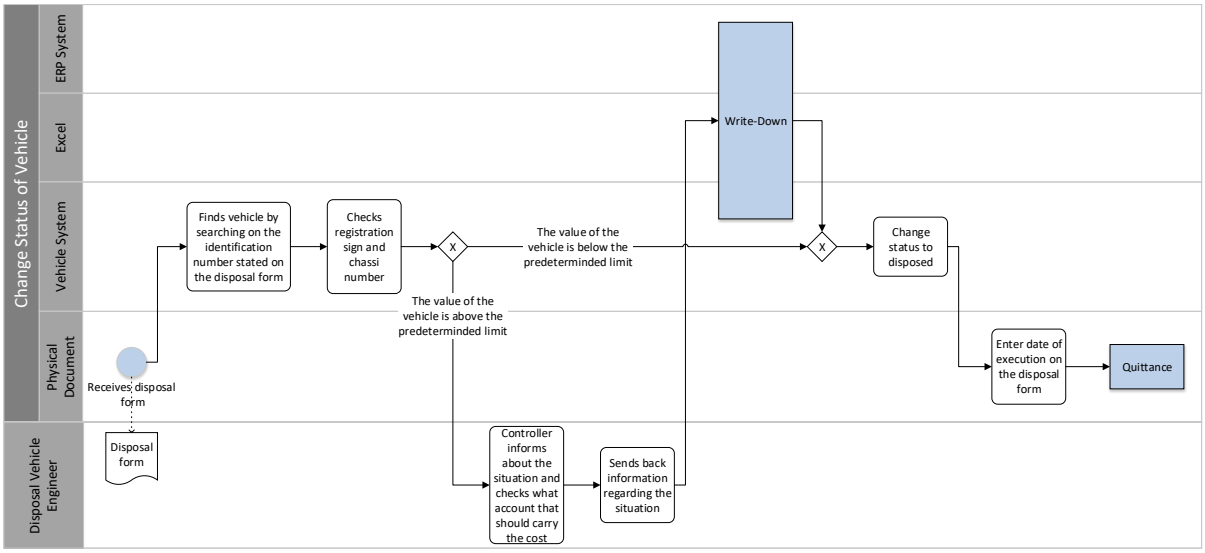

Figure 38. The subprocess Change status of vehicle.

Values with a higher value than the predetermined value forces the controller to contact the disposal vehicle engineer to receive information regarding what account that should be carrying the cost. Then the controller writes-down the value of the vehicle, so the value is the same as the pre-determined value or lower. The process for performing a write-down is described in detail in *4.3.1 Update value of vehicles from production – Write-down*. The status of this vehicle is then changed to "disposed" in the vehicle system, and the date of execution is entered on the disposal form.

Quittance

When the statues of the vehicles are changed in the vehicle system the next step for the controller is to create the quittance, see Figure 40. This subprocess is similar to previously mentioned Quittance, *4.4.5 Creating invoice – Quittance*, but with the purpose to calculates the value of the change in the vehicle system to be able to update the ERP system.

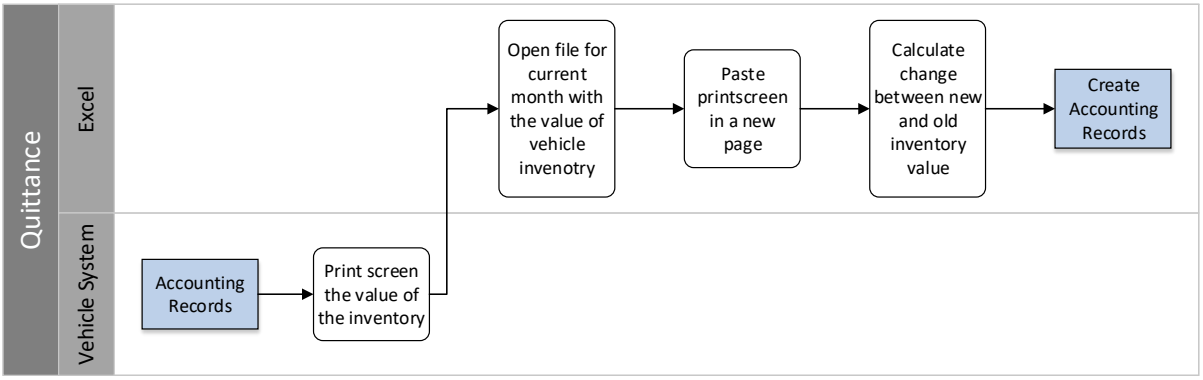

Figure 39. The subprocess Quittance.

Accounting Records

When the quittance is finalised the accounting records to update the ERP system and for the invoice can be created. This is done by the controller. It starts with copying information from the vehicle

system regarding vehicles that have been disposed at the specific date. The information is pasted and arranged in a new excel document, see Figure 41. Depending on dismantler or recycler different information is needed, meaning different information is pasted in the two cases. In the case of the dismantler, an old document used for invoices are opened as a template. The accounting record is also sent to the dismantler, in the process of creating the invoice to dismantler.

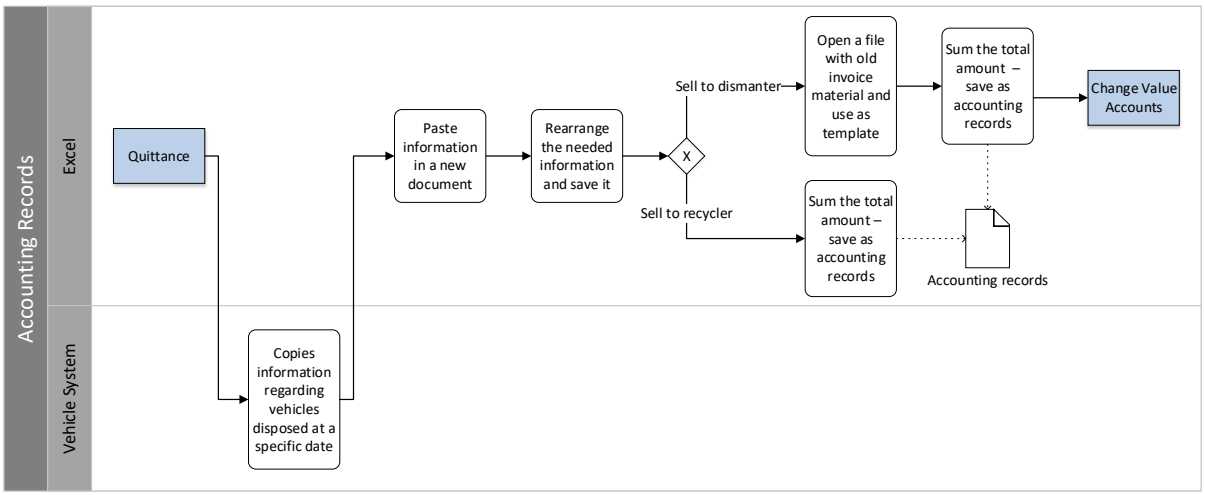

Figure 40. The subprocess regarding Accounting records.

Change Value Accounts

The process starts with that the controller credits the account for the internal vehicle and debit the expense account with the same amount, see Figure 42. From the transaction in the ERP system, a documentation number is created. The accounting record is named after this documentation number together with the date. The document is uploaded as an attachment to the booking in the ERP system as well as saved on the hard drive.

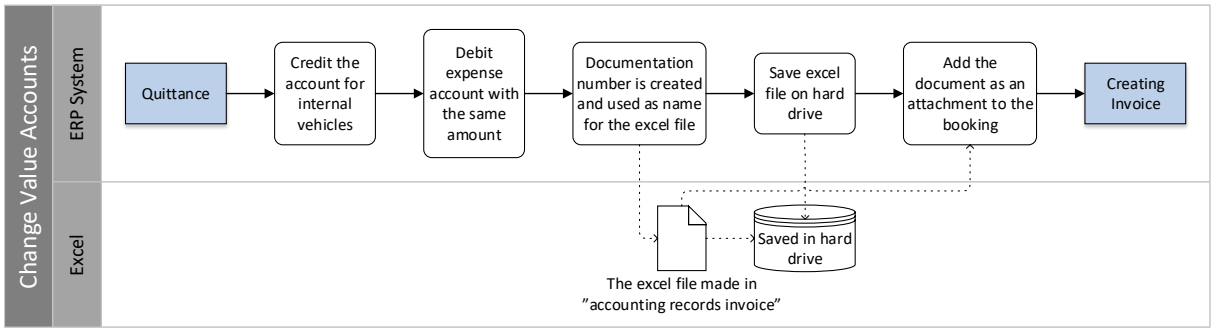

Figure 41. The subprocess Change value accounts.

Creating Invoice in ERP System

In this subprocess, the invoice is created in the ERP system. The information that is needed for the invoice differs in the cases of creating an invoice to the recycler or to the dismantler. In both cases, there is a need to state the name of the sender and receiver. In the case of the recycler, the controller receives an email with a basis for the cost, and this cost is then entered on the invoice, see Figure

43. In the other case, creating an invoice to the dismantler, Volvo decides the price, see Figure 44. It will also be stated in the ERP system to which profit centre the invoice will be paid to.

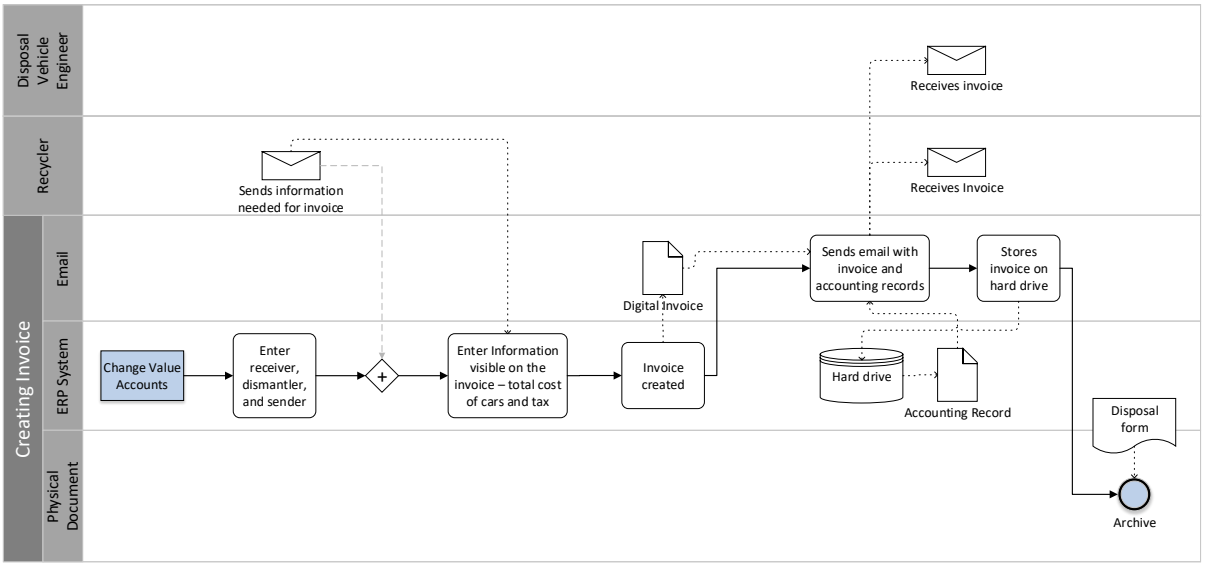

Figure 42. The subprocess Creating invoice to the recycler.

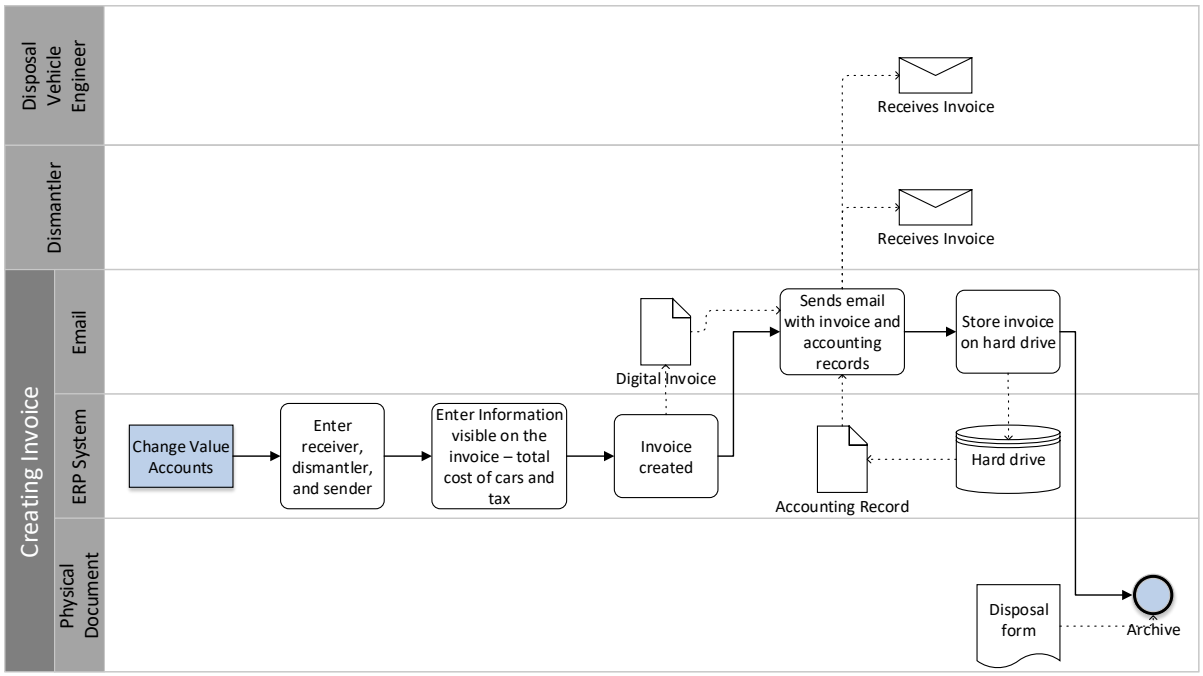

Figure 43.The subprocess Creating invoice to the dismantler.

The invoice and the accounting record is sent by email to the dismantler and to the disposal vehicle engineer. In the case of the recycler, the invoice is only sent to the recycler. In both cases, the invoice and accounting records are stored on the hard drive. The disposal form is sorted according to the identification number and archived in the binders behind corresponding order form.

4.4.6 Statistics

Information about the usage of the three disposal alternatives is presented in Figure 45 and 46. Figure 45 illustrates the spread of the disposal alternatives during the last five years. In the year of 2013, most of the vehicles disposed of were sold to the car dealer, while the recycler and dismantler received approximately the same number of vehicles. In 2014, selling the vehicle to the car dealer was still the most common alternative, but the dismantler received more vehicles than the recycler. The car dealer and the dismantler received about the same number of vehicles in 2015. However, in 2016 the car dealer changed the tendency to decline in percentage for a year, then it was reduced even further in 2017. The dismantler had an opposite experience, as 2016 was the year the tendency to increase was disturbed. The recycler has had a steady increase in per cent all five years. In 2017, the dismantler received the most while the car dealer and the recycler received almost the same amount.

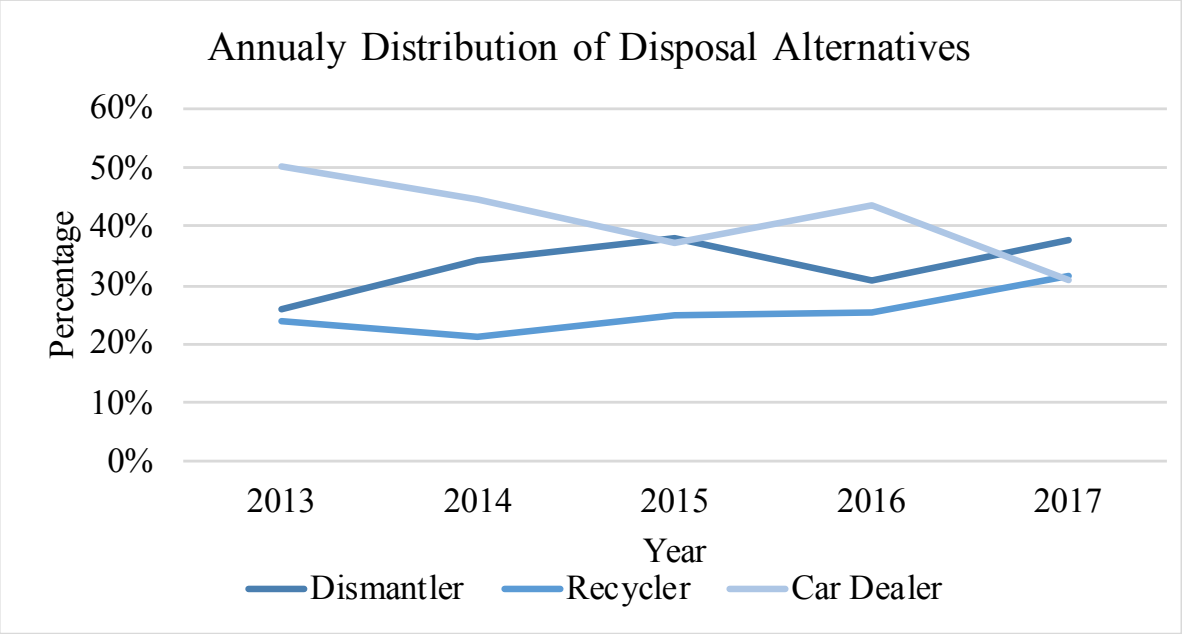

Figure 44. The annual distribution of the disposal alternatives.

Figure 46 illustrates the total per cent of the vehicle that has been disposed of during the five last years. Even though the trend for selling the vehicle to the car dealer shifted over the years, it is the most common disposal alternatives for the internal vehicles at Volvo. In the period, 41 per cent of all the disposed vehicles were sold to the car dealer while the dismantler received 33 per cent and the recycler 26 per cent.

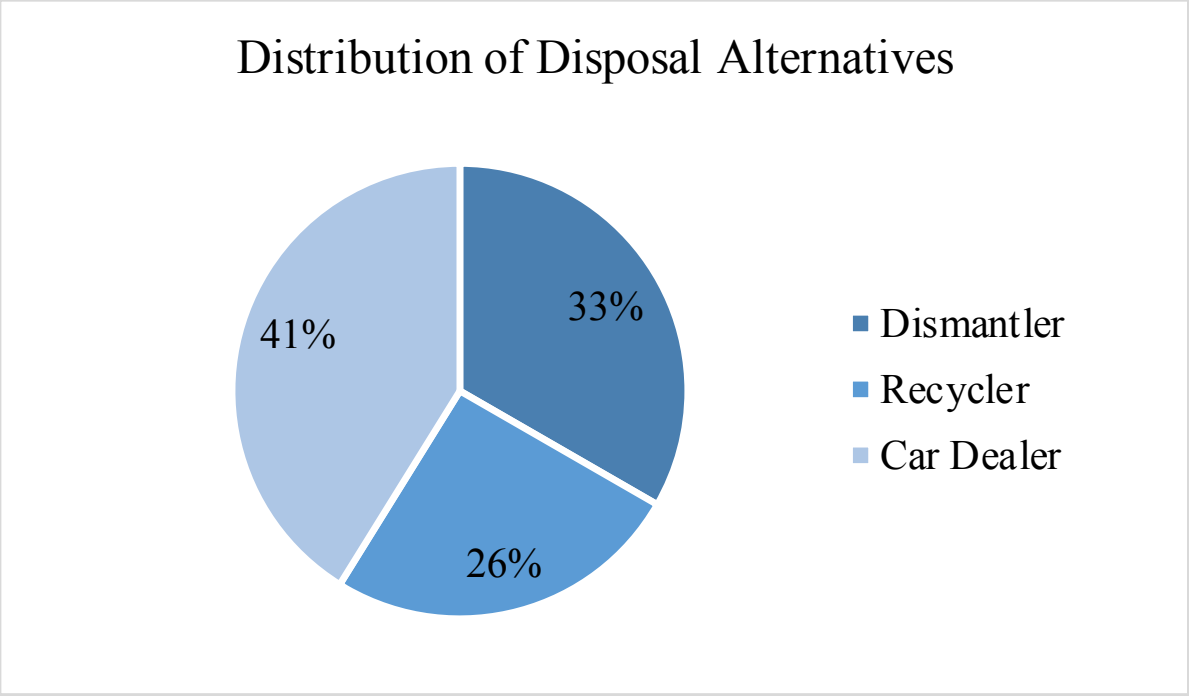

Figure 45. Distribution of the disposal alternatives over a five years period.

There are some different thoughts regarding the disposal of vehicles. One of the interviewees, a vehicle leader, had the opinion that a vehicle after it is used could be saved for future need even if the needs was not yet stated. This is somewhat contractionary to information gathered from another interviewee, the vehicle owner, who had the opinion that a vehicle should be disposed of as soon as a vehicle does not meet any needs at Volvo. Nevertheless, after completed usage, it should be investigated if there is a need for the vehicle by someone else at Volvo. This to maximise the usage of an existing vehicle instead of ordering a new one. The vehicle should not be retained just in case a future need could occur. The needs must exist at the same time as when the vehicles earlier purpose has come to an end, was the view of the vehicle owner. Otherwise disposed of. It was also implied that the best disposal alternative, in an economic perspective, is to sell the vehicle to a car dealer. Though, is not always possible. An internal vehicle can have been exposed to a test that has caused impacts on the vehicle, which cannot be fixed by the workshop at Volvo, and therefore cannot be sold on the second-hand market. The vehicle is then sold to either the dismantler or the recycler.

5 ANALYSIS

The purpose of this chapter is to provide a deeper understanding of the current process and what is required to deliver value to the stakeholder, to lay the foundation for a new improved process. Firstly, the process of *Handling internal vehicles* is analysed according to the subprocesses: *Ordering of internal vehicles, Use of internal vehicles* and *Disposal of internal vehicles*, and the value the included activities create. This is followed by an analysis of the roles, interest or needs the stakeholders have.

5.1 Current Process of Handling internal vehicles

In this section, the processes *Ordering of internal vehicles, Use of internal vehicles* and *Disposal of internal vehicles* is analysed with the focus on what activities that adds value as well as what adds time to the processes. This provides another level of understanding and serves together with chapter 4 to answer the first research question:

- *What does the current process of Handling internal vehicles look like?*

An overview of the roles existing in the *Handling internal vehicles* is presented in Table 5, with the respective main activities in each subprocess. An individual participant can take on more than one role, for example could the vehicle engineer also be the user of the vehicle or the vehicle leader the one to fill out the form, thus taking on the role vehicle engineer.

Table 5. The roles in the different subprocesses and the main activities connected with the role in the respective subprocess.

Role	Process	Main activities
Vehicle Engineer*	1. Ordering of internal vehicles 3. Disposal of internal vehicles	1. Fill out the Order of internal vehicle form 3. a) Decide what to do with the vehicle. When needed b) fill out the disposal form for sale or c) change project/ division responsible
Project Leader*	1. Ordering of internal vehicles	1. Fill out the Order of internal vehicle form
Vehicle Leader (VL) *	1. Ordering of internal vehicles	1. a) Confirm vehicle is needed and b) forward the order to the VL-meeting
Manager	1. Ordering of internal vehicles 3. Disposal of internal vehicles (Used in another test)	1. Approve costs connected with the order of internal vehicle 3. Approve taking over the cost of the vehicle
Responsible for finance	1. Ordering of internal vehicles	1. Approve the cost of the order
Administrator	1. Ordering of internal vehicles	1. Upload the agenda and the protocol of the VL-meeting
Vehicle Owner	1. Ordering of internal vehicles 2. Use of internal vehicles	1. Acknowledge/Approve the order 2. Be the legal owner of the vehicle

Disposal Vehicle Engineer	3. Disposal of internal vehicles	3. a) Fill out the form 'Disposal' for scrapping, b) secure delivery of vehicles, c) fill out copies of transportation and d) change ownership or control registration is gone
Order handler*	1. Ordering of internal vehicles	1. Place the order
Controller	1. Ordering of internal vehicles 2. Use of internal vehicles 3. Disposal of internal vehicles	1. Participating in VL-meeting and receives an order form. 2. a) Update value of internal vehicles, b) sort and archive documents, and c) responsible for the external costs 3. a) Creating invoices and b) sort and archive order forms
Volvo Representative	3. Disposal of internal vehicles	3. a) Loading of the vehicles and b) brings the order form and copy of transportation
Dismantler/recycler/car dealer	3. Disposal of internal vehicles	3. Unregisters the vehicle
Transport provider	3. Disposal of internal vehicles	3. a) Provide transport, and if sold to dismantler b) signs the disposal form on behalf of dismantle
Vehicle inspector	3. Disposal of internal vehicles (To authorised car dealer)	3. a) Control the vehicle and b) take away Special driving dispense
User*	2. Use of internal vehicles	2. a) Performs tests or b) marketing events
Workshop	3. Disposal of internal vehicles	3. Control and updates the vehicle

** Specific person can have multiple roles*

Lastly, one observation from the interviews was that people generally were aware of the activities in the parts they were participating in, but lacked the knowledge regarding the whole process, mentioned by Dumas et al. (2013) as the fragmented process knowledge. There were some interviewees who had broader knowledge and acted as a bridge between narrow domain experts. In the case of the order form, people lacked knowledge regarding when a specific signature was needed and relied upon that one specific person, the vehicle owner, would know. The vehicle owner did possess the knowledge. Nevertheless, any process where some knowledge is captured in few people becomes depended on those people and could be considered a risk. To make the process leaner and perform value-adding activities, it is important to know what happens in the other parts of the process as sharing information can increase the performance (Yu, Yan and Cheng 2001; Rafaeli and Ravid 2003). It is difficult to work effectively towards the same goal without knowing what the others do. Communication and information sharing can help the individuals as well as the company.

5.1.1 Order of Internal Vehicles

The purpose of the process *Ordering of internal vehicles* is to fulfil a need of an internal vehicle within Volvo Cars. This is done by providing the user with an internal vehicle. The internal vehicle

will be used in helping Volvo to deliver value to its customers, by developing better cars, as well as revenue to the company due to marketing. In the process *Ordering of internal vehicles*, the value-adding activities are:

- **Fill out the order form** – It describes what the user wants and for what purpose.
- **Discussing if other vehicles could be used** – It can lead to the user receives an existing internal vehicle and thereby fulfils the need.
- **Approval of the order** – The consent to carry the cost is necessary for the order to be placed.
- **Place the order** – The internal vehicle will be manufactured.

These are the activities that bring the process closer to fulfilling its purpose. Moreover, there are also activities performed in the process that are considered business value-adding. These activities have been categorised in the two types presented by Dumas et al. (2013): business value-adding in the sense of helping to bring value in the future and business value-adding forced by laws, management or specific functions. The activities identified as helping bring value in the future are:

- **Asking questions if the vehicle is needed** – Reduces the risk of unnecessary vehicles are ordered, which saves resources that could be spent helping Volvo Cars increase value to customer or revenue returned.
- **Store the order forms in the protocols of the vehicle leader meeting** – If an issue would arise regarding an order, it can easily be followed what was concluded at the meeting.

While the imposed business value-adding activity is:

- **Approval by signature** – For an approval to be considered valid, a physical signature is required from the person who approved the decision.

The activities will be further analysed. Firstly, the activities connected with the order form will be explored, then activities connected with the vehicle leader meeting and place the order.

The Form

It is understood from the interviews that the change in economic market situation and owner of Volvo Car Corporation has affected the process *Ordering of internal vehicles*. The form has, however, not always followed the changes as can be seen by the lines on the form that is not used when filling out the order form. This can be related to what Dumas et al. (2013) say regarding design and how the design can be based on needs or requirements that no longer exists, leading to non-value adding activities and inefficient processes.

Connected with filling out the order form is that some people download the order form. If the form is stored on personal computers, it can be saved with personal standard information filled out every time, which saves time for the person filling out the form. However, the downloaded order forms will not be updated with the changes in the original form on the database, and thus increasing the time it will take to implement changes.

The form is printed into a physical document because it requires signatures to be valid, which is one of the reasons Olson (2012) mentions. The need for signatures is also one of the reasons for the time-consuming process. Olson (2012) also discuss how the document could be scanned after being signed, as a way of fulfilling the need for signature but reducing the time-consuming activity of archiving physical documents. Volvo, on the other hand, saves the unsigned forms as text documents on an archiving database as well as the signed physical documents in binders. The text document of the unsigned form is supposed to be archived and saved, even though the signatures are not there, due to being on the physical order form. It could, therefore, be questioned what purpose the text document serves.

As an attachment to the VL-meeting protocol, the text document is easy to find, as well as what was decided regarding the vehicle and when it was decided. This is mainly possible because of the titles on the agenda items in the protocol and not the name of the text document, due to a limitation in the database's search function. Wilkinson et al. (1998) write about associating data objects with a unique document number to structure the archiving in an easy way. In this case, it could be interpreted as the agenda items are the data objects that need to be properly named, and not the text document, to ease the archiving and finding. The information added in the protocol regarding if the order was approved or not, could be seen as equivalent with the signature of the vehicle owner. The other signatures are, however, not present, and the text document cannot replace the physical one today.

It is common that an order form to consider multiple vehicles. It is easier for the person who fills out the order form to just state all the vehicle identification numbers on one form instead of having one form for each vehicle. This results in more work for the controller since the controller needs to copy the order form to have one order form for each vehicle. According to the statistics, multiple vehicles is generally the case and therefore the controller needs to perform the extra work often, prolonging the process. Overall, the vehicle engineer or project leader tries to perform the filling out in a more efficient and easy way but are probably not aware that it results in more work for the controller. This could be an example of employees who are involved in the process for internal vehicles do not know what other employees' tasks are within this process.

Vehicle Leader Meeting

When considering the process of *Ordering of internal vehicles,* one of the purposes of multiple signatures and steps are to ensure no unnecessary orders goes through. Volvo strives to ask questions before a vehicle is ordered, because producing a vehicle costs as well as it occupies a spot in production where a car for an end customer could have been, which would generate a direct income. The first level of defence is the vehicle leader questioning the responsible vehicle engineer if no other known vehicle could be used. Validating the need of a vehicle. There is a second level of defence at the VL-meeting, where the vehicle leaders answer the vehicle owner's questions regarding the necessity and discuss if another internal vehicle could be used.

From observing the protocols of the ordered vehicles, it becomes apparent that orders are approved at the VL-meeting. No order was rejected in the observed time period. This concurs with what an interviewee said about the meeting; that the meeting is a place where the vehicle owner becomes aware of the vehicles the vehicle owner is responsible for. Nonetheless, it is still believed when describing the process that rejection can occur. A reason for orders being approved at the meeting

could be that the division, which would carry the cost, has accepted the cost of the vehicle prior to the meeting by signing the order form. In the case of a saleable vehicle for R&D, the cost is approved, or not approved, by the vehicle owner at the meeting. Nevertheless, no unnecessary vehicle should be ordered.

The statistics of orders revealed that the marketing department orders the most vehicles. Marketing is a department where time is of the essence. Having an old model when releasing a new is not considered good marketing. Therefore, the vehicle leader at the marketing department has the authorisation to order internal vehicles and can order vehicles in advance, as the VL-meeting only occur every second week. According to the statistics, 74 per cent of all the vehicles ordered are from the marketing. This means that 74 per cent of all vehicles discussed at the meeting could already have been ordered before the meeting, which questions the necessity of the discussion at the VL-meeting.

Place Order

Another effect of the vehicle leader of the marketing department has authorisation to place orders is that a specific person to place the order is not needed. It is likely that the marketing departments vehicle leader have more knowledge regarding the order than the separate order handler, which reduces the need for contacting the vehicle engineer and ask for information when issues in the specification and thus reduces activities and the time for placing the order.

5.1.2 Use of Internal Vehicles

Here the subprocesses *Update value of vehicles* and *Handling external costs* will be analysed. The *Update value of vehicles* gives the company an overview of its vehicle fleet's value, allowing for a better and more precise govern of the assets, as basing decisions on facts can increase the performance of an organisation (Hellsten and Klefsjö 2000; Bergman and Klefsjö 2011). This, in turn, could help the company to deliver value in the future, which is one of Dumas et al. (2013) definitions of business value-adding. Therefore, the processes *Update value of vehicles* can be seen as business value-adding processes. When considering the handling of external costs, it is paying for services that have been or will be used. The usage of the internal vehicle generally serves to increase the value of Volvo Cars products or revenue. Paying the invoice on time also helps the company deliver future value by not receiving extra cost or bad publicity through reminder fees or ending at the Swedish Enforcement Authority or court. Some of the steps in *Handling external costs*, as well as in *Update value of vehicl*es, could be defined as business value-adding by the other definition by Dumas et al. (2013), as the activities are related to laws and internal accounting policies.

Update Value of Vehicles

The purpose of *Update value of internal vehicles from production* and *Update value of development vehicles* is to keep the value of the vehicle fleet updated with the correct value. This allows Volvo Cars to base decisions on facts and better maximise the company's value creation and revenue. The processes can be defined as business value-adding, and the activities that add value to fulfil the business value-adding process are:

- **Update the value to the systems** – It is first when the value is updated in the vehicle system or right account in the ERP system that it adds value.

- **Ensure the value is correct** – Needs to be the correct value entered for the purpose to be fulfilled.

As the process is business value-adding, the business value-adding activity classification becomes useless. However, the activities are performed by the controller that could add future value to the controller. These activities are named controller value-adding activities and are following activities:

- **Saving all emails** – Can easily follow up events if needed.
- **Sorting the order forms** – Having the order forms sorted makes it easier to find specific order form when needed.

The process also includes activities imposed by laws and internal policies, which are:

- **Upload accounting records to the ERP system** – This provides the basis for why a transaction occurred.
- **Copy an order form for several vehicles** – Each internal vehicle needs to have its own order form.

The activities will be further analysed, starting with the number of tasks needed in the activities. To update the value of the vehicle fleet, the information needs to be transferred between the two systems, the vehicle system and the ERP system, and verify that the information transferred in between is correct. Several systems and programs are involved when the controller performs the activities. An activity generally consists of swapping between different programs, systems or physical document. This is due to the information needed are separated in different systems, text document and emails, which do not communicate with each other, as well as physical document. Some of the physical documents used are text documents or emails printed to make the work of the controller easier, whereas others are the only source of information. The lack of communication between the information sources leads to manual transfer and updates of the vehicle value, which consists of several tasks.

The purpose with the two processes *Update value of vehicles from production* and *Update value of development vehicles* are the same, but the processes differ in regard of some activities and others in the order performed. When tasks are performed in different ways, it can lead to inefficiency due to waste (Slack, Brandon-Jones and Johnston 2013), which is not wanted as it delays the update the value in the systems.

To ensure the value is correct and reduce the risk of finding discrepancy later, value-adding activities as verification or control are performed. One should try to find the problem as soon as possible after it occurs because the longer the problem has existed, the higher the cost to fix. The suspense account is a measure to reduce the risk of problem happening. Another activity that serves to control that the amount is correct is the quittance. The quittance is, however, based on work that was done last time and it, therefore, becomes important that everything was performed correctly and saved last time. Making the human error a factor to consider (mänskliga faktorn n.d.).

When updating the value of development vehicles, lists with one-month overlap are used. This is to check if a vehicle was not updated last time and to update new vehicles, meaning the activities serve both as a control and a way to transfer the value between the system. The tasks are performed manually, indicating the involvement of the human error. Nonetheless, the vehicles missed last time could have had the wrong status at that point and not an effect of human involvement. Vehicles with the wrong status, on the other hand, lead to other risks, as the update of the vehicle is dependent on the controller's memory to remind the vehicle engineer to change it and the vehicle engineer memory to change it. A similar risk exists when internal vehicles used for development, so-called development vehicles, are ordered from production and the controller must postpone the activity of updating the value. Asking for information regarding cost centre as well as changing status adds time to the process, and in the meantime, the value in the system is not correct.

Even when updated, it is questionable to what degree the value is useful as some of the vehicles are set to a specific value. It could be that the set value is calculated in a way that the income from the vehicle is somehow represented. But the impression during the interviews was that the set value had been the same for a long time and thereby not updated to the current market.

The archiving of the different information varies. The daily emails regarding Updates or No updates are saved as emails. This is, according to the controller, not due to policies but rather a security measure. If a problem would occur, the history of daily mail could easily be followed and accessed, and as the information is as text in the email and not in an attachment, there is less risk of difficulties accessing the information later (Olson 2012). In the case of an email with the value of factory complete vehicles from production, that information is stored in up to three media and four places; as an email in Outlook, text document on the hard drive, text document uploaded in the ERP system and sometimes as a physical document in binders. It is understandable that accounting records must be saved, however, several copies are not required.

All order forms are stored and archived in binders. If multiple identification numbers are stated on the form, the order form is copied into the same amount of copies as the form is used for. The sorting of the order forms is based on the identification number, and the task is highly time-consuming. However, as the disposal form of each vehicle needs to be put together with the order form, it saves time when archiving the disposal forms.

Handling External Costs

This process is also classified as business value-adding, as it is paying for activities connected with the usage. The activities that add value to the business value-adding process are:

- **Enter the invoice to be paid in the ERP system** – The invoice needs to be entered into the system for it to be paid.
- **Enter the invoice to be paid on time** – Paying the invoice on time eliminates reminders fees, money that could be spent elsewhere.

Apart from these activities, there are three activities that could be qualified as business value-adding as two support the two activities above and the last controls the expenses of Volvo Cars:

- **Coping the invoice** – Makes it possible to send the invoice to the external organisation which enters the invoice.
- **Enter the invoice to be paid in the web-based accounting system** – The invoice needs to be entered into the system for the internal divisions to know what to be paid.
- **Sorting the invoice after usage** – Expenses generated when the vehicle used privately are carried by the private user, which reduces the risk of Volvo paying for activities that did not bring value to the company.

Then there are activities connected with regulations and policies, which are:

- **Upload of a document to booking in the ERP system** – This provides the basis for why a booking occurred.
- **Archiving of the physical document** – Financial information needs to be saved.

When the internal vehicle is in use physical documents are generated, mainly as invoices. Some of the invoices are for necessities for the vehicle to be used, while others are from the vehicle being driven. The controller trusts the organisations sending the invoices and secures the payment is entered into the ERP system without analysing the source of each cost. The high number of bills is most likely also an effect, as it would be time-consuming controlling each.

The invoices are handled differently depending on the source of the invoice, however, nearly all invoices are scanned at some point. Invoices are classified as financial information, and the archiving will be discussed in *5.1.4 Archiving*.

5.1.3 Disposal of Internal Vehicles

Here the process for disposing of the vehicle will be analysed. The purpose of the process is to either find a new internal area of usage to increase Volvo's delivered value, or to dispose of the vehicle externally to generate income. In the case of the vehicle is sold, an invoice needs to be created to receive the income. In the process there are some activities that add value, which are:

- **Discuss what type of disposal –** Maximises the value or income.
- **Fill out the disposal form** – It states what should be done**.**
- **Transportation of the vehicles –** The vehicle needs to be transported to the disposal company.
- **Control that vehicle in is approved condition –** Vehicle needs to be approved to drive on roads for it to be sold to the car dealer.
- **Owner of the vehicle is changed** – Needed to be able to create the invoice to the car dealer and receive the income.
- **Create and send the invoice** – Informs the disposal company the amount to pay and when.

The activities that can be classified as business value-adding with the possibility to add value to Volvo in the future are:

- **Control that the vehicle is unregistered, or special driving license was taken away** – Reduces future problems and resources needed to fix.

- **Correct cost centre for the vehicle** – Allows the cost to be correctly charged to the user and thus better grounds for management.
- **Sorting disposal forms** – Having the disposal forms sorted makes it easier to find specific disposal form if needed.
- **Calculate correct value to invoice** – Reduces risk of lost income or disputes.
- **Update value of internal vehicle fleet** – Allows Volvo Cars to base decisions on facts.

Two of the activities in the disposal process are imposed business-value adding by regulation and policies:

- **Physical disposal form** – Needed to receive signatures from scrapping company or stamped that changed owner.
- **Upload accounting records to ERP system** - This provides the basis for why a transaction occurred.

A vehicle can be disposed of in four different ways; Volvo finds another purpose for it and keeps it, sell the vehicle to a car dealer or scrapped either by a dismantler or recycler. The three last are connected with creating the invoices and serve to generate income to Volvo.

Depending on alternative, the processes look differently. Moreover, the disposal form is filled out by different participants depending on alternative, even if the same form is used, indicating the processes are not standardised.

After a vehicle has been disposed of to an external party, the controller needs to create an invoice. The time between the vehicle leaves Volvo to the invoice is created could be quite long, mainly due to prerequisites for the controller to be able to create the invoice. In the case of dismantling, the controller will generally receive the form before it is possible to create the invoice. This is because the disposal vehicle engineer has not been able to change status in the vehicle system due to the vehicle has not yet been unregistered by the dismantler. Indicating the controller needs to wait before creating the invoice, and when creating the invoice, there might still be vehicles that do not yet have the right status, which adds extra time to the work. In the case of the recycler, this problem is less likely to occur, as the vehicle has already been unregistered by the recycler when the controller receives the form. Thus, increasing the chance that the disposal engineer has changed the status already as well. In the case of vehicle sold to the car dealer, it should not occur at all as the form is delivered from the disposal vehicle engineer after needed activities are performed.

Disposal Statistics

In *4.4.6 Statistics* the disposal alternatives sold to an authorised car dealer, scrapped by a dismantler and scrapped by a recycler are presented. It should be highlighted, that if a vehicle, that could be used internally, is disposed of externally, a similar vehicle needs to be ordered to fulfils the needs. This is generally a waste of resources because the vehicle sold could have a lower value than the cost of manufacture a new vehicle and it forces the production to postpone a customer order.

Overall most vehicles have been sold to the car dealer. Volvo probably strives for this since it should be the most cost-efficient way to dispose of a vehicle, as Volvo gains higher income from

selling a vehicle to the car dealer. However, the vehicle should probably be used internally if there is a need and the cost of ordering a similar vehicle is higher. An internal vehicle used for marketing purposes, are most often in good condition after ended marketing project and is therefore generally sold to the car dealer but could probably sometimes be reused internally as well. It is highly unlikely that a marketing vehicle would be sold directly to the dismantler or recycler, as it should be a saleable vehicle.

92 per cent of all vehicles ordered over the last three years were registered as saleable after usage, which is not coherent with the percentage sold to the car dealer in the same period. This is mainly because the development vehicles are not included in the process *Ordering of internal vehicles* and therefore not included in the statistic. The development vehicles are included in processes the usage and *Disposal of internal vehicles*, thus included in the disposal statistics. Prototypes of new models are probably not sold to the car dealer or to the dismantler since are confidential material. If these parts or vehicles is visible to the market or to a competitor too early, a lot of new development and invested money can be seen as waste. Therefore, it is more likely that the recycler disposes of most development vehicles, as the vehicle then is totally destroyed. This requires that the recycler is trustworthy and do not release secret information about the vehicles that are under construction and development. After the model is released, the choice of disposal alternative is not as critical.

Another reason behind the difference between saleable vehicles and vehicles sold to the car dealer could be that vehicle is used internally receives a new purpose, which turns the vehicle into not saleable. The new purpose could have been unknown at the point of ordering the vehicle, or the new purpose is part of the vehicle being reused. The first alternative would indicate poor information regarding the planned test, while the second indicates vehicle are reused and thus reducing the need for manufacturing a new vehicle.

Authorised Car Dealer

There are three things that are noticeable about the process disposing to the car dealer. Firstly, two different disposal forms are used indicating lack of consistency which can lead to inefficiency and waste (Slack, Brandon-Jones and Johnston 2013). Marketing has a separate form, something that probably is caused by previous organisation designs and process design, which is another source to activities and tasks that might not add value (Dumas et al. 2013). The slightly extra work for the controller due to has to deliver copies to the responsible person at marketing is such a task. Secondly, Volvo is trying to use electronic disposal form, which indicates that there is a strive to modernising the process and reduce time and paper. Having two different forms instead of one leads to alternative ways in the process and not a standardised procedure. Standardisation reduces the risk of errors and shortens the time as the participant do know what to do. Using electronic form implies that for Volvo an email could be equivalent to a physical signature. There could be a clause in the contract between the parties that allows it. The electronic form does not, in the end, reduce the number of papers and the administration work because the disposal vehicle engineer prints it before sending it to the controller.

Thirdly, the car dealer is not allowed to sell the vehicle until the invoice from Volvo has been received. Moreover, the vehicle has already been delivered to the car dealer and is occupying space at the yard that could have been used for saleable vehicles. The car dealer should, therefore, be

keen on reducing the lead time as much as possible, allowing the vehicle to be sold at an earlier point to the end customers. This could be one of the reasons why the car dealer has agreed to an email is a valid record.

Scrapping

In both scrapping alternatives, the disposal vehicle engineer fills out the form and turns it from a text document to a physical document. The form is signed by representatives from the disposal company at different stages. In the case of recycling, the forms are brought to the recycler while in the case of dismantling, the forms are signed by the transport provider at Volvo and brought to the controller afterwards, even though the transport provider delivers unsigned copies of the disposal forms to the dismantler. The transport provider in the first case is on order from the recycler while the other is ordered by Volvo. The transport provider ordered by Volvo to deliver the vehicles to the dismantler signs on behalf of the dismantler. Moreover, it could be discussed why the provider from the recycler cannot sign on behalf of the recycler, especially when the transportation provider is ordered from the recycler.

The reason behind why the recycler brings the form to the office could relate to the contract between Volvo and the recycler regarding pricing. Today, the recycler sets the price for each vehicle and to have the forms could be a part of the process of doing that. Having the recycler setting the price suggest there is trust between the parties. Nevertheless, there is a risk that the recycler sometime would value the vehicle to low. Independent of the reason why the form is brought to the office, it does add time until Volvo would receive the income from the disposal.

One important thing in the scrapping processes is the copy of transportation. That copy is a document of which vehicles have been scrapped and should have their statuses changed in the Vehicle system, a prerequisite for the controller to create the invoice. Without the document the disposal vehicle engineer would need to save that information somewhere else. However, when the statuses are changed the document no longer serve a purpose and is not archived.

Creating invoice

The controller receives the form in different stages of the process and has different criteria for creating the invoice. When the vehicle has been sold to the car dealer, the controller requires an indication of changed ownership of the vehicle on the physical document as well as changed status in the Vehicle system. In the case of vehicle been scrapped, only the changed status in Vehicle system is necessary. The extra “ownership changed” stamped on the form could be seen as a security measure of truly having changed the ownership, which is a must for the car dealer to be able to sell the vehicle. Nonetheless, the change of status in the scrapping alternatives indicates that the vehicle has been unregistered, which is also of importance for Volvo.

After the invoice is created, the controller needs to sort the disposal forms according to the internal vehicles identification number and adds it to the vehicles place in binders. This is done manually and is time-consuming.

5.1.4 Archiving

Most subprocesses end with an activity called archiving, storage of document and information. Archiving is needed both for bookkeeping purposes and for having control of the happenings of

the company. All subprocesses connected to the process of *Handling internal vehicles* generate some documents that are archived. Table 6 presents which subprocesses that generates which documents, and if the documents are archived physically or digitally.

Table 6. Documents connected to the process of Handling internal vehicles.

Documents to archive:	Physical:	Digital:
Ordering of internal vehicles:		
Order Form		X
Update Value of Internal Vehicles:		
3 Daily Emails with empty update, or mismatch, or no updates of factory complete vehicles		X
The daily email with the value of all updated factory complete vehicle	X	X
Order Form	X	
Excel file over inventory value		X
2 extracted lists of factory complete project vehicles	X	X
Handling External Costs:		
Vehicle inspections	X	
Insurances	X	
Deducible	X	
Congestion charges	X	
Other invoices	X	
Disposal of Internal Vehicles:		
Disposal Form Marketing (2 pcs)	X	
Disposal Form	X	X
Email from car dealer regarding received vehicles		X
Copy of transportation	X	
Accounting records		X
Invoice		X

As seen in the table, a lot of documents are archived physically. While some documents are also stored both physically and digitally. Today it is common to store document digitally on a hard drive and in a way that is easy to access (Hameed et al. 2015). If it is not easy to find the stored documents, the process becomes time-consuming and costly. Most documents archived, both physically and digitally, is not expected to be referenced to again at this point but might be needed for future needs (Olson 2010).

At Volvo, some documents are stored both physically and digitally with no purpose since the digital and physical copy contains the same information. During an interview, it was mentioned that some documents were stored even though Volvo does not require it. Therefore, as Olson (2010) mentions, it is vital to have some kind of policy regarding what to store, for how long and in what shape. It could also be important to include thoughts about the different phases mentioned by Olson (2010), to be more efficient in the archiving procedure. However, according to the Swedish Accounting Standards Board, an original copy regarding financial information needs to be saved at least seven years after existing financial year. If the physical copy is scanned into a digital copy, the original copy needs to be stored in its original shape for four years after excising financial year. Which can answer the question regarding why in some cases a document is stored both physically and digitally.

After an internal vehicle is disposed of the disposal form will be stored together with the order form, which requires to first find the order form in the right shelf and binder and then place the

disposal form together with the order form. This indicates that the archiving procedure is highly time-consuming. If a document is not archived physically, it is archived digitally. Most of the documents stored digitally are documents that are stored on the computer as a text document or as an email. When storing information both as a text document and as emails, there is a risk that the information on is non-accessible since the program needs to be updated and if the information is created in an older version it can be a risk that the information is non-accessible when needed in the future.

5.2 Stakeholders Interest and Needs

In this section the identified stakeholder will be presented in regard to the different subprocesses of *Handling internal vehicles*: *Ordering of internal vehicles*, *Update value of internal vehicles, Handling external costs* and *Disposal of internal vehicles*. The interest and needs of the stakeholder will be described and serve to answer the second research question:

- *Who are the stakeholders in the process of Handling internal vehicles and what are the stakeholders' roles, interests and needs?*

Some stakeholders have stakes in several of the processes, and Volvo Car Corporation is a stakeholder in all processes. It is Volvo Cars that sets the procedures and policies to follow, which directly affects the process. Volvos interest as a stakeholder is to increase the reputation, brand and customer base, in other words, increase the goodwill of the company. Improving the processes is also of interest, which probably will result in increased revenue and decreased cost connected to the process of *Handling internal vehicle*s.

5.2.1 Order of Internal Vehicles

In the process *Handling internal vehicles*, the first subprocess is *Ordering of internal vehicles*. The stakeholders for this process are production, people participating in the process, the planned user of the internal vehicle, Volvo Car Corporation and the customer of Volvo Cars, see Figure 47.

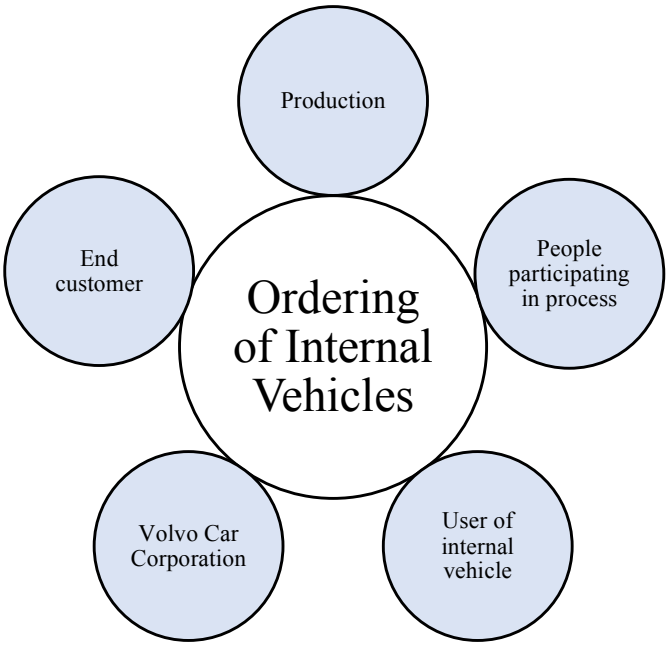

Figure 46. The stakeholders of Ordering of internal vehicles.

Production is affected by the ordering process due to manufacturing the vehicles. The user of the vehicle would often, due to R&D or marketing environment need for short lead time, need the vehicle shortly. This affects productions planning. Each spot in production for an internal vehicle means postponement of a car to the customer, which would have brought direct income. Therefore, it should be in the interest of production to receive few orders with good time margin. Some of the vehicles are used for the purpose of marketing, likely increasing the company's sales and thus the number of vehicles to produce. An increased production indicates that each spot in production becomes of higher value, as the competition increases. Implying even lower interest in receiving orders of internal vehicles. Nevertheless, if it would not have been for the internal vehicle used by marketing, not as many customers might have been interested. Therefore, production should be keen on manufacturing internal vehicle as well, particularly with good time for planning the production.

Four times a year some parts of the vehicles are changed. As a try-out, these new parts in vehicles are ordered as internal vehicles. The internal vehicle occupies spots in production, but production should be aware of the orders of the vehicles will come and see it as a possibility to try the new parts in production. It happens that vehicle with errors are manufactured and therefore cannot be sold to the customer. When this occurs, the vehicle must be "ordered" through the process *Ordering of internal vehicles*. The production might still carry the cost of the vehicle, but it could gain Volvo by finding other areas where the vehicle could be used or if possible be sold on the second-hand market. In this aspect, production could be considered a participant due to filling out the order form.

All participants in the process can be considered stakeholders due to perform the activities and tasks in the process and are therefore affected by the design and changes. The participants have various roles and supposed to perform different activities, therefore the needs and effect of, e.g. a

change can appear differently. The activities and tasks each participant performs should be easy to do and not take too much time, as this is not the main activity in the employment.

One role that has a high interest in the outcome of the process, an ordered vehicle, is the user of the vehicle. The user has a need to perform a test or a marketing event, where the vehicle is needed. The changes in the automotive industry are happening rapidly, and test needs to be performed with short deadlines to keep up with the marketing demand. The marketing department is responsible for events regarding promotions of new vehicles, these kinds of events have a strict deadline for when the vehicle is needed. It is in the interest of the user that the ordering process is short and that the vehicle is manufactured shortly after ordered.

The marketing department is one of the users of the internal vehicle. Volvo Cars has an interest in marketing department's activities as it becomes branding, showing new vehicles at different events. Volvo Cars also has the interest in the test performed as it helps to produce better vehicles, meaning good publicity, and reducing the number of call-backs due to safety or quality faults, which could generate bad publicity. Therefore, Volvo Cars sees the need for internal vehicles to be ordered and used. Closely connected with the performance of the vehicle is the customer. The customer wants a vehicle, which fulfils or exceeds the promised requirements.

5.2.2 Use of Internal Vehicles

In this section, the identified stakeholder will be presented for the second subprocess, *Use of internal vehicles*. Since this subprocess is divided up into two smaller processes, the identified stakeholder to each of them will be presented separately.

Update Value of Internal Vehicles

In the processes where the value of the vehicle is updated the stakeholders are the controller, Volvo Cars and the government, see Figure 48.

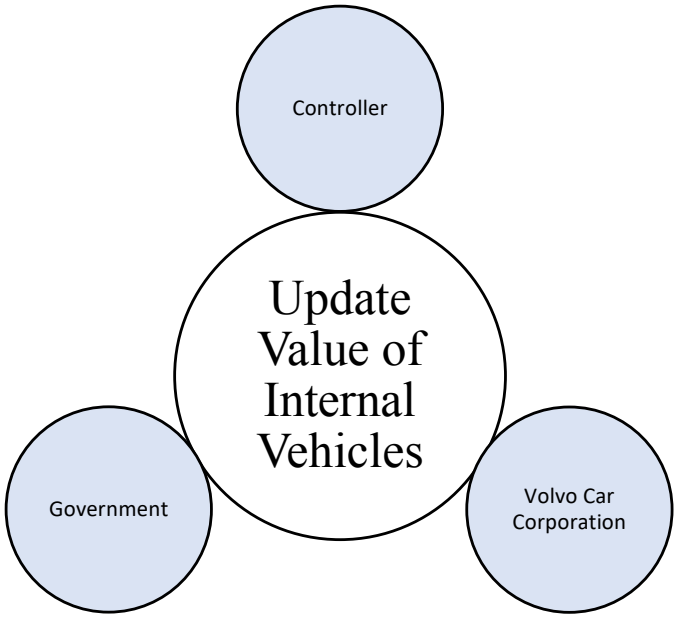

Figure 47. The stakeholders of Update value of internal vehicles.

The controller is the only participant in the processes and performs all activities and tasks. If changes in policies or design are made, the controller would be affected. The process is business value adding, and some activities add value to the controller. Therefore, it is in the interest of the controller to reduce the number of activities and tasks that do not add value, but the process should still fulfil the policies and regulations. It is also in the interest of Volvo Cars to reduce the activities and tasks as long as requirements are fulfilled, as it would reduce the cost of the fulfilment. However, since the controller needs to sort the physical documents before archiving it could be of interest to the controller to ease the process.

The processes in *Update value of internal vehicles* concerns the same subject, updating the value of the vehicle, but are performed in different ways. Standardising the process would reduce time considering what to do due to repeating the process more often and reduce the risk of error. Therefore, standardisation is in the interest of the controller and Volvo Car Corporation.

The government sets the laws and needs the laws to be obeyed. Based on the laws, regulations and policies are created, which need to be followed by Volvo Car Corporation. The regulations of interest in this process concern the bookkeeping and the annual report, which could if not followed lead to serious issues for Volvo Car Corporation. The keeping of books lays in the interest of the finance department of Volvo, who therefore puts requirements on the controller activities.

The process adds value to the company by keeping the value of the Volvo's vehicle fleet updated. This could be used as a basis when making decisions at Volvo. Therefore, Volvo needs the value to be updated. It is, however, questionable to what degree the value is useful as some of the vehicles are set to a specific value.

Handling External Costs

The stakeholders for *Handling external costs* are the controller, the user of the vehicle, the organisation sending the invoice, Volvo Cars and the vehicle owner, see Figure 49. The controller performs the activities and tasks in the process, and the process is defined as business value adding. The controller has interest in the process since changes in the process impact the controller's way of working.

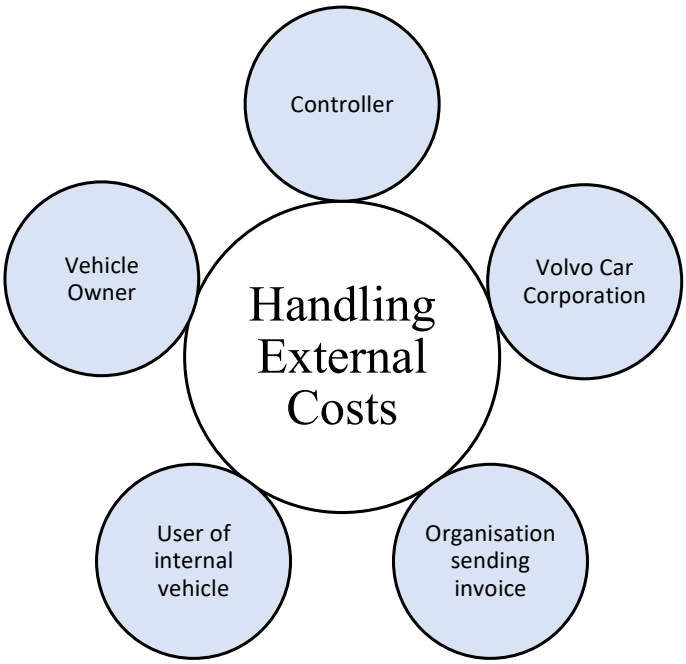

Figure 48. The stakeholders of Handling external costs.

Not all invoices are generated from the vehicle being used, some are prerequisite for the vehicle to be used. Moreover, in the cases where the invoice is created as an event from the vehicle being used, the user is a stakeholder. When only creating the invoice the interest from the user should be considered low, but when the user is responsible for paying the invoice the interest should be higher. The need should be to have a process where accessing the invoice or information is easy.

The organisation sending the invoice has the interest of the invoice to be paid and Volvo Cars has the interest of paying the invoice, preferably in time. If the bill is not paid in time, it will lead to reminders fee. If not paid at all it could lead to a legal dispute, which could end up costing. The vehicle owner has a high interest in not ending in a legal dispute, due to having responsibility and being liable.

5.2.3 Disposal of Internal Vehicles

The last process in regard to the internal vehicle at Volvo is the *Disposal of internal vehicles*. The stakeholders are presented in Figure 50 and are following; people participating in the process, the disposal company for the specific disposal alternative, the vehicle owner, Volvo Car Corporation and in the case of disposed to the car dealer the vehicle inspector and the end customer. The participants in the process have similar interests and needs as in the *Ordering of internal vehicles* due to the same reasoning. However, included in the participants are the disposal vehicle engineers, in whose employment handling disposal could be considered as the main activity.

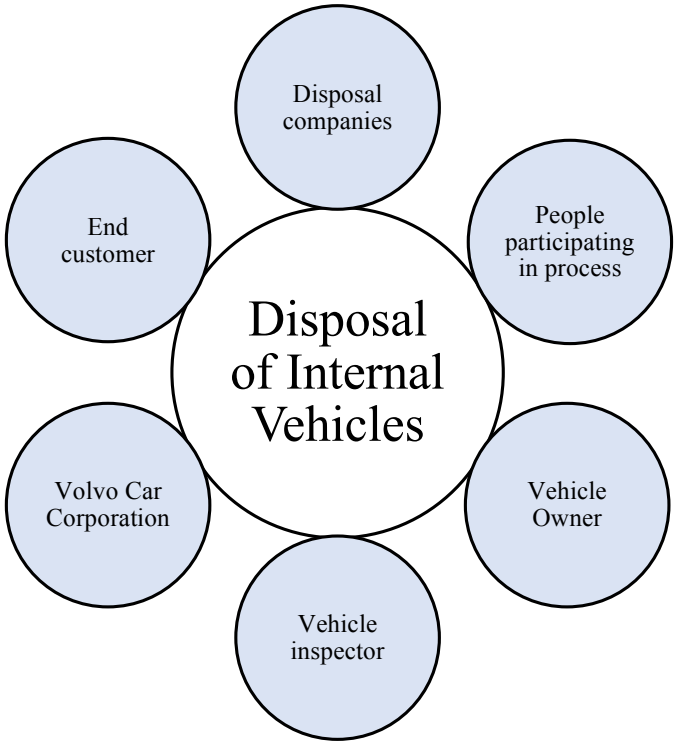

Figure 49. The stakeholders of Disposal of internal vehicles.

The disposal companies can be considered as a participant, due to performing activities in the process, but is not included in the definition of participants because being external parties. The disposal companies can affect the process by requirements on procedures, but as the internal vehicles serve as input in the disposal companies' businesses there are a mutual interest in the disposal of the vehicles. Volvo wishes to sell the vehicle, and the disposal company needs supply. From the input, the disposal company creates its income. The scrapping companies can scrap the vehicles directly upon receiving the vehicles, while the car dealer cannot sell the vehicles until received the invoice. Therefore, is the time aspect of the subprocess, *Creating invoice*, of high interest to the car dealer and prefer it to be short. Contrary to the scrapping companies. The scrapping companies can, however, affect the time until receives an invoice by delaying un-registration and in the recycler's case, also by delaying sending the value of the vehicles recycled.

As the vehicle is disposed of, the vehicle owner is no longer the owner of the vehicle and thus not responsible for future activities in regard to the vehicle. Therefore, it is essential that the process is designed so that the ownership is taken away from the vehicle owner, either by changing it or by removing the vehicle in the authority's system, "Bilregistret".

When disposing of an internal vehicle through the car dealer, the vehicle inspector is the participant who removes the special driving dispense and gives the vehicle a regular diving dispense. The vehicle inspector affects the process by either visiting Volvo or staying in own facility, creating the need for the vehicles to go there. In all cases of disposing through the car dealer, the end customer is a stakeholder. The process allows the customer to purchase a Volvo car in another way, on the second-hand market. For that reason, the interest from the end customer is that vehicles are disposed of to the car dealer.

6 RECOMMENDATION

In this chapter, the new suggested process for *Handling internal vehicles* is presented. The chapter is divided after the subprocesses: *Ordering of internal vehicles, Use of internal vehicles* and *Disposal of internal vehicles*. In each subchapter, the background to the improvements is presented and the new subprocesses are described with its impacts. The new processes are based upon usage of an internal IT system. This as it would reduce the time and allow participants to oversee the different main processes easily and at what step or status in the processes the vehicle is in at the moment. The requirements on the internal system are also described. This chapter aims to answer the third research question:

- *How should the process be designed to fulfil the needs of the stakeholders in a more efficient way?*

It should be highlighted that the suggested processes are processes to strive for but would need to be adapted for limitation in the IT system that is being developed at Volvo Cars. For the activities where limitation might occur, alternatives are discussed. The processes are not as detailed as the current process, allowing adaptation of the requirements and process to suit the other purposes the IT system shall meet at Volvo.

The system should distribute the activities after the process model as it reduces human involvement and therefore reduces the mistakes as it controls what the next step is going to be and when it can be performed. During the whole process, notifications will appear for the person who needs to perform a task, which will hopefully help to perform the tasks in time and in right way. The system is therefore responsible for pushing the process forward on the right path, where people cannot miss tasks that are needed to be performed. This results in a safer process.

Volvo should also have a process map which is regularly updated as it allows for noticing changes easier and then question the design, reducing the risk of having step no longer needed due to the evolvement of processes and organisation. Keeping the number of non-value-adding activities as low as possible. Here the data that will be logged in the system might be of use, as it provides an accurate view of the activities. The data logged also provides the possibility of easier providing statistical analysis and calculating measures to compare.

6.1 Order of Internal Vehicles

The process *Ordering of internal vehicles* serves to provide the user with vehicles, which could be used internally for testing, transportation, development or in marketing. It was described in the stakeholder analysis that both R&D and marketing are areas where short lead time is crucial. Production, however, would prefer a reasonable time margin. By shortening the time from when the vehicle engineer fills out the form until the order is placed, production can receive the order earlier. This indicates, if the point of filling out the order form remains at the same time ahead of preferred manufacturing week as in the current process, that production receives a better time margin for planning. Nonetheless, production can manufacture vehicles within existing time margin, which indicates that the total lead time from filling out order form to internal vehicle delivered could be reduced. Thus, fulfilling the need of the user.

The user performs activities that are beneficial for Volvo Cars, in regard to branding and quality. Volvo Cars is also interested in reducing cost, which could be reached by increasing the use of existing vehicles and reducing the ordering of new internal vehicles. The managing of Volvo's vehicle fleet is therefore essential. From the analysis of the vehicle leader meeting, it can be concluded that the meeting's purpose is somewhat inadequate. If it is to serve the purpose of managing Volvo's vehicle fleet by deciding if the vehicle is approved or not, the order of the vehicle cannot already have been placed.

The people participating in the process are interested in having a process where the activities are easy to perform. One thing that was presented regarding the order form was that to ease filling out the form, people could have the file downloaded and with prefilled out text and information. One of the participants, in the meaning of receiving the order form, is the controller performing the archiving in a later stage. The controller has the need of easy accessing a specific document.

To fulfil the purpose of reducing the lead time, regain control over the process and make the tasks easier for the participants. The process uses an electronic online order form which only including things to enter that is necessary and should be an adapted version of the current order form presented in *4.1.1 Ordering of internal vehicles*. Volvo should investigate what information needs to be included on the forms since people can get confused when exposed to information that is unnecessary for the task. As the order form is digital and stored in only one place, updates to the order form would be implemented for everyone directly.

The system could prevent vehicles from being ordered until approved, allowing the company to manage its fleet. The system does not only reduce the time that was between filling out the form and vehicle leading meeting, which could be up to two weeks, but also the time spends on asking for approval from manager and finance department. The change to using the system would also reduce the amount of physical document needed to be sorted, as the order forms would be an electronic text document make the archiving easier.

6.1.1 Requirements on System

The design of the process puts requirements on the system. There are some information and function that needs to be fulfilled. These requirements are presented in Table 7, together with the value the requirement creates and how the stakeholders are impacted. Requirement 1 – 3 concerns the information stored connected to the vehicle and how it could be used. Demand 4 is that the specification of the vehicle should be controlled by the system when it is filled out, and requirement 5 is that the order form should be electronic. People need to have accounts in the system and demand 6-8 relate to the possibilities with these accounts. Requirement 9 and 10 deals with the flow in the process. It should be noted that when activities are reduced, it leads to lower cost for Volvo Cars concerning in performance of the process and allows the person to do other activities.

Table 7. The requirements on the system, the created value and impact on stakeholders.

Requirements:	Value Creation:	Impacts on Stakeholders:
Ordering of Internal Vehicles:		
1. Each vehicle needs its own unique identification number. To the identification it should be possible to add/connect information and documents. Information needed is specification, information from ordering forms, possibly schedule of use, etcetera.	**1.** • Information regarding a vehicle can be found in the same place, making needed information easier to find. • Can base decisions when managing the vehicle fleet on facts. • Creates the foundation for the system and the other requirements.	**1. Participants** - Reduces the activities of finding wanted information. **Volvo Cars** - Allows for better management.
2. Have a search function based on specification and present vehicle with same or similar specification.	**2.** • Provides an overview over existing vehicles that could be used instead of ordering a new internal vehicle. • Should be used before filling out the order form.	**2. Participants -** A reduced time searching for possible vehicle. Allows for other discussions at the vehicle leader meeting. Could eliminate need for approving the order, due to no new vehicle needed. **Vehicle engineer/project leader** - Could eliminates the need for filling out the form. **Volvo Cars** - Allows for better usage and management of internal vehicle.
3. Have a function of request to use existing vehicle. The request then needs some kind of approval.	**3.** • Allows for increased usage of vehicles. • The request needs to be considered to ensure the usage of the vehicle do not interfere with other planned activities and if it would change the possible disposal alternative. An example, if the request included performing test making the vehicle not saleable, it is better to use a not saleable vehicle if possible.	**3. User of internal vehicle** - Could receive vehicle faster. **Production** - Reduced number of internal vehicle to produce. **Customer** - Receives own vehicle from production faster. **Volvo Cars** - A lower cost.
4. A online electronic form for order of internal vehicle.	**4.** • When the order form is updated, everyone will use the update version. • Reduces amount of physical documents. • Allows the order form to be sent electronical. • Makes it easy to find the order form as it is connected with the identification number of the internal vehicle.	**4. Participants** - Eliminated activities of physical deliver the order form. **Controller** - A reduced time to find the order form. No need for sorting and archiving the physical document. **User** - A shorter process until order is placed. **Volvo Cars** - Updates are implemented directly and can therefore deliver the indented value faster. Reduced need for archiving physical documents. Activities are eliminated.
5. Control so specification is OK for ordering.	**5.** • Reduces the need for the order handler to contact vehicle engineer for problems with the specification. • Allows the order to be placed faster.	**5. Order handler** - Eliminated activities. **User -** A shorter process until order is placed.
6. Personal standard information can be pre-enrolled in the form. Pre-enrolled information should remain even if updates are done to the form.	**6.** • Makes the process of filling out the order form easier and less time-consuming.	**6. Vehicle engineer/project leader** - Easier to fill out the order form.
7. Personal accounts to which authorisation can be delegated. The accounts needs ta be considered as electronic identification.	**7.** • Allows for control over who can do what in the system. • Prerequisite for having electronic approval.	**7. Volvo Cars** - A reduced risk for mistakes and can control when a order can be placed.
8. Have a function of electronic approval/signature.	**8.** • The order of internal vehicle can be shortened in time, as no need to find the persons who signatures are necessary and no need to wait until a vehicle leader meeting.	**8. Participants** - Eliminated activities of physical deliver the order form to have it signed. **User** - A shorter time from order form filled out to order is placed and thus manufactured. **Volvo Cars** - Can regain control over what internal vehicles are ordered, as the time from filling out the order to order is approved is short. There is no need to order an internal vehicle before it is approved.
9. The system should push the process forward. Possibly with the help of some notification system.	**9.** • Activities is performed in a predetermined and standardised order. Based on information entered in the form, people in need of approving the order is identified. This information is used when performing the activities. • Reduces the risk that important activities are missed.	**9. Participants** - No need for pushing the order form forward. Becomes informed when there is an task that needs to be performed. However, correct information must have been entered into the order form. **Production** - Only manufacturing vehicles that have been approved and are therefore necessary. **Volvo Cars** - A reduces risk for mistakes. Can control when a order can be placed.
10. Activities, decisions and events needs to be able to be followed.	**10.** • Can follow the process as it happens. • Can go back to check what did happen.	**10. Participants** - Can see the status of the order form and remind people if the order is urgent. **User** - Can see the status of the order of internal vehicle. **Volvo Cars** - A reduced need for saving documents separately as all activities and events can be followed in the system.

6.1.2 New Ordering of Internal Vehicles

All tasks in the process are carried out in the system. The process would start with the vehicle engineer or project leader fills out the order form, see Figure 51. The order form is in the system together with the possibility to save pre-entered information. After the form is filled out the flow could take two different paths depending on the vehicle is a factory damaged vehicle or not. The difference is that if it is not a factory damaged vehicle, meaning the vehicle has not yet been produced, a search in existing and ordered internal vehicles is performed before entering the same flow as the factory damaged vehicles.

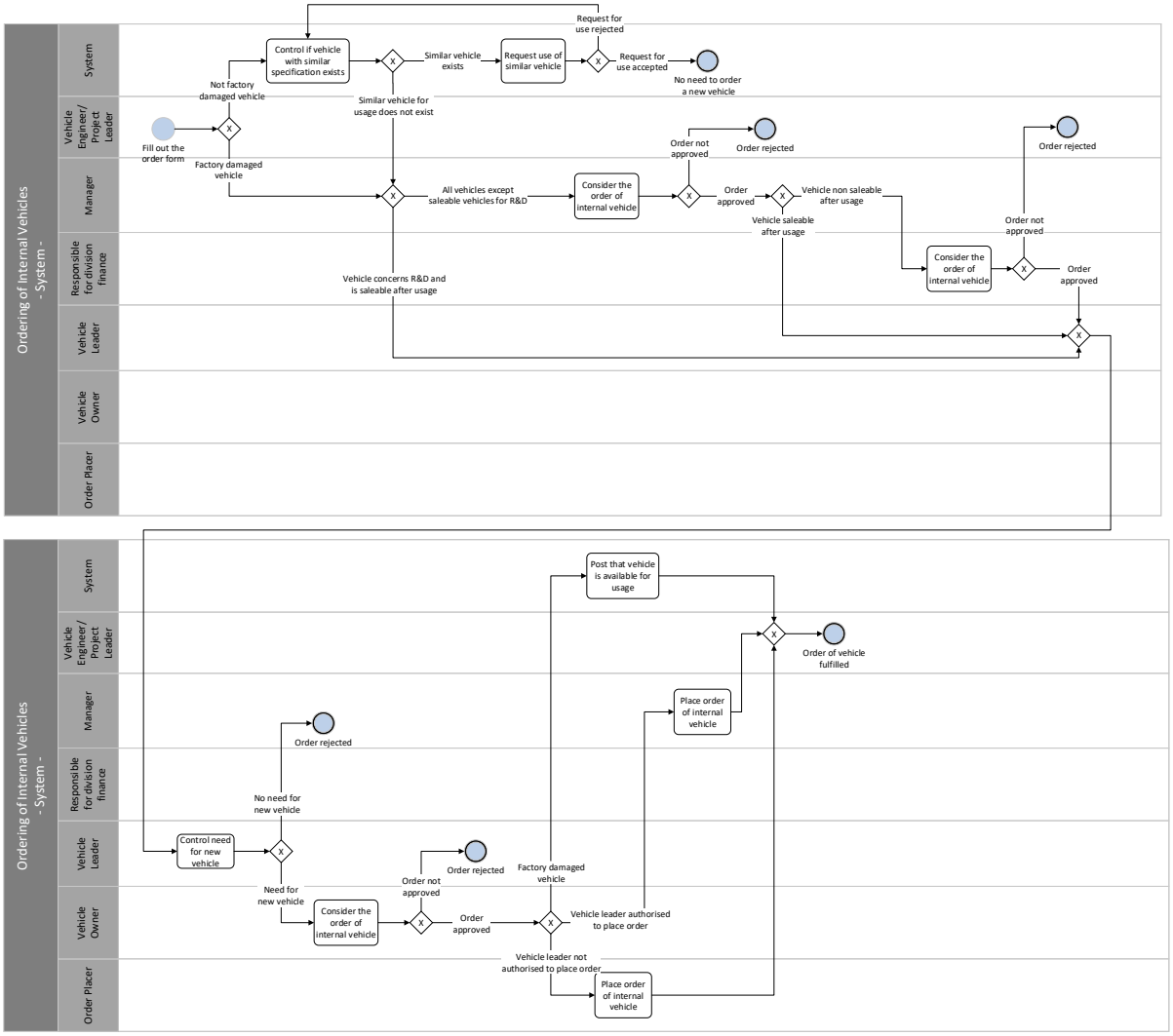

Figure 50. The new process Ordering of internal vehicles.

The system searches for a similar specification and provides an overview of all vehicles with a similar specification. In this overview information regarding a vehicle's exact specification, scheduled and what activities are planned for the vehicle can be accessed. Preferably a search in the existing vehicle has been performed before filling out the form, but this step serves as a defence that no unnecessary vehicles are ordered. The step forces the person filling out the order form to

check against the existing vehicles. If a vehicle that could fulfil the need is found a request for using the vehicle can be sent. An accepted request indicates that there is no longer a need for the new vehicle and the process ends there. In case of rejected, the vehicle engineer or project leader should receive a notification about it.

When confirmed by the vehicle engineer or project leader that no existing vehicle could be used, the next step is determined by if the vehicle is saleable and from R&D, or not. This is where the process joins the flow of the factory damaged vehicles. For a factory damaged vehicle to be ordered, and no search in the system performed, a specific authorisation should be needed.

The process proceeds with a notification to the manager if the vehicle is from R&D and not saleable. As the manager was entered in the order form, the system can automatically send it. The manager considers the order. All information to take a decision should be included in the order. In case the order is not approved, the vehicle engineer should be notified. In the notification, a motivation of the decision could be included. If it should be possible or not change the purpose or specification of a rejected vehicle to more suite the motivation should be further investigated.

An approved order of a saleable vehicle by the manager leads to a notification is delivered to the vehicle leader, also stated in the form and thereby automated. An approved order of a vehicle not saleable after use, the notification goes to the stated person responsible for the division's financials, who needs to make a decision. Rejection of the order leads to notification to the vehicle engineer or project leader and approval leads to the vehicle leader receives a notification. In the case of a saleable R&D vehicle, there is no need for approval from the manager and financial at this stage and the order should be sent directly to the vehicle leader.

The vehicle leader can control the need for the vehicle by searching for similar specifications, so no unnecessary vehicle is sent for approval to the vehicle owner. An accepted order by the vehicle leader sends a notification regarding the order of internal vehicle to the vehicle owner, who has the final approval.

What happens after the approval from the vehicle owner depends on if a factory damaged vehicle or what department ordered the internal vehicle. For orders concerning factory damaged vehicle, the vehicle should be posted in the system as available for usage for a time period and notification could be sent to the vehicle leaders. Then the vehicle should enter the normal flow and if no need identified, the disposal alternative should be considered. When the vehicle needs to be ordered either the vehicle leader, if authorised, or order handler is notified. The reason why it still might exist vehicle leaders with authorisation is for the marketing department to still control the time from being notified and the placement of order and not need to be dependent on someone else. The placement of order should be smooth and without any problems as the specification has been checked when entered. When the order is placed the vehicle engineer or project leader should be notified, and the process ends.

6.2 Use of Internal Vehicles

The activities in *Use of internal vehicles* are overall business value adding and serves the purpose of fulfilling the needs of the finance department and the government. The activities are performed manually and should be reduced, but without compromising the function the activities fill.

6.2.1 Update Value of Internal Vehicles

The processes regarding update the value of the vehicles has three stakeholders. One is the controller who performs the activities and tasks in the processes, ensuring Volvo Cars that the value is updated and correct. Both controller and Volvo Cars are interested in reducing and standardising the tasks, as it would lower the risk of errors and reducing the time and cost of fulfilling the purpose.

Volvo Car Corporation also needs the value to be updated and correct to manage the vehicle fleet and base decisions on facts. To be able to manage the fleet, Volvo needs to be able to see the value of each vehicle, while when making other decisions the total sum is more useful. For any of the values to be useful, the value needs to be correct. Lastly, the processes must obey the law. This is a need from the government and Volvo Cars, and if not following the law, it becomes a legal issue.

Several of the tasks performed in the current processes are due to information needs to be transferred between systems. The new process is however based on system integration, and several tasks can, therefore, be eliminated. Only updating the new system when an internal vehicle is factory complete a standardised process can be reached. To not lose control over what is happening with the vehicle, the controller still needs to participate in the process. That way, someone would notice when a problem occurred but not perform unnecessary business-value adding activities.

The value of Volvo's vehicle fleet becomes more accurate as the controller would receive notification when a development vehicle for new models are completed and could update it with the specific value directly and not only once a month. The specified value present used by Volvo Cars should be reconsidered. It is based on an old decision, and the company should reflect over its purpose and if the purpose is fulfilled today.

Requirements on System

The changes in the process concerning update the value of an internal vehicle is based on using the system and therefore adds some requirements to the system, see Table 8. The first two requirements relate to the possibility to update the vehicle. Requirement 3 is the same as requirement 9 in *Ordering of internal vehicles*, however, stated together with the value the requirement creates in this process as well as its impact on the stakeholders. Demand 4 and 5 are functions the system needs to have within the system, while 6 - 8 are functions the system needs to do connected with the ERP system. Requirement 9 concerns write-downs needed to be performed after changes in the conditions of the vehicle and the value. The last demand is to ensure all accounting action can be motivated.

Table 8. The requirements on the system, the created value and impact on stakeholders based on the new Update value of internal vehicles.

Requirements:	Value Creation:	Impacts on Stakeholders:
Update Value of Vehicles:		
1. Can be updated with information of factory complete vehicle.	**1.** • Eliminates the need for sending email concerning updates as all information regarding events is stored in the system. • Eliminates the need for going through printed list manually to update the development vehicles. • Vehicles used in development for new models are updated directly. • Standardise the process of update value of vehicle as it does not differ in task for the controller depending on vehicle.	**1.** **Controller** - Reduced activities and performs the same tasks each time, which lower the risk of mistakes. No need for printing emails regarding updates to later archive. **Volvo Cars** - A increased correctness of the total value of internal vehicles. A reduces the risk for human error and shorter time for the process.
2. Can connect the factory complete vehicle with order of internal vehicle form or order of development vehicle form.	**2.** • Eliminates the screech for a specific ordering form. • Eliminates the need for contacting vehicle engineers for information regarding cost.	**2.** **Controller** - Eliminated activities. **Volvo Cars** - Eliminated activities and reduced time.
3. The system should push the process forward. Possibly with the help of some notification system.	**3.** • Informs the controller of activities in need to be performed. Vehicle can be updated within short notice of being factory completed.	**3.** **Controller** - Is notified when a vehicle needs to update. **Volvo Cars** - The value of the vehicle fleet is updated and can be used as a basis for decisions.
4. Present options which are programmed to gather information and perform different events. Preferably the information and events can be overviewed before confirming the option.	**4.** • Allows the controller to control the process. • Allows a standardised process in regard of the tasks performed by the controller. • Eliminates the need for performing quittance and write down manually.	**4.** **Controller -** Reduced activities and performs the same tasks each time, which lower the risk of mistakes**.** **Volvo Cars** - Reduced activities and time for the process. Lower risk for errors.
5. Calculate the difference between two saved values.	**5.** • Allows the write-down to be performed automatically as an event in an option.	**5.** **Controller** - Eliminated activities. **Volvo Cars** - Eliminated activities and reduced time. A reduced risk for human errors.
6. Create object in the ERP system.	**6.** • Allows the updates of factory complete vehicle to be communicated to the system. • Allows each vehicle to has separated values in the ERP system.	**6.** **Volvo Cars** - A better foundation for managing the vehicle fleet, as can base decisions on facts.
7. Transfer information to the ERP system.	**7.** • Eliminates the need of updating the ERP system manually.	**7.** **Controller** - Eliminated activities. **Volvo Cars** - Eliminated activities and reduced time. A reduced risk for human errors.
8. Debit accounts in the ERP system.	**8.** • Allows the write-down to be performed automatically as an event in an option.	**8.** **Controller** - Eliminated activities. **Volvo Cars** - Eliminated activities and reduced time. A reduced risk for human errors.
9. A function informing the controller that an internal vehicles value needs to be written-down. All required information needed to perform the write-down should be entered in the system.	**9.** • Informs the controller when a write-down is needed.	**9.** **Controller** - Makes the write-down easier and reduces the need of asking for cost centre. **Volvo Cars** - The value of the internal vehicle is updated faster and more correct.
10. Follow events performed.	**10.** • Can follow what has happened and when.	**10.** **Government** - Information regarding accounting actions is accessible.

New Update Value of Internal Vehicles

The new process starts when a factory complete internal vehicle is manufactured, and the vehicle and its value from production are sent and entered into the system. The system notifies the controller that factory complete internal vehicle has been entered into the system, see Figure 52. The controller opens the new internal vehicle which the notification concerns. There, the controller is presented with options. The options are connected to the vehicle and the information entered regarding the vehicle. One option is for vehicles used in the development of new models, the development vehicles. The two other options are for internal vehicles ordered from production by the order form, one alternative for internal vehicles saleable after usage and one for vehicles not saleable after usage. The last alternative means the vehicle needs to be written-down and someone needs to carry the cost.

The information of what category suits the vehicle can be found in the system and the order form of the internal vehicle. The controller verifies the vehicles category by choosing the corresponding option. This step serves as a control step to reduce the risk of errors connected to the value of the vehicle. Depending on the option, the value is transferred to the ERP system and updated in the system.

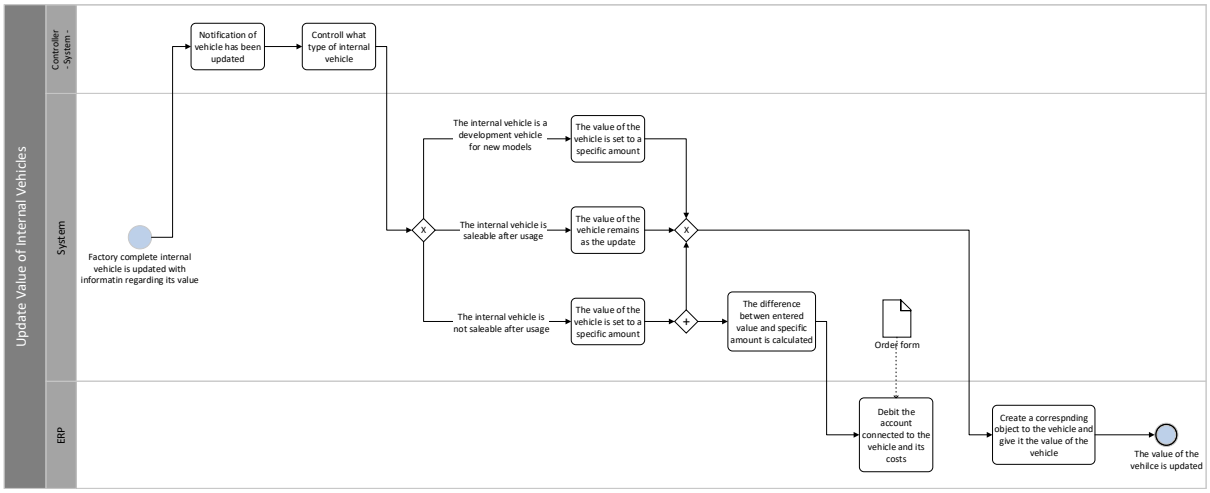

Figure 51. The new process Update value of internal vehicles.

When the vehicle is used for developing new models, the value of the vehicle should be changed to a specified amount. The value is entered into the ERP system by system integration. The ERP system should separate each vehicle for the purpose of managing the fleet. In case of a saleable internal vehicle, the steps are the same, but the value entered into the ERP system is the value from production.

If the vehicle is not saleable, two things occur. Firstly, the value of the vehicle is set to a specified amount and entered into the ERP system by system integration. Secondly, the difference between the value from production and the specified amount is calculated. This represents the write-down value. This amount is transferred to the ERP system together with information regarding the account to carry the costs. In the ERP system, the account is debited. This process of updating the value and debiting an account should also be possible if the controller receives a notification that

a write-down of a vehicle's value is necessary. The controller should then have the possibility to set the value to anything.

However, if system integration of this level does not fit within the planned system integration or if it is not economically motivated, the system should provide the controller with documents that could ease the update of the ERP system. Suggestively, these documents could if possible be uploaded into the ERP system and by that update the values, or the documents information could be copied and pasted into the system by the controller. By allowing the system to generate the documents and then copied to the ERP system, the risk of human error is mitigated.

6.2.2 Handling External Costs

During the usage, external costs arise and affect the stakeholders. The controller is responsible for performing the work connected to the external cost and prefers a smooth process. The user of the internal vehicle when the cost was generated, could be an employee who used the vehicle for a private purpose. The employee is then responsible for paying the invoices connected to that specific occasion and would also prefer a smooth process for receiving and paying the invoice.

The invoicing organisation's interest in the process is to receive the payment within time, which also aligns with the vehicle owner and Volvo Cars interest. Volvo can be affected by both receiving reminder fees and possibly the company brand is adversely affected, while the vehicle owner has the legal responsibility for the internal vehicle and could be affected privately.

The suggestions for the new process aims to reduce the need for sorting and archiving the invoices as well as it should be easy to divide the invoices according to the user and to follow up.

Requirements of the System

To improve the process *Handling external costs*, there are two requirements that should be fulfilled. The requirements on the system are presented in Table 9, together with possible value creation and impacts on stakeholders. The first requirement refers to the possibility to connect invoices to an internal vehicle. The second requirement is rather a suggestion than a demand, as it could make the process even smoother.

Table 9. The requirements on the system, the created value and impact on stakeholders.

Requirements:	Value Creation:	Impacts on Stakeholders:
Handling External Costs:		
1. Can upload invoices into the system connected to the vehicle.	1. • All information for the internal vehicle is available at the same place.	1. **Controller -** Can follow up the invoices and reduce the time for finding the invoice. **Volvo Cars** - Better control over an internal vehicle and the cost connected to it.
2. Preferably: Can automatically connect an invoice to the user/employee who used the vehicle based on the entered date for when the cost was generated, which internal vehicle and the schedule for that specific vehicle.	2. • Easier to divide payments between different employees. Just upload the cost connected to the vehicle and date, and the system knows if it is a type of invoice that needs to be paid for by the employee.	2. **Controller** - Can see who will pay the invoice. **User of internal vehicle** - Can easier see what invoices to pay and for what. **Volvo Cars** - Get control over the invoices the employee is connected to, and to control that the invoice actually is connected to the time the employee used the vehicle.

New Handling External Costs

The new process of *Handling external costs* is rather recommendations on how the current process can be improved in general terms than presenting a design. It should be investigated to what extent direct debit and receiving the invoices by email could be used. This would reduce the need for sort and storing the bills into binders, as the invoices are digital and can be archived electronically.

The invoices can then be uploaded to the system and archived connected to the internal vehicles corresponding identification number in the system. Follow up the activities of an internal vehicle becomes easier if all information concerning a vehicle is in one place. Receiving the invoices on email also reduces the storage area needed for the archiving binders.

6.3 Disposal of Internal Vehicles

In the process *Disposal of internal vehicles,* the aim is to choose the most cost-efficient alternative of disposing of the vehicle. In this process, several stakeholders have interests or needs. As in most subprocesses, Volvo Car Corporation has interests. One interest in the disposal process is that no unnecessary orderings of new internal vehicles occur. Another to maximise the usage of an internal vehicle or to dispose of it when no predicted need exists or when disposing of the vehicle is the most profitable solution, since the disposal process generates an income for Volvo.

The disposal companies interests and needs vary between the three alternatives for disposal. The car dealer's interest is to receive the invoice as fast as possible. Today, the car dealer cannot sell the vehicle until the invoice is received. While the scrapping companies need is just to receive vehicles on a regular basis in order to keep their businesses running.

The needs of the participants of the disposal process are mainly to have a user-friendly, smooth, and in some way standardised process. By standardising the process, the risks of something being missed is mitigated. The disposal process is dependent on that every person performs tasks correct and at the right time. An example of this is the vehicle owner, who must rely on the disposal vehicle engineer concerning the change of ownership of the internal vehicles sold to the car dealer. The end customer is also dependent on the change of ownership, as it is a prerequisite for the car dealer to be able to sell the vehicle on the second-hand market.

The new design is based on using a digital form through the whole process if possible, instead of today's combination of both physical and digital forms. The digital form makes the process faster since physical document handling is time-consuming. The current disposal form, presented in *4.1.2 Disposal of internal vehicles*, also needs to be adapted to what information is needed to be entered.

When creating the invoice, the controller will be more efficient as first notified when vehicles are ready to be billed as well as easier to find the right disposal form. A result of a shorter invoice process is that the car dealer can receive the invoice earlier and therefore sale the vehicle to the second-hand market. Which also shorten the process for the end customer to buy the vehicle from the car dealer.

6.3.1 Requirements on System

To improve the process *Disposal of internal vehicles,* there are some requirements on the system. The new process is based on the fulfilment of these requirements. These requirements are presented in Table 10 together with the explanation about the value creation for the process and how these requirements impact the stakeholders. The four first requirements are connected with the disposal, and the last four are connected with creating the invoices. Requirement 1 is about having a digital disposal form, while requirements 2 and 3 concerns the control the system has. Demand number 4 is only applicable if an electronic signing device is in use. The next two requirements, 5 and 6, are connected to prerequisites for the controller to start creating the invoices

and requirement 7 is about the possibility to extract accounting records to ease the invoice creation. The last demand is to ensure that cost and profit are transferred to the right accounts.

Table 10. The requirements on the system, the created value and impact on stakeholders based on the new disposal process.

Requirements:	Value Creation:	Impacts on Stakeholders:
Disposal of Internal Vehiclesl:		
1. The disposal form is digital. According to the different disposal alternatives, the system should enter information in the disposal form and personal standard information should be pre-enrolled in the form.	1. • Reduces amount of physical documents. • Makes the process of filling out the disposal form easier and less time-consuming. • Allows the disposal form to be sent electronical. • Makes it easy to find the disposal form as it is connected with the identification number of the internal vehicle. • When the disposal form is updated, everyone will use the update version.	1. **Vehicle engineer, project leader or disposal vehicle engineer** - Easier to fill out the form. **Controller** - A reduced time to find the disposal form. No need for sorting and archiving the physical document. **Volvo Cars** - Shorter time to fill out the disposal form..
2. Should notify when trying to dispose of an internal vehicle which there is an exists need for.	2. • Can increases the usage of existing vehicle. • A reduced risk of disposing of a vehicle with a current need.	2. **Volvo Cars** - Maximisation of the usage and resources.
3. The system should push the process forward. Possibly with the help of some notification system.	3. • To remove the risk that an important activities being missed. • Results in that the activities is performed in a standardised order.	3. **Vehicle engineer, project leader or disposal vehicle engineer** - A reduced risk that no important activity is missed or forgotten. **Vehicle Owner** - Fewer uncertainties regarding if the ownership is changed. **Controller** - Knows when to start the tasks and a reduced risk that no important activity is missed or forgotten. **Car Dealer** - Receives the invoice faster.
4. In the case of electronic signing device, the system should automatically send an email with the signed disposal form or the signature is uploaded to the system where a signed disposal form can be extracted and attached in an email.	4. • Makes the process of sending the vehicles to the scrapping companies easier and less-time consuming. • Email automatically sent reduces the risk for forgot to send the form to the disposal company • Reducing the administrative paper work and archiving of the disposal form.	4. **Volvo Representatives** - Less paper administration work connected to the transportation of the internal vehicles. **Volvo Cars** - A reduced need for archiving, which reduces the costs and the area needed for the archiving.
Creating Invoice:		
5. The controller receives a notification when the ownership is changed or vehicle unregistered and the system opens up the possibilities to create the invoice.	5. • The system ensures that the controller cannot create the invoice before the ownership is changed, which is a requirement for billing.	5. **The Controller** - Is sure that it is possible to create the invoice.
6. Visualise which internal vehicle has been disposed of and to whom. This information must be accessed easily.	6. • If the process generates this information it reduced the administrative work connected to it today.	6. **The Controller** - Less work connected to the accounting records. The information is visible and the work in excel is removed.
7. Possible to extract lists with the total amount and specific vehicles, which will be used as accounting records.	7. • If the a list with this information can be extracted from the system the time for the controller to create the invoice is reduced. • The risk of the human factor to gather the work information is reduced.	7. **The Controller** - No more need to double check that right information was picked since the system provide the controller with the right information.
8. Possible to enter and update information regarding cost centres and profit centres for the vehicles. The ERP system needs to be updated with this information and if changes occur.	8. • Facilities the way to have control over information, changes of departments is performed in the system which can impact both cost centre and profit centres which need to be updated in the ERP system as well. This to ensure the right department takes care of the costs and that the right department receives the income after a vehicle is disposed of.	8. **The Controller** - No more need to update two systems. Right and the same information at both places. Important that the economic information regarding cost centre and profit centre is correct.

6.3.2 New Disposal of Internal Vehicles

The process starts when an internal vehicle does not have any more purpose in its current project. The vehicle engineer will then check if someone has requested the vehicle for another purpose before starting to consider the disposal alternatives, see Figure 53. Checking for requests is an activity that should be performed during the usage of the internal vehicle as well, however, is of high importance to do before choosing to dispose of the vehicle externally and it allows for finding internal use easier. In the case of no request, or more specifically if the is no predicted need for the vehicle, the vehicle should be disposed of externally. Depending on the condition of the vehicle, the vehicle will be disposed of to either one of the scrapping companies, if the vehicle is in poor condition, or to the car dealer, if in good condition. When the internal vehicle is disposed of externally an invoice needs to be created and sent, which is the end of the process.

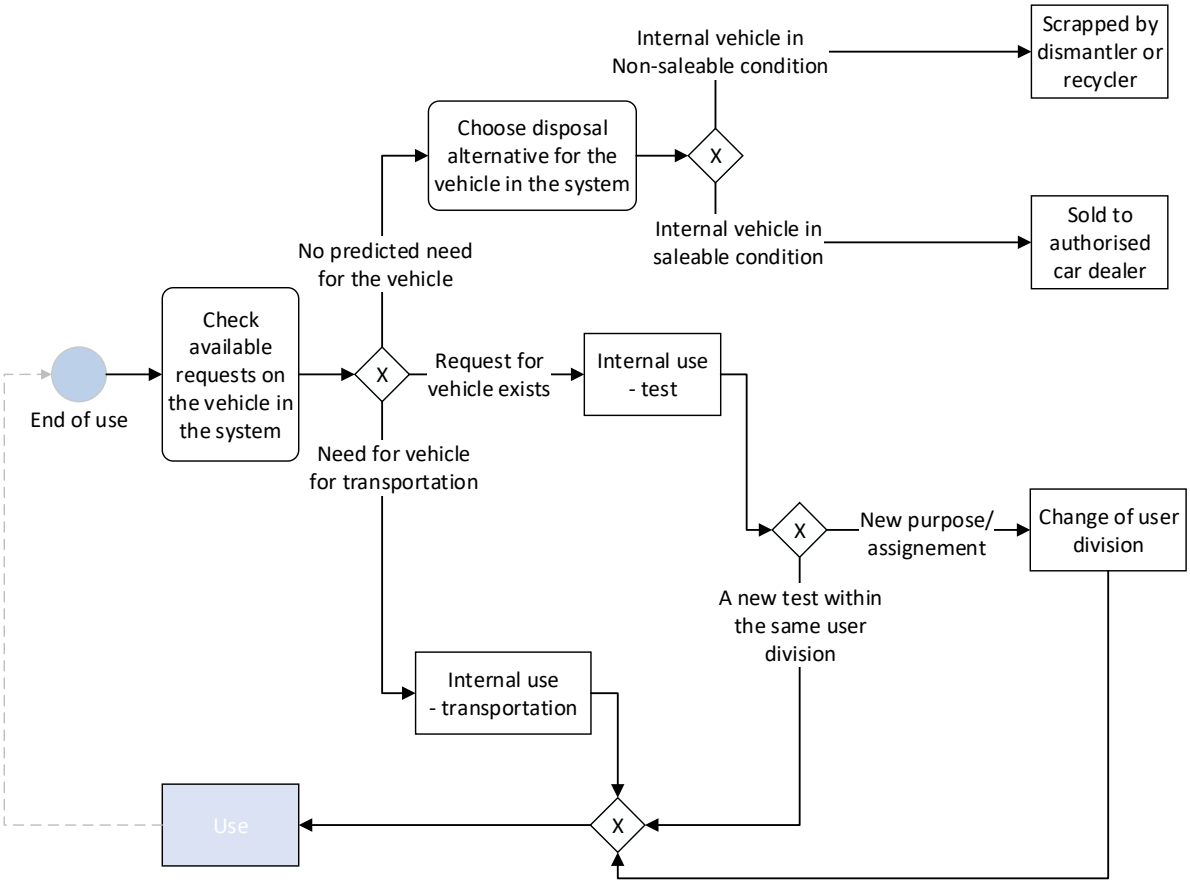

Figure 52. Overview of the new Disposal of internal vehicles.

If there is a request for internal use, either for use it for transportation or in a test, the vehicle should not be disposed of externally. In the case the request comes from another division, it needs to be changed in the system, see Figure 54. The former vehicle engineer needs to fill out to what division the vehicle will be moved, the system then sends out a request to that division where the new vehicle engineer needs to accept the changes. Then the new division can start scheduling and using the internal vehicle and when finished the vehicle will come back to the start of the disposal process.

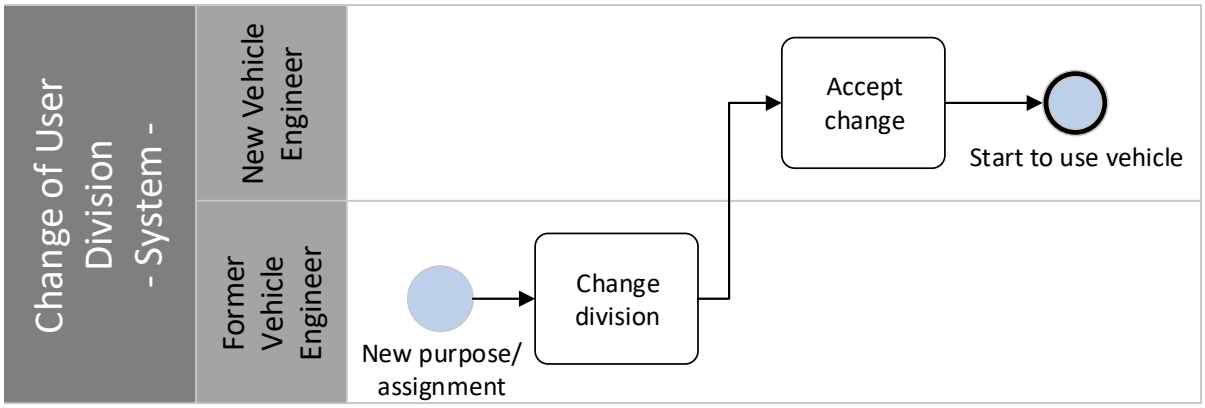

Figure 53.The new process for changing internal division.

Sell to Authorised Car Dealer

The process for disposing of the vehicle to an authorised car dealer is similar to the current process and starts with the vehicle engineer or project leader fills out a disposal form, see Figure 55. When the form is filled out the workshop is notified that the internal vehicle needs to be controlled. The workshop sends an email with the disposal form attached to the car dealer after finished the check of the internal vehicle. When the car dealer has received the vehicles the car dealer replies with an email to the disposal engineer as confirmation of which vehicles that have been received. The disposal engineer uploads this email of confirmation to the system. The system responds with a notification that the disposal vehicle engineer needs to control that the special driving dispense is removed. When the disposal vehicle engineer has confirmed the removal of the special driving dispense, the disposal engineer is reminded that the ownership must be changed. After the disposal engineer has changed the ownership of the vehicle, the controller receives a notification that the ownership is changed and that the invoice can be created to the car dealer. This notification could be designed to be sent after a set number of vehicles or based on a time limit, to ensure the invoice includes more than one vehicle.

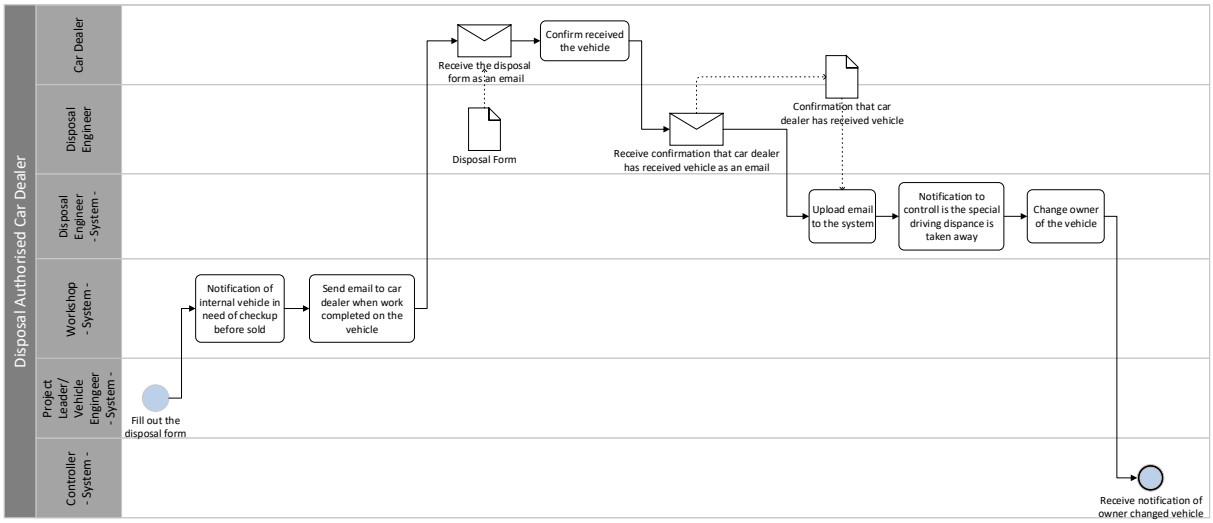

Figure 54. The new process Internal vehicle sold to car dealer.

Sell to Scrapping Company

When the internal vehicle is disposed of to a scrapping company, the recycler or the dismantler, the process will be the same. This is based on making the processes leaner which is more efficient for the company, instead of doing it in different ways according to who the receiver is. When it is decided that the vehicle is going to be disposed of by selling it to a scrapper, the disposal engineer receives a notification that a disposal form needs to be filled out. This is only possible if the value of the vehicle is below a specified value. If not, the vehicle engineer needs to inform the controller that the internal vehicle needs to be written-down. When that is done, the disposal engineer can be notified.

After the form is filled out in the system and the price of the vehicle entered, the disposal engineer secures transportation for the vehicles. This is not performed in the system but done manually, see Figure 56. The disposal engineer then informs the representatives at Volvo about what date and time the transportation provider will arrive and what vehicles that will be loaded. This can be done either manually or in the system.

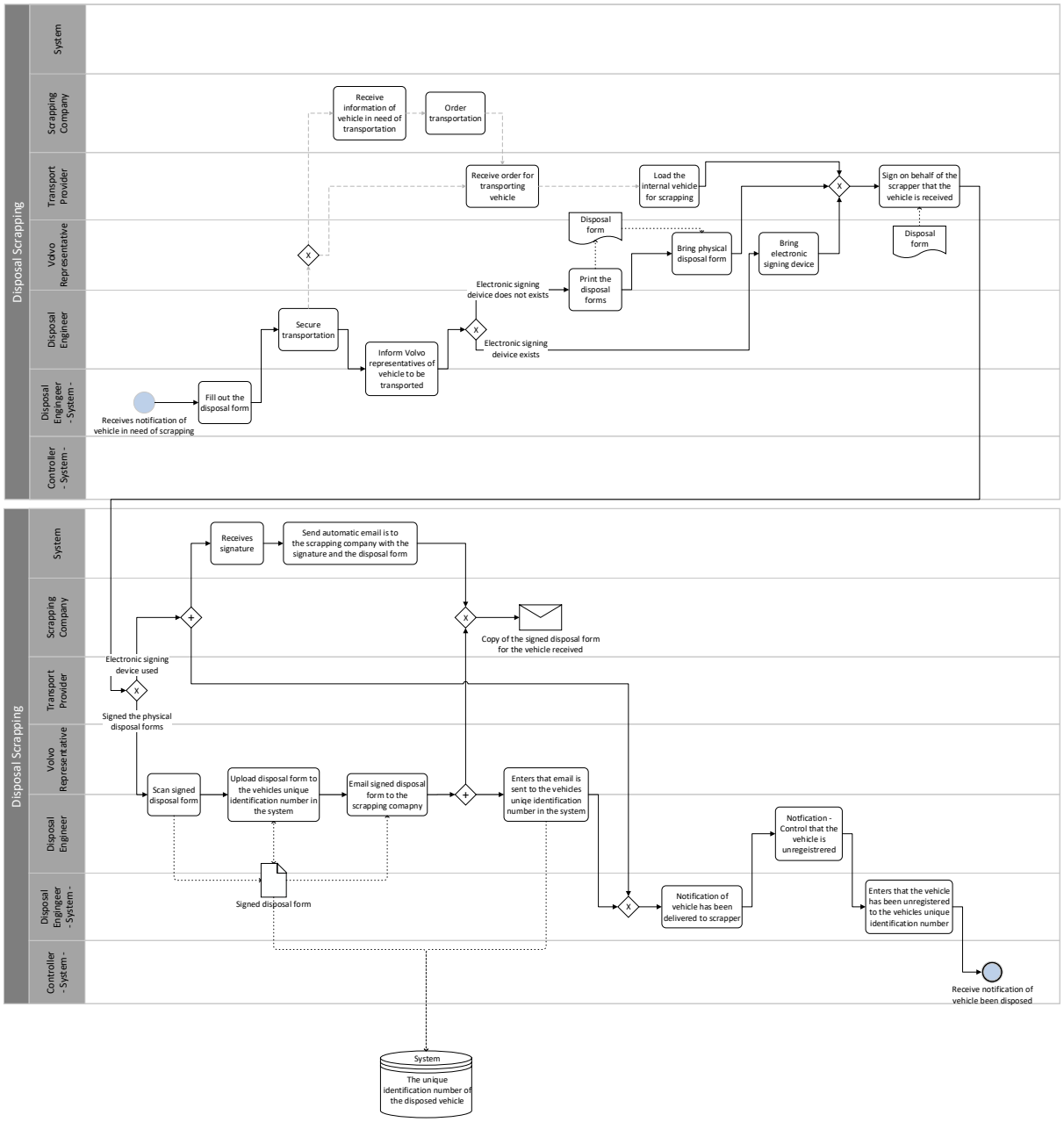

Figure 55. The new process Disposing to scrapping company.

For the disposal form to be digital during the whole disposal process, some kind of device for electronic signing is necessary, since a signature of receiving the vehicle is needed. This requires, however, that the transport provider can sign on behalf of both the dismantler and the recycler. This is also a requirement for the process to work even when a physical disposal form is used, even if it in this case is easier to work around. If no device is used, the form needs to be printed out by either the disposal engineer or the representative and signed by the transport provider when picking up the vehicles. This physical disposal form is then scanned, uploaded to the system and connected to the vehicles identification number. This scanned copy is then sent by email to the scrapping company, so either the recycler or the dismantler. In the other case, when the form is signed with

the electronic device, the signed disposal form can be the sent to the scrapping company by email, possibly automatically.

In both cases, the system is updated with information that the email has been sent to the scrapping company. Based on this update a notification regarding control if the vehicle has been unregistered in "Bilregistret" is sent to the disposal engineer after a set time. If unregistered, the disposal engineer confirms it in the system, and the controller receives information about that the vehicle has been disposed and that it is time to create the invoice.

Create Invoice

The new process for creating the invoice, see Figure 55, resembles the current processes for creating invoices to dismantler, recycler and the car dealer. The current process consists, however, of time-consuming administrative work regarding gather information from the vehicle system and rearrange it to obtain information needed for the invoice. This administrative work does not exist in the new process. The aim is that the new system has the information about how many vehicles that have been disposed of, to whom and to what price. Therefore, when the controller is notified in the system that internal vehicles have been disposed of, it is possible to extract lists or accounting records from the system where the information is stated.

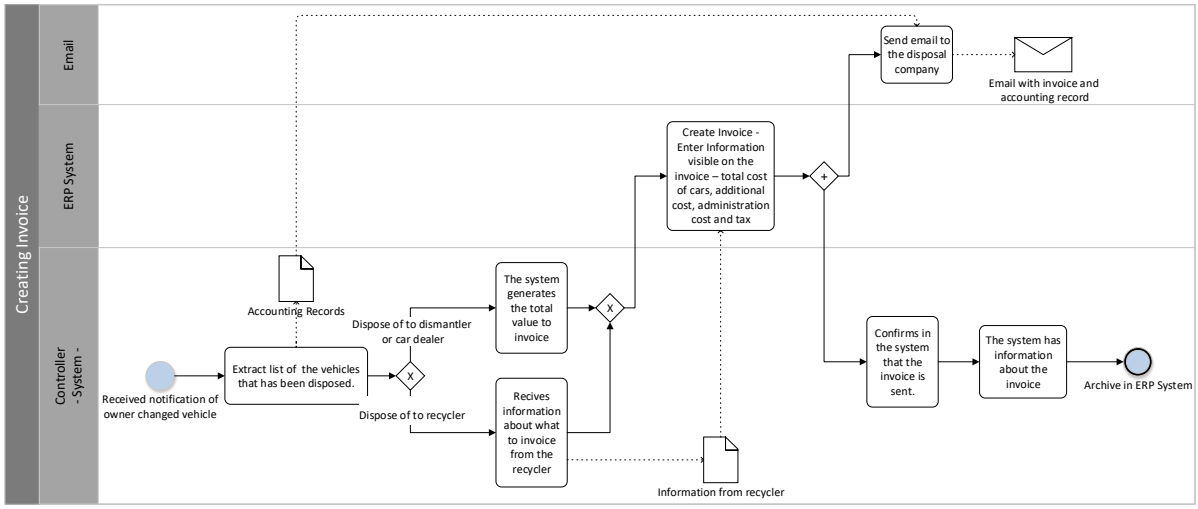

Figure 56. The new process for Creating invoice.

The invoice is created in the ERP system in the same way as today. When the invoice is finalised in the ERP system, an accounting record from the system is uploaded as an attachment to the ERP system. The invoice is then sent by email to the disposal company with an accounting record attached. After the invoice is sent, the controller should update the system with information about the invoice and confirm that it is sent. With the information, it is possible to find the invoice in the ERP system, where it will be stored.

6.4 Archiving

To reduce the time spend on archiving, it is needed to investigate in which documents that need to be saved and analyse the possibilities for storing it digitally. It is recommended to investigate in which documents that can be stored in the system, connected to the vehicles identification number.

To store documents in the system and to connect the documents with the vehicle all information regarding the vehicle can be stored and accessed at the same place. If some of the documents cannot be stored in the system, it could be useful to use some kind of cloud computing, where no software needs to be installed on the computer. However, when storing documents in the cloud, the information can be reached from anyplace at any time and Volvo only needs to pay for what is used. To store information in the system or in a cloud-based system is much safer according to the risk of fire, due to a fire can destroy all documents if the documents are stored physically. By having documents stored electronically instead of physically the need for having a large storing facility for documents is also reduced as well as the risk of losing information as the ink may fade.

The recommendation, to make the archiving process smoother, is to use the system as much as possible for storing the document needed. It would be of value if the system would help the company to organise their archiving process, for example by having an algorithm that places the different document in different phases. Documents that are needed in the daily work and documents that create value for Volvos everyday business should be stored in a way that facilitates the access of the data, in a so-called operational phase. In the other case, if the document is needed on a timely basis, for example, to be used in end-of-year reports. This kind of data would preferably be placed in a reference phase, and when the data is not expected to be used anymore but still needs to be saved, it would be good to save the documents in an archiving phase.

An analysis over the document stored, presented in *5.1.4 Archiving*, has been made and it is realised that some of the documents are stored without a purpose and these documents will not exist in the new processes for ordering and disposal. A summary over which documents that, in the new process, will be stored digitally and physically is presented in Table 11.

Table 11. Documents archived in the new process.

Documents to archive:	**Physical:**	**Digital:**
Ordering of Internal Vehicles:		
Order Form		**X**
Handling External Costs:		
Vehicle inspections	**X**	**X**
Insurances	**X**	**X**
Deducible	**X**	**X**
Congestion charges	**X**	**X**
Other invoices	**X**	**X**
Disposal of Internal Vehicles:		
Disposal Form	**X**	**X**
Email from car dealer regarding received vehicles		**X**
Accounting records		**X**
Invoice		**X**

The reason why the invoices regarding external costs will be saved both physically and digitally is that the invoices today arrives physically and according to the Swedish Accounting Standards Board, an original copy needs to be stored in its original shape in some years even though if a copy in another shape also is stored. It is recommended that Volvo investigates in the possibilities to receive the invoices for external cost on email, which makes the storage process of them easier since the invoices do not need to be scanned in order to be saved digitally and the handling process of the physical copies will no longer exist. But if that is impossible, the invoices will be scanned in and stored digitally, and the original copy will be stored for a shorter period of time. The reason why the disposal form will occur both digitally and physically depends on if a device for signing the disposal form can be used or not. If it is possible to use a device for signing the document, the physical copy will not exist.

7 CONCLUSION

The purpose of this thesis was to map and improve the process of *Handling internal vehicle*s. To do that, the current subprocesses of *Handling internal vehicles* has been presented as flow charts showing the different participants, activities and decisions as well as the corresponding stakeholders in the process and their roles, interests or needs. To give a more profound understanding, the process maps were supplemented with some additional statistical information.

The illustrations of the process help answer the first research question: *What does the current process of Handling internal vehicles look like?* When analysing the subprocesses, it became apparent that the type of activities performed, and the number of people participated differed and could do so depending on the situation in a specific subprocess, creating a complex process. All subprocesses of *Handling internal vehicles* contains business value-adding activities imposed by regulation, which generally were connected with work needed to be performed manually and use of physical documents, as well as non-value adding activities. As a consequence, the process is time-consuming as it involves several participants. When being in a market situation where it is required to develop cars faster and with more technical solutions, Volvo Cars needs to have more efficient processes. Since all car manufacturers are in the same situation, the analysis performed in this thesis can be useful for other car companies' administrative processes connected to development.

To provide more effective processes, the stakeholders of the processes have been identified and the second research question answered: *Who are the stakeholders in the process of Handling internal vehicles and what are the stakeholders' roles, interests and needs?* Two stakeholders, the controller and Volvo Car Corporation, had an interest in all subprocesses. The controller is interested in reducing the number of manually performed tasks, and Volvo Cars has the interest in reducing all activities that do not generate value. The need and interest for a less time-consuming process and tasks easy to perform reoccurred for several stakeholders in different processes.

With the basis of the current subprocesses of *Handling internal vehicles* and the interest and needs from the stakeholders, the third research question was undertaken: *How should the process be designed to fulfil the needs of the different stakeholders in a more efficient way?* A new process aiming to increase the effectiveness and efficiency of the process by reducing the non-value-adding and imposed business value-adding activities has been recommended. This is primarily done by three changes. Firstly, using digital forms, which make the filling out the form more efficient and reduces the need for sorting when archived. Secondly, having electronic approval, which reduces the time for an order to be approved and thirdly, using system integration and reducing several of the activities performed manually. Based on the needs from the new design of the process, requirements to implement in the IT system that is being developed at Volvo Cars has been presented. The new process of *Handling internal vehicles* provides Volvo Cars with a more efficient, controlled and standardised process, which will reduce the time and mistakes and still deliver value to the user of the internal vehicle and Volvo Cars.

To conclude, this thesis supports the statement that administrative processes have not been a prioritised area for improvements, and this is also observed in a company in a market where digitalisation is crucial for the competitiveness of the company.

From the study, it can also be concluded that process mapping is an excellent method to use when striving to improve a process for several reasons. Firstly, process maps are an easy and effective way to show the process. This could be used when trying to overcome that people in a process generally only know their own activities and lack the holistic view. Secondly, illustrating the process helps the understanding of the process. The texts and the maps support each other in providing a description of the process that is easy to comprehend. Thirdly, drawing process maps create a deeper understanding of the persons performing the study. Profound knowledge of the process is required to develop suitable improvements. Fourthly, when creating the process maps, areas that are unclear are quickly brought to the surface and making the understanding of the process more efficient. Fifthly, it is easy to identify and correct areas that are misunderstood when discussing the process with the participants of the process. The feedback can quickly be incorporated into the work and be confirmed at the same time. However, it is important to keep in mind that creating a valid process map can be time-consuming, especially when the process including several participants and is not standardised.

The study demonstrates that process mapping and Business process management is applicable even for administrative processes and is a method that should be used by other companies. As a result of mapping the administrative process, areas of improvement were easily identified. With the help of digitalisation and system integration more efficient administrative processes can be developed, e.g. by using electronic approval and reducing the need for physical archiving.

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APPENDIX I - Interview Questions: Vehicle Leaders

Interview connected to the process Ordering of Internal Vehicles:

- Vad är din titel?
- Vad arbetar du med?
- Vad är ditt ansvar i denna process?
- Vad har du arbetat med tidigare?
- Vilken koppling har du till Order of internal vehicle?
- Hur skulle du beskriva att den processen ser ut?
- Vad anser du är syftet med processens steg?
- Vilka parter är inblandade?
- Vad är deras roll?
- Vilka mer kan vara intressanta att prata med gällande processen?

Interview connected to the process Disposal of Internal Vehicles:

- Vad är ditt ansvar i denna process?
- Vilken koppling har du till Disposal of internal vehicle?
- Hur skulle du beskriva att den processen ser ut?
- Vad anser du är syftet med processens steg?
- Vilka parter är inblandade?
- Vad är deras roll?
- Vilka mer kan vara intressanta att prata med gällande processen?

Follow up-Interview regarding Ordering of internal vehicles:

- Kan du (kort) berätta om ditt ansvar som ”Fordons Ansvarig”?
    - Har du vagningenjörer under dig?
- Hur går din avdelning tillväga när ni beställer bilar?
    - Hur ofta beställer ni bilar? (Gånger/år Antal)
    - Beställer ni via blanketten ”Beställning av produktionsvagn”?
    - Vad för typ av bilar beställer ni?
    - Är det ett behov från din egen avdelning eller kan det komma utifrån?
    - Vem fyller i blanketten (beställning av produktionsvagn)?
- Hur får du blanketten? (mejl, fysiskt)
- Vem skickar blanketten till administratören av VL-mötet?
    - När skickas blanketten till administratören av VL-mötet?
    - Vilka signaturer behöver du innan du tar med lappen till VL-mötet?
    - Vem anser du är ansvarig för att få de signaturerna?
- Vet du vad som händer efter VL-mötet?
- Vem beställer era fordon?
- Får du någon bekräftelse eller leveransvecka?

APPENDIX II - Interview Questions: Disposal Vehicle Engineer

Interview connected to the process Ordering of Internal Vehicles:

- Vad är din titel?
- Vad arbetar du med?
- Vad är ditt ansvar i denna process?
- Vad har du arbetat med tidigare?
- Vilken koppling har du till Order of internal vehicle?
- Hur skulle du beskriva att den processen ser ut?
- Vad anser du är syftet med processens steg?
- Vilka parter är inblandade?
- Vad är deras roll?
- Vilka mer kan vara intressanta att prata med gällande processen?

Interview connected to the process Disposal of Internal Vehicles:

- Vad är ditt ansvar i denna process?
- Vilken koppling har du till Disposal of internal vehicle?
- Hur skulle du beskriva att den processen ser ut?
- Vad anser du är syftet med processens steg?
- Vilka parter är inblandade?
- Vad är deras roll?
- Vilka mer kan vara intressanta att prata med gällande processen?

Follow up-Interview regarding Disposal of internal vehicles:

- När sker en avyttring?
- Har du statistik på avyttringar?
- När man fattar beslut kring vad som ska göras med bilen efter avslutat projekt.
    - Vilka är med i det beslutet?
    - Diskuteras alla alternativ samtidigt eller väljer man först spara eller sälja? Där sälja menas; sälja till bilhandlare, till skroten, eller återförsäljare av delar.
- Vart ställs bilar när de ska doneras eller väntas till nästa "projekt"/användning?
- Frågor angående när kostnadsstället behöver ändras:
    - Vad är det som avgör om KU behöver ändras?
    - Byter man bara mellan projekt eller mellan avdelningar också?
    - Vem kontaktar accountant med informationen om att ändra KU.
    - I vilka fall behöver KU inte ändras?
    - Behövs något speciellt för att flytta bilen till annat projekt?
- Vem är det som fyller i avryttningsblanketten?
    - Den som vill skrota?
    - Fordonsansvarige?
    - Skiljer detta sig för de olika fallen?
- När ska man skriva i mottagare?
    - Hur vet man mottagarna?

- Hur vet dismantler/ scrapper/köpare att de ska komma och hämta/ta emot?
    - Hur får de information om detta?
    - När får de information om detta?
    - Via vilken kanal?

Försäljning till bilförsäljare:

- Hur tar sig bilen till den interna verkstaden?
    - Kan verkstaden upptäcka att bilen inte är säljbar?
        - Vad händer isåfall?
    - Vem ansvarar för kostnaderna när bilen uppdateras/ändras? För i de fall när bilen ska säljas, så finns inget KU med på den gröna blanketten.
- Vi fick information om att bilprovningen tar bort den speciella provbils-dispensen.
    - Vem är bilprovningen?
- Vem förflyttar bilen från verkstaden till bilförsäljaren?
    - Vem ger blanketten till bilverkstaden?
    - När blanketten flyttas tillbaka från bilförsäljaren till Volvo, vem gör denna för flyttningen?
- Vem är det som ägarbyter bilen?
    - När sker detta?
- När vehicle engineer får tillbaka blanketten så kollar han om ägarbytet är skett.
    - Vad händer om bilen inte är ägarbytt?

Försäljning till recycler:

- "Blanketten + registreringsbevis åker med bilen till skroten"
    - Vem gör förflyttningen av bilen?
- Skroten kollar så att de har fått rätt bil
    - Vad händer om de inte är rätt bil de har fått?
- Kan vem som helst på skoten signera att de mottagit rätt fordon?
- Är det skroten som avregistrerar bilen efter att de har mottagit den?
    - Om inte, vem är det?
- Vem är representanten som tar med sig lapparna?
    - Lägger denna person personligen lapparna i lenas box?

Försäljning till dismantler:

- Som vi förstått det så signerar den som kör bilarna till dismalte blanketten?
    - Kontrollerar denna person också att de fått rätt bilar?
    - Vem förflyttar sedan blanketten till Accountants fack?
    - Är chauffören ansvarig för att registreringsbevisen följer med?
        - Vem har tagit hand om dem här på Volvo?
        - Vart förvaras dem?
- Avregisterar dismantler fordonet?

APPENDIX III - Interview Questions: Order Handler

- Vad är din titel?
- Vad är dina arbetsuppgifter/ansvarsområden?
- Kan du beskriva med några få meningar vad du arbetar med?
- Är du orderläggare för alla Vehicle Leaders?
    - Om inte, varför är ni uppdelade?
    - Vilka är i så fall de andra orderläggarna
- Hur vet du att du ska beställa ett fordon?
- Vilken information behöver du för att lägga en beställning?
- Hur får du beställningsblanketten?
    - Av vem får du den?
    - Får du den digitalt eller fysiskt?
    - Vad kollar du på blanketten innan du beställer?
    - Ska det vara vissa signaturer på blanketten?
        - Berors det på situation?
- Andra frågor angående "beställning av produktionsvagn" blanketten:
    - Signerar du blanketten?
    - När signerar du isåfall?
    - Signerar du för samtliga beställningar eller endast i enstaka fall?
- Vad gör du efter en beställning?
    - Lämnar du lappen vidare till någon?
    - För du in information om det någonstans?
    - För du det vidare till någon?
- Skulle du kunna förklara hur du går tillväga när du lägger en beställning?

APPENDIX IV - Interview Questions: Administrator of the Vehicle Leader Meeting

- Vad är din titel?
- Vad är dina arbetsuppgifter/ansvarsområden?
- Kan du beskriva med några få meningar vad du arbetar med?
- Vad anser du är skillnaden på bilbeställarmöte och VL-möte?
- Är du ansvarig på båda mötena?
- Anser du att det är någon skillnad och vilket av dem är då mer "övergripande"?
- Vad är din uppgift inför ett bilbeställarmöte/VL-möte?
    - Förberedelser?
    - Kollar du på anteckningar från förut?
    - Vilken relation har du till "bilbeställarblanketten/beställning av produktionsvagn"?
- Vad är ditt ansvarsområde kring bilbeställningsblanketten?
    - Är du ansvarig för att ladda upp blanketterna i digitalt format och föra in det i databasen?
    - Uppdaterar du blanketten?
    - Hur kommer fordonsingenjörerna åt blanketten?
- Vad sparas i protokollet kring blanketten?
    - Sparas blanketterna om den blir nekade?
    - Sparas blanketten om den blir godkänd?
    - I vilket syfte sparas blanketterna?
- Vem använder protokollet?
    - Hur länge sparas protokollet?
    - Vad gör du med protokollet?
    - Är det en policy eller lagkrav att föra protokoll?
    - Inkluderar det kravet blanketterna?