Tampere University of Applied Sciences

Supply Chain Analysis of Body Converted Crafters of Volkswagen Commercial Vehicles in Finland

Martin Böttcher
Mechanical Engineering
Bachelor's Thesis
May 2020

ABSTRACT

Tampereen ammattikorkeakoulu

Tampere University of Applied Sciences

Double Degree Programme in Mechanical Engineering

Martin Böttcher

Supply Chain Analysis of Body Converted Crafters of Volkswagen Commercial Vehicles in Finland

Bachelor's thesis 67 pages, appendices 28 pages

May 2021

The objective of this bachelor's thesis was to, firstly, illustrate the supply chain of body converted Crafters of Volkswagen Commercial Vehicles and to, secondly, detect improvement potential in this supply chain. To explain the practical background of the project, the involved supply chain stakeholders, Volkswagen Commercial Vehicles, the importer K-Auto and Premium Partners of the Volkswagen Group, responsible for body conversions, were initially presented. Afterwards, serving as a theoretical background of this thesis, the term and purpose of supply chain management as well as the framework for conducting the bachelor thesis, the so-called Business Process Management Lifecycle, were described. The Business Process Management Lifecycle proposes a Supply Chain Operations Reference model, that was used to structurally gather process information in interviews and to illustrate the supply chain processes afterwards. In terms of improvement potential, a Process Portfolio was used to evaluate the processes according to their need of improvement. The improvement potential of the most urgent processes to work on was subsequently verified and eliminated.

As a result, the project has illustrated the supply chain of body converted Crafters. Furthermore, delivery costs of Crafters equipped with four-wheel drive have been reduced by (…) % and thereby, additionally, the scope to use foreign body builders could have been broadened. Moreover, the project has contributed to improvement potential in terms of spare parts warehousing and after-sales communication, which shall be analysed by further projects.

Keywords: Supply Chain Management, Logistics, Business Process Management Lifecycle, Supply Chain Operations Reference Model

Authors statement:

Hereby I, Martin Böttcher, assure that I have prepared the present bachelor thesis independently, have used no aids other than those indicated and have marked the passages of the thesis that were taken in the wording or essential content from other works with exact indication of the source.

Hanover, 14.05.2021 M. Böttcher

Blocking note:

This bachelor thesis is written in cooperation with K-Auto and parts are confidential. Therefore, publication of the text components marked in red as well as Figures and Tables that are also marked in red is strictly prohibited. The red marked information must be treated confidentially and cannot be made available to the public. The publication or reproductions, even partial, of the red marked parts are not permitted without the express permission of K-Auto. Access to the mentioned parts of the thesis will only be made available to proof readers.

The blocked contents were replaced by "(…)".

CONTENTS

List of Figures

List of Tables

Glossary

ATLAS	Automobil-Abwicklungs-System
BPM	Business Process Management
ETKA	Electronical Teilekatalog
IFA	Integrierte Fahrzeugabwicklung
SEMEX	SE Mäkinen Logistics Extranet
SCOR	Supply Chain Operations Reference
TAMK	Tampereen ammattikorkeakoulu
VW	Volkswagen
VW CV	Volkswagen Commercial Vehicles

1 INTRODUCTION

1.1 Current Situation

A company is at risk to lose 40% percent of yearly profits every ten years due to supply chain interruptions, according to a study of McKinsey Global Institute (2020). The current semiconductor crisis exemplifies the impact and complexity of supply chains very well: Due to increasing demand of electronic devices like laptops and tablets in the current Corona pandemic, the need of semiconductor products has been increased tremendously (Heise, 2021). At once, environmental disasters such as flooding and dryness in raw material extraction areas like China and Taiwan have led to decreasing availability of semiconductors (Zeit, 2021). Due to this increase of demand and decrease of supply, the automotive industry is confronted with costs of several hundred million Euros and potential production downtimes of up to four and a half million cars in 2021 (Handelsblatt, 2021). The impact of supply chains on the financial state of a company becomes apparent.

The financial state of the Volkswagen (VW) Group is strained. Due to former penalty fees of more than 30 billion Euros for Diesel Gate in 2015 (Deutschlandfunk, 2021) as well as current invests in e-mobility and digitalisation of more than 62 billion (Frankfurter Allgemeine Zeitung, 2020), the Group is forced to provide profit-yielding products. A possible way to generate streams of revenue and address customers successfully are body conversions. Body conversions encompass equipment or adjustments of vehicles to expand their usability. Especially, Volkswagen Commercial Vehicles (VW CV) requires these customized solutions to address differing needs of their commercial customers (Volkswagen Group, 2020a).

To support the integration of body conversions and improve sales in foreign markets, this project is going to address the Crafter and its body conversions in the Finnish market. The car model is also significantly concerned by the above-described semiconductor crisis. In April of 2021, the production was interrupted for three weeks in Wrzesnia, the production plant of the Crafter in Poland (Hannoversche Allgemeine Zeitung , 2021).

1.2 Project Target Setting

The following bachelor's thesis has been done in collaboration with VW CV and its Finnish importer K-Auto. From a business related point of view, the objective is to illustrate the current supply chain processes of body converted Crafters in Finland by conducting interviews with the involved supply chain stakeholders. Right now, the body conversion supply chain of Crafters is just partly documented. Furthermore, during the investigation, improvement potential shall be detected in the supply chain processes. This project should serve as a discussion basis for the involved companies.

To reach the above-mentioned objectives, the following research questions are going to be answered in this thesis:

1) Which theoretical models can be used to illustrate and analyse the complexity of supply chain processes?
2) How can the process information be collected in a structured manner?
3) Who is involved in the supply chain of body converted Crafters?
4) Which processes exist in the supply chain of body converted Crafters?
5) To what extent can improvement potential be detected in the supply chain of body converted Crafters?

From an academic point of view, the objective of this project is to demonstrate knowledge and capabilities, learned in the double degree programme of Industrial Engineering at Hochschule Hannover (HSH) and Mechanical Engineering at Tampereen ammattikorkeakoulu (TAMK), to achieve the bachelor's degree in both programmes (Tampere University of Applied Sciences, 2019).

1.3 Thesis Structure

The thesis is going to start with a brief introduction of the involved companies VW CV and K-Auto. Additionally, the role of second stage manufacturers, also called body builder, or Premium Partner in the context of the Volkswagen Group, is introduced in chapter two of this thesis.
Subsequently, the theoretical background for conducting the thesis is set in terms of definition and purpose of supply chain management in chapter three.

In the following chapter four, the framework for conducting the practical project in this thesis, the Business Process Management (BPM) Lifecycle, is presented. The BPM Lifecycle is divided in an excluded phase, which is executed once in terms of BPM, and a multi-iterative and repeatable cycle, consisting of five phases. The core of this thesis is based on the excluded phase, process identification. The applied theoretical models of this phase, a Supply Chain Operations Reference (SCOR) model and a Process Portfolio are introduced. Additionally, the other phases of the lifecycle are described to guide the analysis of one supply chain element in detail.

Semi-standardized expert interviews based on the previously stated SCOR model serve as data collection method for body converted Crafters supply chain process information. The theoretical background is therefore presented in chapter five.

Afterwards, in chapter six, the project is carried out and the described theoretical models are applied. Consequently, the current supply chain processes of body converted Crafters are questioned, structurally illustrated and evaluated according to their need of improvement. Additionally, to not just propose improvement areas, but also to achieve countable results, the previously detected potential in terms of Crafter four-wheel drive conversion is analysed and prepared for implementation.

Finally, the results found in this thesis are summarized, reflected and an outlook for further research is given in chapter seven of this thesis.

2 COMPANY PRESENTATION

2.1 The Volkswagen Group

The VW Group consists of twelve independent car manufacturer brands and one financial service provider. Starting in the upper left corner and continuing line by line in Figure 1 (Volkswagen Group, 2021b), the twelve carmaker brands are Volkswagen, Audi, Seat, Skoda, Bentley, Bugatti, Lamborghini, Porsche, Ducati, VW CV and MAN. The product portfolio of the VW Group encompasses different types of vehicles like commercial light vehicles, trucks and busses, luxury cars, passenger cars and motorcycles. The financial company is called Volkswagen Financial Services and deals with car insurances, leasing contracts and financing of cars. The logo of the company is illustrated at the lower edge of Figure 1.

FIGURE 1. Brands of the VW Group

2.2 Volkswagen Commercial Vehicles

The brand VW CV is headquartered in Hanover and started operating independently in 1995 as the fifth brand of the VW Group in addition to VW passenger cars, Audi, SEAT and Skoda. Before that, the brand VW CV was part of VW passenger cars. Today, more than 23,955 people are employed at VW CV. The company is the leading brand for autonomous driving as well as for mobility and transport services of the VW Group (Volkswagen Commercial Vehicles, 2021d).

The current product portfolio of VW CV is shown in Figure 2 (AMAG Automobil und Motoren AG, n.d.). It encompasses, considered from the left to the right edge of the Figure, the Pick-Up Amarok, the Crafter Van, the smaller light-weight delivery car Caddy and the Transporter (Volkswagen Commercial Vehicles, 2021c). Each of the models Crafter, Caddy and Transporter is available in different specifications for passenger transportation as well as for commercial purposes (Volkswagen Commercial Vehicles, 2021a).

FIGURE 2. Product portfolio of VW CV

The Transporter, also called T-Model, has been being produced in the headquarter factory in Hanover, Germany, since 1955. The Pick-Up Amarok production in Hanover ended in the end of 2020, but still continues in Pacheco, where Volkswagen Argentina has launched a plant in 1980 (Volkswagen Group, 2021b). The Caddy is produced in Poznan by Volkswagen Poznan GmbH, a 100% subsidiary of VW CV. Regarding the Crafter, a new factory has been built to produce the second generation of Crafter in Wrzesnia in 2016 (Volkswagen Group, 2018).

In 2020, 372,000 cars have been delivered to customers, which is, in contrast to almost half a million cars in 2019, a loss of 24.4 percent. The sales revenue has been decreased by nearly 20 percent between 2019 and 2020. The operational income declined from 510 million in 2019 to a minus of 454 million in 2020 (Volkswagen Group, 2021b). The numbers show that VW CV has to improve its sales and use chances to improve its revenue.

2.3 Volkswagen Premium Partner

A body builder, also known as second stage manufacturer, is a company that adds specific parts to vehicles produced by original equipment manufacturer, in order to enhance the application spectrum for customers (Hilgers 2016, 3). Hence, body builders are especially important to satisfy specific needs of commercial customers. In 2015, 76 percent of light commercial vehicles, characterized by a gross weight of under 3.5 tons, have been additionally converted by a second stage manufacturer. For cars with more than 3.5 tons gross weight, 70 percent of sold cars were treated by body builders (Ludanek 2017, 167-168).

VW CV provides body conversions in collaboration with second stage manufacturers for several application areas like the construction and forest business, public authorities, craftsmen, delivery service provider, fire departments as well as for medical transportation and transportation of disabled people (Volkswagen Group, 2021a). In Figure 3, a Crafter converted for a fire department is shown (Volkswagen Commercial Vehicles, 2021b). In this case, the conversion concerns the interior in terms of a specific seat and built-in cupboards as well as the exterior regarding sirens and flashing blue lights.

FIGURE 3. A Crafter converted for a fire department

The VW Group distinguishes their body builder network in so-called Registered Converters, Integrated Partners and Premium Partners, where the Premium Partner certification is the highest form of collaboration. To become a Premium Partner, a company has to comply with several internal and external standards like the ISO 9001 (Aalto, S., 2021). All body builders have access to product information required for development of body conversions such as CAD-data or technical drawings. Additionally, Integrated and Premium Partners have the right to use an official logo to show their certification by VW CV. In contrast to Integrated Partners, Premium Partners are earlier informed about incoming product changes and have the right to use the same templates as VW CV for their marketing campaigns. Additionally, it is possible for Premium Partners to collaborate with VW CV in marketing campaigns and trade show appearances (Volkswagen Commercial Vehicles, 2018).

2.4 K-Group and K-Auto

The K-Group, also called Kesko, is a Finnish company operating in the trading sector of groceries, building and technical trades as well as car trades. In 2020, approximately 39,000 people were employed at Kesko and its K-retailers. The K-Group owns more than 1,800 stores in seven countries: Poland, Sweden, Norway, Latvia, Lithuania, Estonia and Finland (Kesko, n.d.).

The K-Group has recorded net sales of 10,669 million Euros and an operating profit of almost 570 million Euros. Figure 4 illustrates the shares of net sales and its operating profit according to its divisions (Kesko, 2021). The car trade division is called K-Auto and contributes to net sales with 893 million and operating profit with 23 million Euros at least, which equates 8.3% of total net sales and 4.1% of the total operating profit. In contrast, the grocery trade as the strongest division has had a net sales share of 54% with 5,732 million Euros and an operating profit share of 66% with 375 million Euros. The building and technical trade division was accountable for 38% of total net sales with 4,066 million Euros and for 36% of the operating profit with total earnings of 202 million Euros (Kesko, 2021).

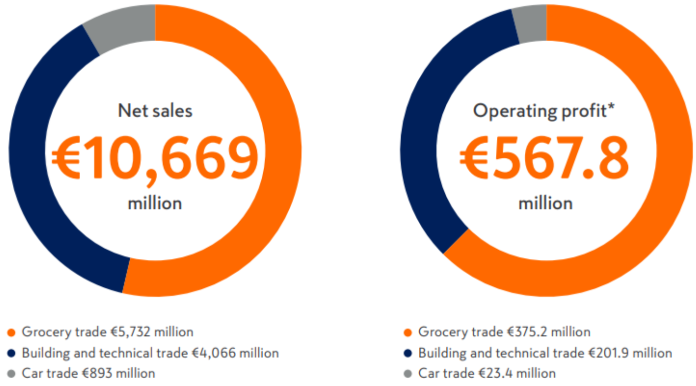

FIGURE 4. Share of net sales and operating profits per K-Group divisions

The car trade divisions imports and markets all brands of the VW Group in collaboration with the in-house dealer-network K-Caara in Finland. K-Auto imported 18,140 cars in the previous year 2020, leading to a total market share of 17%. In respect of the brand’s market performance, VW CV had the biggest market share of all imported brands with 21% in the light commercial vehicle segment (Kesko, 2021). The numbers show that VW CV has potential to improve the overall share of Kesko’s car trade division K-Auto.

3 THEORETICAL BACKGROUND OF SUPPLY CHAIN MANAGEMENT

3.1 Definition of Supply Chain and Supply Chain Management

The term supply chain encloses all steps needed to create a product for the customer. It starts with acquisition of raw material, encompasses all manufacturing and assembling operations, envelopes every transportation and storage activities as well as includes all recycling and reshipment operations of a product. Commonly, several jointly collaborating companies and organizations are involved in a supply chain, which are organized in a complex network (Zijm, et al., 2019, p. 33). An example of a broad network for fulfilling customer's demand is shown in Figure 5, where four suppliers, two manufacturer, three distribution centre and two retailer are involved (Erenay, et al., 2015).

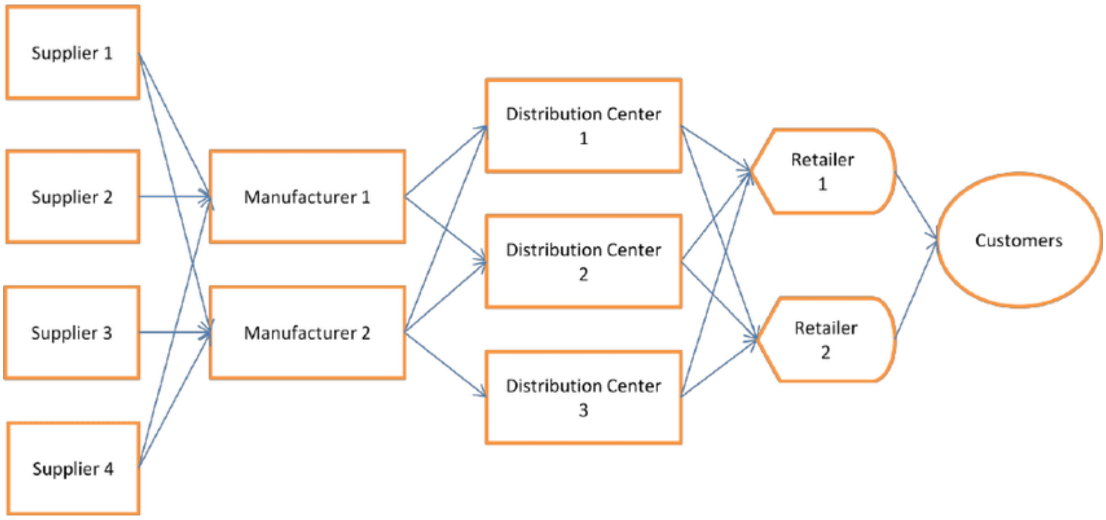

FIGURE 5. Example of a complex supply chain network

According to the Council of Supply Chain Management Professionals (2020), supply chain management encloses the planning and management of a company's supply chain including all logistics related activities as well as purchasing and conversion activities. Especially, the coordination and collaboration with stakeholders of the supply chain like suppliers, manufacturers, logistics service provider, retailer and customers have to be ensured (CSCMP, 2020).

The concept of supply chain is sometimes mixed up with the theoretical approach of value chain (Werner 2020, 11). In contrast to supply chain, value chain is more far-reaching because it also includes supportive activities required for adding value to a product like human resource management and technology development (Khan & Yu 2019, 3). Furthermore, aspects like corporate identity and customer retention of a product are considered by value chain but are of minor importance in terms of supply chain (Werner 2020, 18). Another difference is that the concept of supply chain is classified in an operational dimension, while the approach of value chain is rather contextualized in a strategic one. The main purpose of value chain is to identify customer value and subsequently create competitive advantages by providing superior products and services, while supply chain ensures the smooth creation of these products (Tarver, 2020). However, despite some differences between these terms, it can be stated that the approach of supply chain is crucial for an efficient value chain. It embraces the concept of supply chain because well-working supply chain processes are fundamental for ensuring customer satisfaction and thereby assuring a benefit (Khan & Yu 2019, 3).

Furthermore, the concept of supply chain management is sometimes also used synonymously with the term of logistics management (Werner 2020, 12). From a theoretical point of view, logistics management is defined as a part of supply chain management because it contains all transportation and storage processes of raw material, components and products. Additionally, it ensures an appropriate flow of information within the group of supply chain stakeholder. However, the collaborative aspect of actively coordinating different stakeholders is not included in logistics. In that respect, the concept of supply chain management is even more comprehensive in comparison to logistics (Zijm et al. 2019, 33).

The relationship of logistics management and supply chain management is illustrated in Figure 6 (Zijm et al. 2019, 34). The concept of supply chain management embraces the logistics management approach under consideration of creating a collaborating network, which may take place on a supranational level to benefit from globally operating companies.

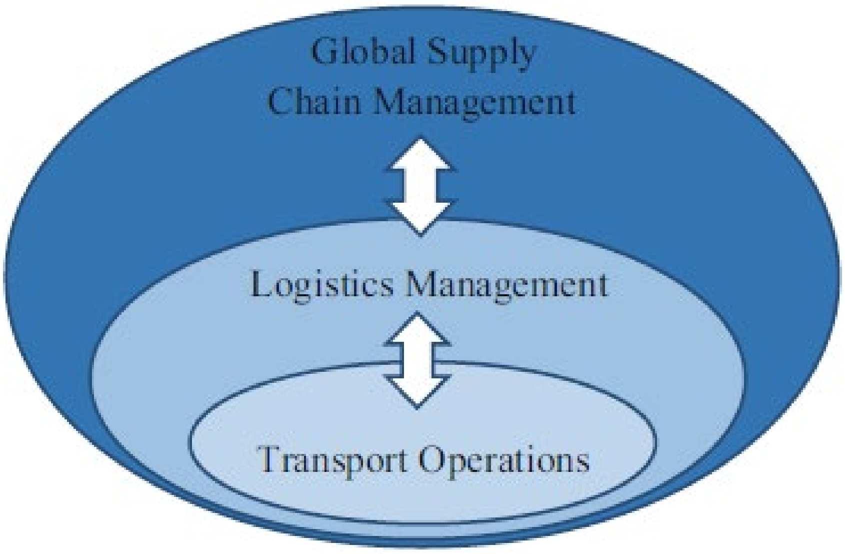

FIGURE 6. Relationship of Supply Chain and Logistics Management

3.2 Purpose of Supply Chain Management

The purpose of supply chain management is to assure a sufficient supply of goods, information and cash flows within supply chain stakeholders, while increasing quality, decreasing costs and improving supply chain's performance in terms of flexibility and time (Werner 2020, 29).

Referring to the former task of supplying goods sufficiently, the so-called 7R objective illustrates the requirements of this aspect appropriately. According to Zijm et al. (2019, 38), supply chain management has to ensure:

The **R**ight goods (i.e. as ordered)
In the **R**ight quantity
With the **R**ight quality
At the **R**ight time
At the **R**ight place
At the **R**ight cost
At the **R**ight sustainable impact/ footprint

Considered from a theoretical perspective, as already stated in the former chapter, the transportation and storage of materials, parts and completed products is the core element of logistics as subcomponent of supply chain management. Hence, the purpose is to efficiently fulfil customer demands (Christopher 2016, 2).

In the following of this chapter, supply chain management's task of affording information sufficiently is described by highlighting four commonly shared types of information within a supply chain. Moreover, one of the most urgent problems of inaccurate information management is illustrated, the so-called bullwhip effect.

In general, due to the fact that several companies are engaged in a supply chain, a well-working information-flow is required to ensure a smooth collaboration (Ha & Tang 2017, 27). Even though a multiplicity of various information is exchanged, four main types of information can be classified related to supply chain management: demand, forecast, inventory status information and product development information. Ideally starting with the customer, the demand information flows along upstream stages of the supply chain and requests a product, parts of a product or services. Forecast data is quite similar to demand information but it has to be defined rather as estimation of future demand than concrete order. Inventory status information encompasses all data concerning quantity and availability of inventory at each stage of the supply chain. Product development information is defined as data which is given by a manufacturer, working on a new product or service, for informing its downstream or upstream partners and making pre-adjustments of their processes possible (Ha & Tang 2017, 28).

An incorrect flow of information reduces the effectiveness of supply chains in fulfilling customer's desires. One of the phenomena caused by an inaccurate information-flow is called bullwhip effect. This is defined as amplification of demand along upstream stages of the supply chain starting at the initial customer request (Ha & Tang 2017, 5). The bullwhip effect is caused by various information-flow shortcomings. One of the main problems is that manufacturers tend to actively overestimate their forecasts to avoid dealing with supply shortages. The costs of cancelling consciously over-forecasted orders, so-called phantom orders, are lower in comparison to the risk of running out of stock. However, although costs are reduced for a single actor, the overall performance of supply chain is decreased (Ha & Tang 2017, 32). In addition to incorrect forecast information, inventory status information is frequently considered insufficiently and consequently exaggerated orders are demanded. Furthermore, due to experienced delays in deliveries, the amount of required safety stock could increase, which leads to excessive order volumes (Ha & Tang 2017, 5).

The bullwhip effect is exemplary shown in Figure 7 related to the information order management of a consumer, a retailer, a distributor and manufacturer (Teixeira, 2021). The amount of raw material, subcomponents or product orders increases along the supply chain due to the previously stated information-flow shortcomings. The customer is sufficiently supplied, but the overall performance of the supply chain is inefficient. The phenomenon is called bullwhip, because the increase of order amount looks like a bullwhip as presented in Figure 7.

FIGURE 7. The bullwhip effect exemplary shown in a supply chain of four parties

In the literature, issues and tasks related to financial flows within supply chain networks are frequently discussed, but the financial dimension of supply chain management has to be considered as well. The financial flow encompasses issued invoices and their specifications in terms of payment terms, physical and virtual cash payments (Pfohl & Gomm 2009, 149-151).

As presented in Figure 8 (Zijm et al. 2019, 29), financial, information and material flows move in both directions along the upstream, presented by the node (n-1) as well as downstream parts, presented by the node (n+1) of the supply chain.

To illustrate the flow in both directions more concretely, if the node (i) in the middle of the Figure is considered as manufacturer of cars, information concerning availability of specific models, current production capacities and estimated delivery days could be given to a retailer, represented by node (i+1). In return, the retailer sends order requests to the manufacturer. After the manufacturer has received raw material and subcomponents, expressed by work-in-process (WIP) in Figure 8, from his supplier, represented by node (i-1), the demanded car is producible and subsequently, the finished good is transported to the retailer. Lastly, an invoice is issued to the retailer.

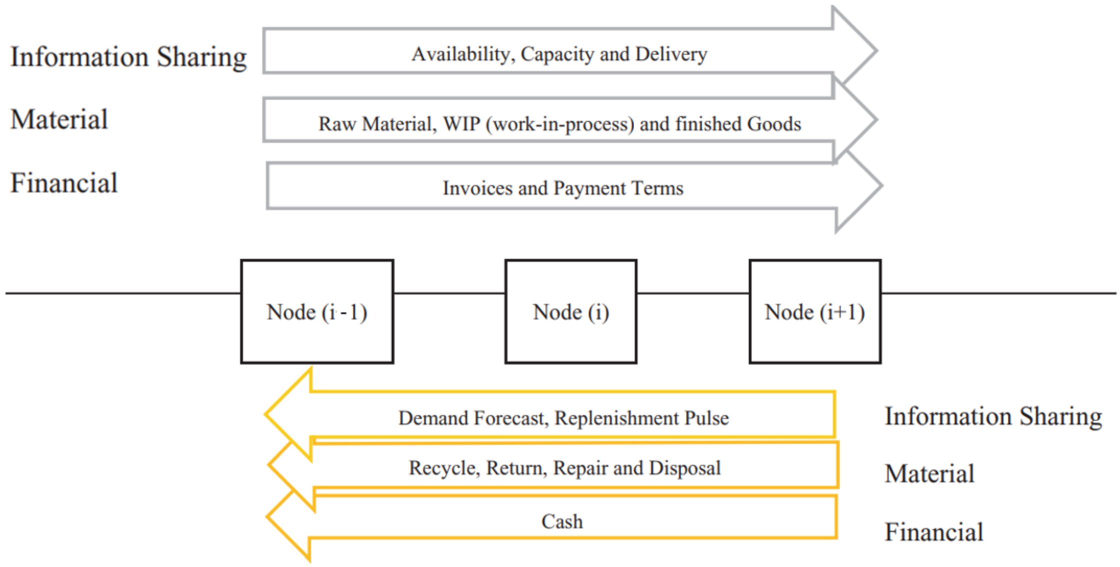

FIGURE 8. Flows within a supply chain move in both directions

4 BUSINESS PROCESS MANAGEMENT LIFECYCLE

4.1 Introduction of Business Process Management Lifecycle

Before the term BPM is explained, the definition of business processes is considered. According to Liebetruth (2020, 2), a business process is described as target-oriented and regularly executed sequence of activities to convert an input into a desired output. To illustrate this input-output-relation exemplarily, input variables could include raw material, information or manpower which is used to produce the output of, for example, a finished product. The required steps to convert a process-initiating input into one or multiple process-ending outputs are predefined (EABPM 2014, 61). In respect of repeatability, the theoretical approach of processes is distinguished from the concept of non-recurring projects (Gadatsch 2020, 6). Several employees, departments or companies are engaged in processes, usually supported by a plurality of software information systems (Gadatsch 2020, 5).

The main purpose of business process management is to align processes for fulfilling customer demands and for achieving operational and strategic aims of a business (Schmelzer & Sesselmann 2010, 6). Process management includes planning, implementation, analysing and optimization of all business processes (EABPM 2014, 62). The key activities of process management are commonly described by a Plan-Do-Check-Act-cycle (PDCA-cycle). However, several interpretations of these PDCA-cycle exist (Kosieradzka & Rostek 2021, 35).

The BPM Lifecycle by Dumas et al. (2018, p. 23) shall be applied as a framework to improve supply chain processes of body converted Crafters. The approach has been chosen because the model starts with an excluded phase, where processes of a company are identified on a high-level and structured according to their need of improvement. This phase is executed once and provides a map of processes to work on for the following phases of the lifecycle, which are organized as a multi-iterative and repeatable cycle (Kosieradzka & Rostek 2021, 38-39). In total, the BPM lifecycle includes six phases, illustrated in Figure 9: Process identification, process discovery, process analysis, process redesign, process implementation and process monitoring (Dumas et al. 2018, 23).

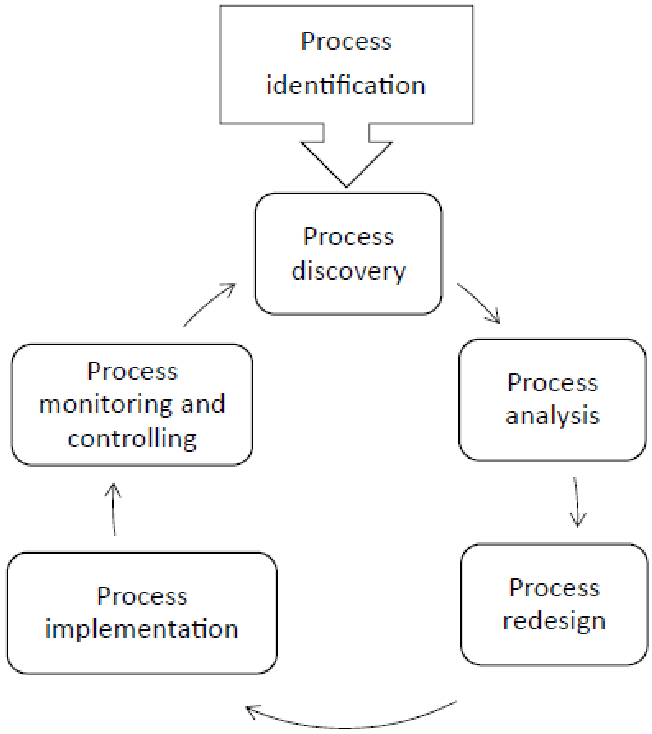

FIGURE 9. BPM lifecycle with an excluded process identification phase

The main purpose of this thesis is to create the process identification phase, because no overview of the processes exist currently at K-Auto. A map of processes existing in the supply chain should be created and improvement potential shall be detected. Additionally, to not only detect issues and also achieve countable results, the most urgent process to work on will be conducted through the remaining phases of the lifecycle.

4.2 Step 1 - Process Identification

In theory, the stage process identification is divided in two steps: the first step is called process architecture definition and the second one is designated as process selection. The purpose of process architecture definition is to systematically illustrate the dealt with business processes and their interdependencies. Subsequently, in terms of process selection, the most urgent processes to be analysed in detail, are identified. Due to limited temporal and financial resources, the selection of business processes according to their urgency is recommended (Dumas et al. 2018, 35).

4.2.1 Process Architecture Definition by SCOR

Referring to process architecture definition as the first step of the excluded process identification phase presented in the former chapter, processes can be described differently in terms of applied perspectives and theoretical models. One possibly used tool to describe processes is a reference model (Dumas et al. 2018, 45). This is a predefined set of ideal processes to identify and illustrate current business practices, which are not standardized and clearly documented yet (Gadatsch 2020, 43). The main advantage of a reference model for describing business processes is that it provides a standardized tool-kit to ensure that all relevant processes have been considered (Dumas et al. 2018, 46). The tool-kit serves predominantly as a framework and hence, is adjustable in accordance to specific requirements of an industry or the dealt with company (Liebetruth 2020, 29). Well-known examples of reference models are the Information Technology Infrastructure Library (ITIL) by AXELOS, the Process Clarification Framework (PCF) or the Supply Chain Operations Reference Model, shortly written as SCOR, by APICS (Dumas et al. 2018, 46).

The latter one is an approach to describe supply chain processes (Werner 2020, 71). Hence, in contrast to other models for describing business processes, the SCOR-model is specialized in illustrating supply chain operations (Bolstorff et al. 2007, 17). Another advantage of this model is that it can be applied in terms of producing companies, service providers, wholesaler as well as retailers (Bolstorff et al. 2007, 22).

The SCOR-model has been developed by the Supply Chain Council (SCC) and was firstly published in 1996. The SCC is a non-profit association founded by the business consultancies Advanced Manufacturing Research and Pittiglio Rabin Todd & McGrath, a subsidiary of PricewaterhouseCoopers, in collaboration with sixty-nine companies from different industries (Werner 2020, 70). In 2014, SCC and the Association for Operations Management (APICS), an organization for the improvement of business processes announced their merger to APICS Supply Chain Council (Eshkenazi, 2014). Today, the company improves continuously the SCOR approach in collaboration with more than 1,500 organizations from different sectors like BASF, General Electric, Procter & Gamble or IBM (Werner 2020, 70).

The SCOR-model encompasses three steps to describe a supply chain level-by-level. The first step portrays the general context of a supply chain in terms of involved companies, their geographical location as well as the traded products. Furthermore, it is defined, which parts of supply chain are considered in the following two steps. This is done by a pre-selection through five process elements: plan, source, make, deliver and return for each stakeholder of the supply chain (Supply Chain Council 2012, 3). Afterwards, in the second step, the process elements are particularly described by a standardized SCOR-Toolbox, where each process element consists of different subcategories to work on. The SCOR-Toolbox is going to be explained in the following of this chapter. In the third stage, after a superior draft of the supply chain has been developed and the processes of each stakeholder were identified, the particular process steps of each process element are structurally shown (Bolstorff et al. 2007, 20).

To illustrate the step-by-step approach of SCOR more comprehensively, Figure 10 has been created (Gulledge et al. 2001). In the first phase, the supply chain and the processes to be described are defined. This step is called top level description (Werner 2020, 71). Subsequently, the previously determined process elements are further detailed by the SCOR-Toolbox, presented in Figure 12 on page 22, where each process element is further described by subcategories of the element (Bolstorff et al. 2007, 20). In the case, presented in Figure 10, the return process element, visible in the upper right corner between retailer and customer, is further described in terms of reasons for the return process. In this case, the return process due to unexpected product defects as well as the return process due to regular maintenance is considered. In the literature, the second step is called configuration level (Werner 2020, 72). Lastly, each process element is structurally illustrated, as presented in the lower right corner of Figure 10. The step is designated as process element level, as shown in Figure 10 (Werner 2020, 75).

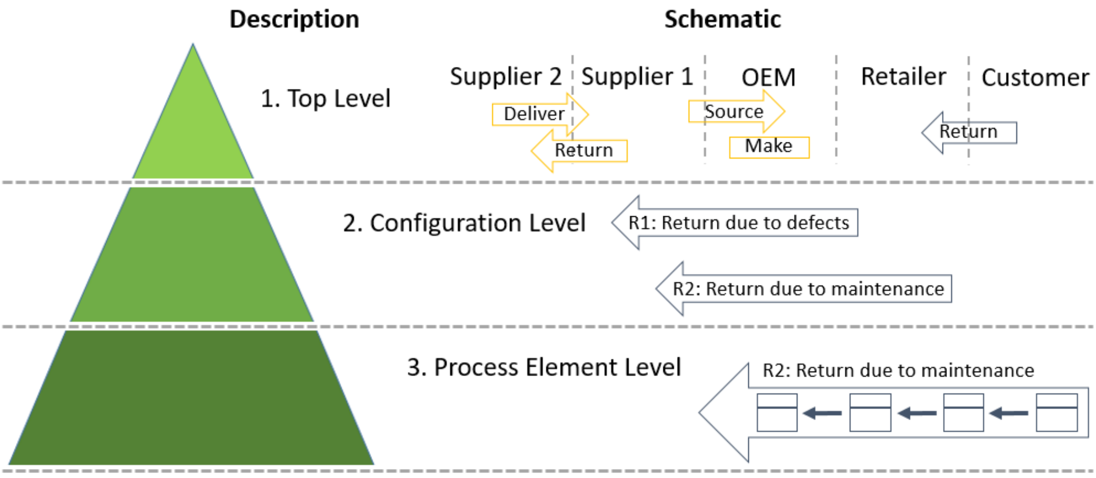

FIGURE 10. Approach of SCOR to describe supply chain processes (Gulledge, et al. 2001, modified)

Top Level Description

In the following paragraph, the process elements of top-level description are explained in detail. According to Werner (2020, 73), five process elements are distinguished: plan, source, make, deliver and return. In other versions of SCOR, another process element is added, which is called enable. The enable process element encompasses all information exchange operations (Bolstorff et al. 2007, 135). However, Werner (2020, p. 74) summarizes all information management operations in so-called infrastructure processes. The process elements to define supply chain operations are illustratively shown in Figure 11 (Zijm et al. 2019, 35)

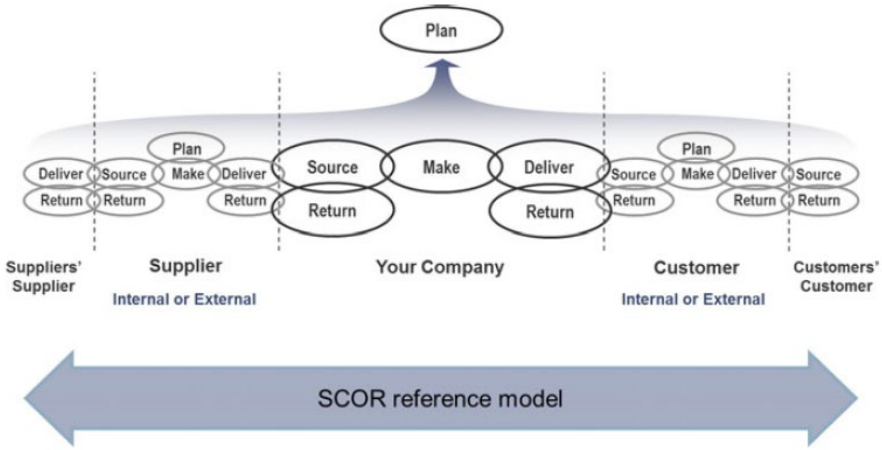

FIGURE 11. Process elements of SCOR on the top-level description

The process elements source, deliver and return describe the interrelation of supply chain stakeholders to their upstream supplier and downstream customer stages. The make process element defines the internal operations executed by the considered supply chain stakeholder. For example, if the supply chain stage designated as *your company* in Figure 11 is a car manufacturer, the source element would describe how tires and other subcomponents of cars are transported from previous suppliers to the production line of *your company*. The make element would describe the assembling process of subcomponents to a final car and the deliver process element would describe its transport to the next supply chain stage like a retailer or customer. If any returning operations are required, for example, due to quality issues in subcomponents or the car itself, these operations are considered by the process element return. The process element return is divided in source return to an upstream stage and deliver return back from a downstream stage of the dealt with supply chain stakeholder (Werner 2020, 73). In terms of the former car manufacturer example, returning of subcomponents to suppliers would be considered by the process element source return, while returns of already delivered cars would be considered by the process element deliver return. The process elements source, make, deliver and return are also designated as execution operations. Execution operations change the characteristics or location of raw material, components or finished products (Bolstorff et al. 2007, 135). Additionally, these elements are controlled by a superior plan process element. Plan processes measure and subsequently align the amount of required resources for accomplishing the desired outcome (Bolstorff et al. 2007, 135).

Configuration Level Description

In the following Figure 12, the SCOR-Toolbox provided by Werner (2020, 74) is shown to describe the process elements of the first step more detailed. In terms of the process element plan, planning operations could deal with the general design of a company's supply chain (P1) as well as with the planning of source (P2), make (P3), deliver (P4) and return (P5) process elements.

Furthermore, as visible in Figure 12, the process elements source, make and deliver are distinguished in terms of their production strategy of the dealt with material, component or final product. The make-to-stock approach (MTS) is defined by a production program based on estimated forecasts instead of real customer orders. Raw materials, components and finished products are produced and subsequently stored ahead until they are demanded by the downstream stage of the supply chain stakeholder. In contrast, the make-to-order strategy (MTO) as well as the engineering-to-order strategy (ETO) are characterized by a production program, which is scheduled based on specific customer orders. The difference between these production strategies is caused by the accomplishable complexity of customer desires. In terms of ETO, the customer is able to order a highly customized and complex product, while, referring to MTO, just a limited variety of product variants are selectable (Barbosa & Azevedo 2018, 5147).

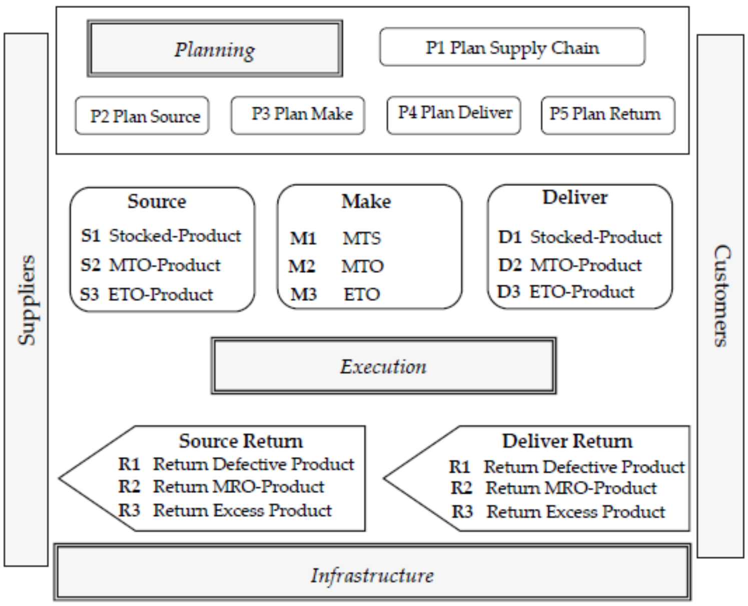

FIGURE 12. SCOR-Toolbox to describe process elements in detail

The returning operations are subdivided corresponding to reason for the return. Firstly, the return of material, components or finished products from a downstream or back to an upstream stage of the supply chain could be caused by defects, which is shown by R1 in Figure 12. Secondly, the return operations may take place due to maintenance, repair or overhaul activities, which is expressed by the abbreviation MRO, which stands for **m**aintenance, **r**epair, **o**verhaul, in the figure. Thirdly, material, components or finished products have been sourced or delivered excessively and therefore it is required to return the excessive amount (Werner 2020, 74).

Process Element Level Description

In terms of the third SCOR step, after the process elements of each supply chain stakeholder have been described, each process element is structurally shown in concrete process steps (Werner 2020, 75). For example, the make process element of a product requires four steps: withdrawal of material, manufacturing, packaging and storing as presented in Figure 13.

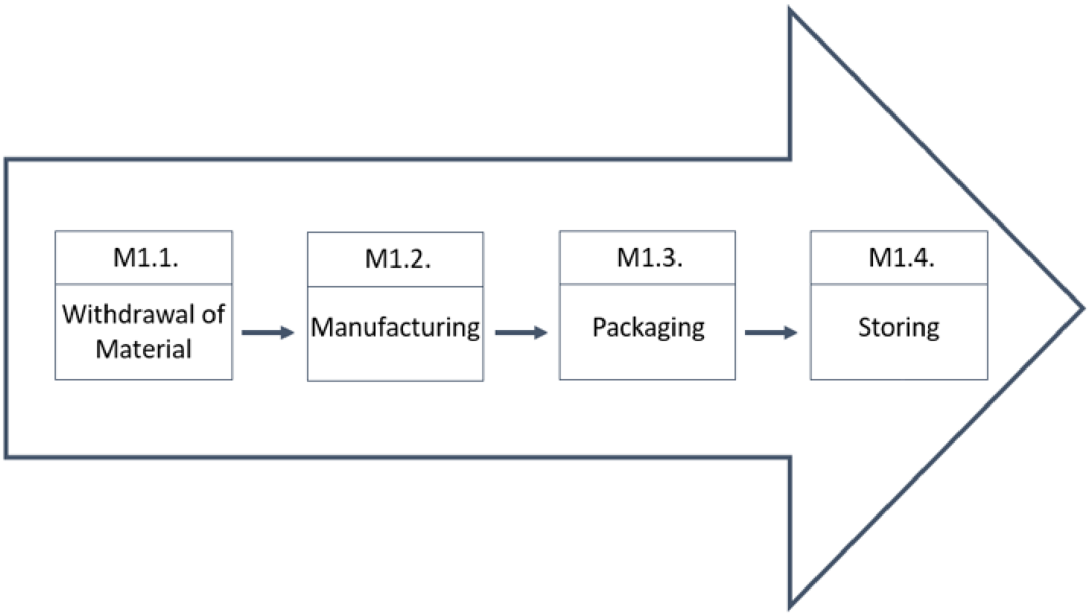

FIGURE 13. Exemplary process arrow of SCOR process element level (Werner 2020, 76, modified)

The documentation of each process step is usually standardized. Plan operations are described by a capital “P”, sourcing activities are labelled by “S”, making operations by “M”, delivery activities by “D” and return processes are designated by the capital letter “R” (Bolstorff et al. 2007, 135). The subcategories are designated with a pre-defined digit in addition to the previously stated capital. For instance, as visible in the SCOR-Toolbox of (Werner 2020, 74), return due to defects is designated with R1, return due to maintenance, repair or overhaul is designated with R2 and return due to excessiveness is marked by R3. Additionally, according to their execution order, the detailed process steps are marked with a second digit. For instance, if the previously stated product example is produced and stored ahead (M1; MTS), the first step of scheduling a production slot is designated with M1.1., withdrawal of material with M1.2., manufacturing with M1.3., packaging with M1.4. and storing is marked with M1.5 (Bolstorff et al. 2007).

4.2.2 Process Selection by Process Portfolio

Referring to process selection as the second step of the excluded BPM process identification phase, a frequently used tool to determine the demand of improvement for particular processes is the Process Portfolio. It encompasses all dealt with processes and visualizes these according to different criteria. Thereby, the management of a company is able to decide which processes should be considered in detail. In the beginning of BPM, it is proposed to select just a small project and gain learning effects. Too many improvement projects lead to complexity of coordination because business processes are usually interrelated. The process selection is based on three different dimensions: strategic importance, health and feasibility of the process (Dumas et al. 2018, 64).

The first criteria, strategic importance, evaluates the value of the chosen process regarding strategic goals of a company. For example, if a predominantly revenue-orientated business generates most of its revenue after a product has been sold, after-sales processes are most important. In general, the strategic importance of a process is commonly assessed under consultation of senior managers of a company.

The second criterion health describes the efficiency of converting an input into a desired output or, in other words, the process performance. The most common performance dimensions are time, costs, flexibility and quality in terms of processes (Dumas et al. 2018, 65-66). The first element time could be assessed by throughput time, also called cycle time, which measures the required time for successfully conducting a process. Additionally, the time dimension could be further detailed by, for example, measuring waiting or idle times in the process (Dumas et al. 2018, 59). Regarding costs, the potential to reduce costs is usually assessed. Moreover, the improvement of revenue and yield could be targeted as well (Dumas et al. 2018, 60). The third process performance dimension, flexibility, defines the capability of a process to react to changes. For instance, the additional costs for converting 20% more input into output could be measured (Dumas et al. 2018, 61).

Referring to the fourth supply chain process performance aspect quality, four definitions are stated by Nagurney and Li (2016, 6-7). The first one describes quality as degree of meeting customer's requirements. However, customers of the process with differing requirements exist, leading to a rather subjective process evaluation. Further, the authors define that, secondly, quality is excellence or, thirdly, value. Both terms are too abstract and hence, not suitable for a practical evaluation of supply chain process quality in this thesis. The last aspect for quality by Nagurny and Li (2016), the conformance-to-specification approach, most likely enables measurability of quality. This concept defines quality as the deviation of internally predefined expectations of a process and its real manifestation. To measure the quality numerically, the costs for eliminating quality shortcomings are calculated. For example, expenses for dealing with complaints or rework are measured (Nagurney & Li 2016, 8-9).

The third criterion, feasibility, suggests the convertibility of a process. Some processes are not easily adjustable due to complex allocation of competences or political and cultural obstacles. The element feasibility is distinguished in low, medium and high, which is expressed by different levels of grey of bubbles marking a process (Dumas et al. 2018, 56-57). An exemplary process portfolio by Dumas et al. (2018, 64) is shown in Figure 14. The criteria strategic importance is included on the y-axis, health shown on the x-axis and feasibility expressed by the colour of the process bubbles. To choose one process to deal with in the following of the BPM lifecycle, the selection focus is set on unhealthy processes with both, a high strategic importance as well as high feasibility.

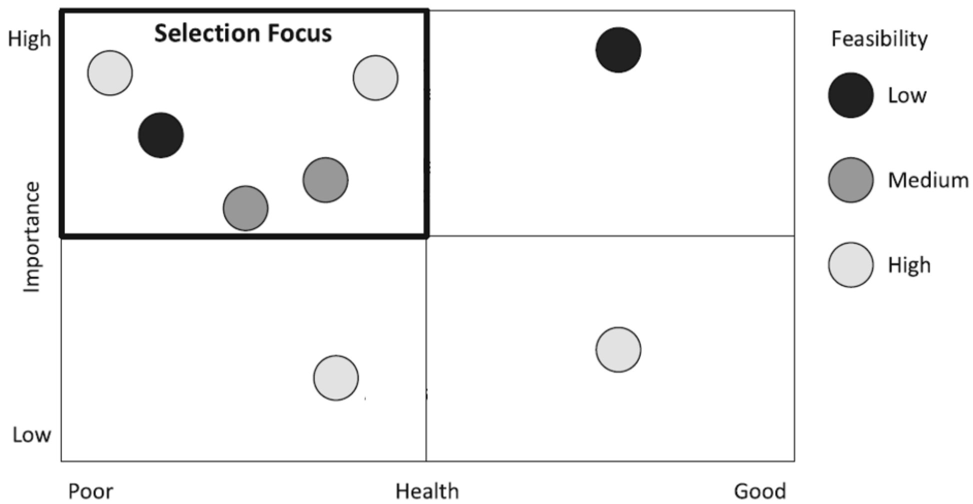

FIGURE 14. Process portfolio template (Dumas et al., 2018, 64, modified)

4.3 Step 2 – Process Discovery

After the processes have been identified and the most relevant process to work on has been selected, the process steps of the chosen process should be discovered in detail (Dumas, et al. 2018, 75). The tool proposed by BPM literature to clearly explore the process steps is a swimlane-diagram (Dumas et al. 2018, 18). A swimlane-diagram is used to highlight dependencies and responsibilities of processes across interdivisional or organizational borders. Each lane indicates the circle of influence of a division or a company. To illustrate process flows in swimlane diagrams, different so-called languages are applied like the widely-used Business Process Model and Notation (BPMN) standard, launched by the Object Management Group (OMG) in 2013 (Dumas et al. 2018, 18). However, the modelling approach of BPMN integrated in swimlanes is rather used for modelling detailed administrative processes and hence, does not suit for complex supply chain processes very well (Liebetruth 2020, 41).

Therefore, the supply chain process selected in the process portfolio, introduced in chapter 4.2.2, is modelled in detail by concretizing the process element level of the SCOR-model, presented in chapter 4.2.1. The structurally shown process steps of each element, as previously presented in Figure 13, are particularly described by standardized process cards (Werner 2020, 76). According to Werner (2020, 78-79), the process cards encompass core Key Performance Indicators (KPIs), which are described in Table 1.

Key Performance Indicators are multifaceted and always depend on the considered kind of process step. A process step related to storing finished goods requires different KPIs than a transport process step. For example, regarding transportation, it is important to measure the covered distance of the transport, while the amount of required warehouse capacity is evaluated for the storing activity (Liebetruth 2020, 56).

TABLE 1. KPIs included in SCOR process cards

Key Performance Indicator	**Definition**
On Time Delivery to Request	Measures the amount of orders which have been delivered in time to the customer in %
Order Fulfilment Lead-time	Required time to fulfil a task in days
Upside Production Flexibility	Required time to adjust the process step to produce 20% more of the step's output
Total Supply Chain Costs	Costs of the process step in relation to the total revenue of the process' product
Cash-to-Cash-Cycle	Time between invoice and final cash payment
Inventory Days of Supply	Number of days that inventory is hold in stock until it is sold to or used by a customer
Asset Turns	Amount of inventory turnovers per year

The applied discovery method is similar to the concept of value stream mapping, as shown in the literature of Liebetruth (2020, 46) or logistic related value stream mapping introduced by Knössig (2013, 135-144). However, to not exceed the amount of applied theoretical models in this thesis, the SCOR approach is deepened as shown in Figure 15, instead of newly introducing value stream mapping.

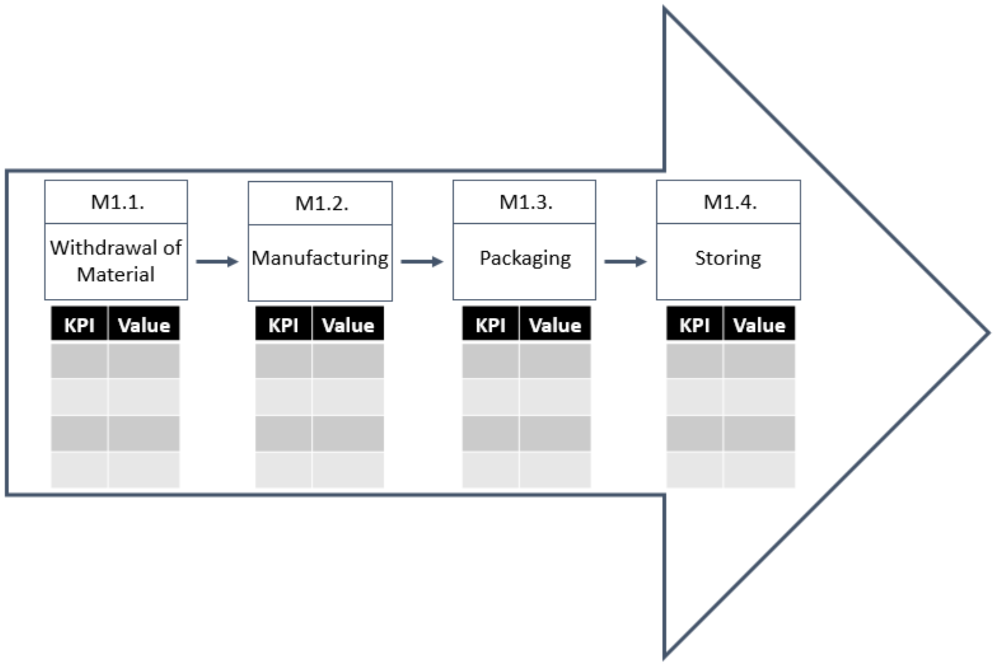

FIGURE 15. SCOR process arrows extended by KPIs

4.4 Step 3 – Process Analysis

After the current process model has been illustrated in the second step of the BPM lifecycle, process discovery, the chosen process can be analysed by various tools in detail. One of these tools is waste analysis, a core technique of the Toyota Production System developed by Taiichi Ohno in the 1970s, which has been accommodated in the so-called lean principles (Dumas et al. 2018, 218-219).

Waste analysis tries to improve the efficiency of a company by eliminating all operations that do not add value to products or services of a business and thereby are not beneficial for customers (Fiedler 2018, 13). The Japanese term for waste is designated as muda (Dumas, et al., 2018, p. 219). According to Koether and Meier (2017, 9), seven types of muda exist: transportation, motion, waiting, inventory, defects, overproduction and overprocessing. To keep the seven types in mind more easily, three categories are introduced: move, hold and overdo. Move encompasses waste caused by transportation and motion, while the hold group summarizes excessive inventory and waiting times. The latter on, overdo, comprises defects, overproduction as well as overprocessing (Dumas et al. 2018, 219).

4.5 Step 4 – Process Redesign

The fourth step of BPM lifecycle is called process redesign or process improvement. In this phase, different solutions are provided and tested to eliminate the detected issues of the former phase process analysis (Dumas et al. 2018, 297). For example, if it has been inspected that quality defects frequently occur in the production process of a company, the manufacturing operations could be compared to business practices of a company with similar products. This redesign tool is called benchmarking and describes the comparison of current in-house processes with business practices of a similar company (Dumas et al. 2018, 309). The BPM phase of process redesign goes hand-in-hand with the former phase of process analysis. If shortcomings are detected while process analysis, the redesign phase tries to reduce the revealed shortcomings. However, if a new process model has been proposed by a redesign method, the validity of it is proofed by process analysis techniques such as waste-analysis (Dumas et al. 2018, 23).

To illustrate the complexity of different redesign models, the so-called Redesign Orbit of Dumas et. al. (2018, 306) is slightly adopted shown in Figure 16. As the x-axis, the y-axis and the two circles of different sizes show in the Figure, the editors classify tools for redesigning processes on the basis of three dimensions. The redesign models are either transactional, which means that processes are redesigned incrementally, or transformational, which describes a completely new, and disruptive redesign. Furthermore, it is assessed if the redesign tool takes into account external practices and factors or predominantly focuses on in-house practices. Moreover, the analytical or creative manifestation of a redesign tool is evaluated. The applied redesign tool in this thesis is benchmarking. As shown in Figure 16, it is described as outward-looking, because it takes into account external business practices of a similar company. The benchmark approach tries to adopt already existing business practices and therefore, is evaluated as rather analytical than creative. Due to the already existing character of the solution, the redesign tool is rather classified as transactional than transformational (Dumas et al. 2018, 306).

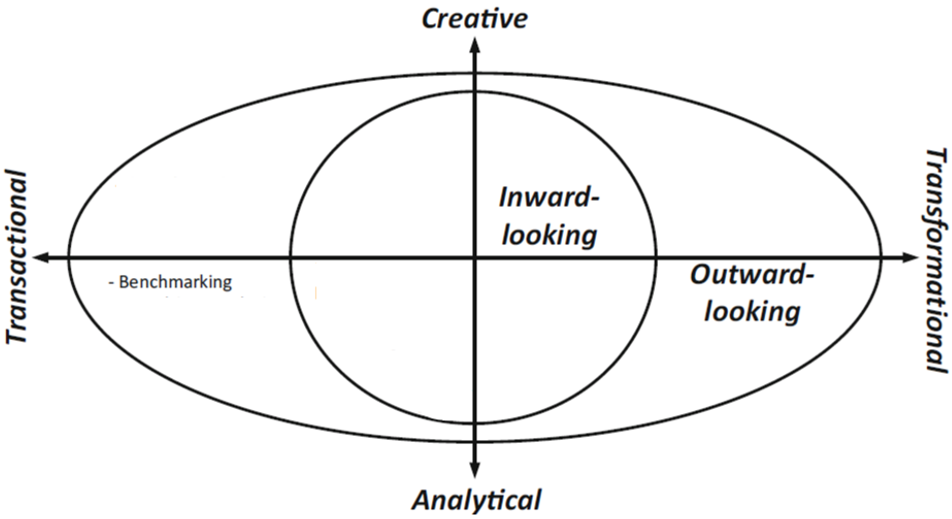

FIGURE 16. Redesign orbit to classify different redesign tools (Dumas et al. 2018, 306, modified)

4.6 Step 5 – Process Implementation

After a to-be process model has been created, the implementation of it is executed in the fifth step. The implementation phase embraces changes related to process practices executed by humans as well as required changes of process automation (Dumas et al. 2018, 23). In terms of process automation, abstract process models are translated into executable process instructions. For instance, if a new concept to manufacture cars at a production line should be implemented, the machine software is adjusted to fulfil the desired concept appropriately (Dumas et al. 2018, 371). Referring to the process practices by humans, the process participants are informed about the upcoming changes. At this stage, it is possible to appoint change experts to assist the process modification. Additionally, training sessions are provided to ensure a smooth start of the new method. For instance, with regard to the former production line example, health and safety briefings can be held and instructions of new manufacturing practices are given to the employed workforce (Dumas et al. 2018, 22).

4.7 Step 6 – Process Monitoring

Monitoring newly implemented processes is important to recognize performance deviations, which were not expected or thought about beforehand. At this point, collecting quantitative data is crucial to detect deviations of performance objectives and their real manifestation (Dumas et al. 2018, 23). For example, in terms of the former production line illustration, if the quality issues are reduced by the new process, but the costs of running it exceed the costs of rework, the new production procedure does not contribute to the overall objectives of the company. A frequently applied tool to monitor process performances is a dashboard with graphically illustrated Key Performance Indicators (Dumas et al. 2018, 415).

5 DATA COLLECTION METHOD

5.1 Standardized, Semi-standardized and Unstructured Interviews

Interview is a commonly used tool to collect qualitative data (Helfferich 2019, 669), but could also be utilized to gather quantitative data (Bogner et al. 2014, 23). Quantitative data are numerical and more generalized, while qualitative data are non-numerical and rather classified as subjective (Singh & Ramdeo 2020, 212). To illustrate it more clearly, the results of a comprehensive survey concerning an upcoming parliamentary election would be classified as quantitative data, while the detailed motivation of a single household to vote for a specific party would be characterized as qualitative data.

In general, three different types of interviews are distinguished in terms of their prepared guideline and its included questions: the standardized, the structured and the unstructured interview (Wübbenhorst, 2018). The structured one is sometimes also designated as semi-standardized interview (Flick 2017, 203).

The standardized interview is useful to conduct quantitative data (Von dem Berge 2020, 276). This type of interview is characterized by a standardized guideline with predetermined closed questions. Closed questions mean that a dedicated set of answers is given to the interviewee . The interviewer conducts the interview precisely according to the guideline in terms of wording and sequence of questions. It is not possible to add any question intuitively (Von dem Berge 2020, 277). The standardized interview is quite similar to questionnaire surveys. However, the oral conduction is beneficial if the interviewed person faces literacy difficulties (Ryan et al. 2009 , 310).

Structured or semi-standardized interviews are characterized by a guideline encompassing open-ended questions the interviewer would like to deal with. The term open-ended means that the interviewee is able to reply freely without considering a set of predetermined answers. In contrast to standardized interviews, the questions can be asked disorderly and flexible in terms of wording. Furthermore, the interviewer is able to add questions intuitively. The guideline serves merely as a list of cornerstones, contradicting the structured interview (Edwards & Holland 2013, 29). It is assumed that the interviewee has a subjective amount of knowledge, which is revealed by a predefined set of open-ended questions (Flick 2017, 203).

The last type, unstructured interviews, encompass neither a guideline with prepared questions nor a predetermined list of selectable answers. The interviewer decides intuitively which questions should be dealt with. Then, the candidate answers these questions without any restrictions in terms of length and structure (Von dem Berge 2020, 278).

5.2 Expert Interviews

The expert interview is a specific type of standardized or semi-standardized interviews based on a predefined guideline (Flick 2017, 214). It is also possible to conduct expert interviews without a guideline (Bogner et al., 2014, 1). However, this is not appropriate for describing complex processes due to commonly faced time issues of experts. The standardized or semi-standardized expert interview directly focuses on required aspects which should discussed during the interview (Flick 2017, 215).

According to Bogner et al., experts are defined as qualified persons with special knowledge (2014, 9). In the literature, expert knowledge is distinguished in three types: technical, process-related and evaluative comprehension. Technical knowledge is defined as objective information carried by an expert that could be also requested by interviewing a different expert of the same field. In contrast to the generality of technical knowledge, process-related knowledge is based on personal experiences of the expert with specific processes, interactions and organizations. Even though the knowledge depends on subjective perceptions, it is still factual and does not include personal assessments. The third type, evaluative knowledge, embraces all personal assessments of subjectively experienced processes, interactions and organizations (Bogner et al. 2014, 19).

The selection of experts highly influences the outcome of the interviews. Therefore, the selected interviewees should be directly engaged in the analysed issues. Furthermore, it is required that the participants are willing to and, additionally, have enough time to talk about the desired aspects (Von dem Berge 2020, 282-283).

The prepared guideline for the expert interview should be developed based on the dealt with issue or, if a theoretical approach could be beneficially applied, on this theory (Von dem Berge 2020, 286). The theory is used to divide the interview in homogeneous sections and subsequently, create interviewee-tailored questions which contribute to the aim of the interview (Flick 2017, 204). The structure of a guideline should prevent abrupt topic changes to ensure a fluent stream of speech. Moreover, descriptive and evaluating questions shall be asked in separated sections of the conversation (Helfferich 2019, 677). Referring to the procedure, the interview should start with a short introduction of the interviewer and, additionally, the context as well as the approximate structure of the interview (Niederberger & Wassermann 2015, 59).

After the expert interview has been conducted, it can be evaluated by applying various methods which depend on the goal of the interview (Niederberger & Wassermann, 2015, 61). According to the purpose, three types of expert interviews are distinguished: explorative expert interviews for gaining first insights of an unknown field. Systemized expert interviews for gathering comprehensive and detailed information of a known field as well as expert interviews for creating new theoretical hypothesis in a scientific context (Bogner et al. 2014, 23-25). If expert interviews intend to gather comprehensive and detailed information of a known field, the collected data are analysed and specific parts of the interview are written down according to the prepared questions of the guideline (Niederberger & Wassermann 2015, 61-62).

6 PROJECT

6.1 Process Architecture Definition by SCOR

6.1.1 Top Level Description by SCOR

The Top Level description as first step of SCOR, according to chapter 4.2.1, to create the process architecture definition as first step of the excluded process identification phase described in chapter 4.2, has been done in collaboration with the supervisors of this thesis, Mr. Aalto and Mr. Hyvönen. As previously described in the purpose of this project (see chapter 1.2), the supply chain of body converted Crafters shall be illustrated to create a common discussion basis for the involved companies. The supply chain is not well documented yet and hence, do not provide a basis to discuss process adjustments and improvements.

As presented in Figure 17, the supply chain of body converted Crafters consists of five stages: VW CV, the logistics company SE Mäkinen, Premium Partners, K-Caara dealerships and end-customers.

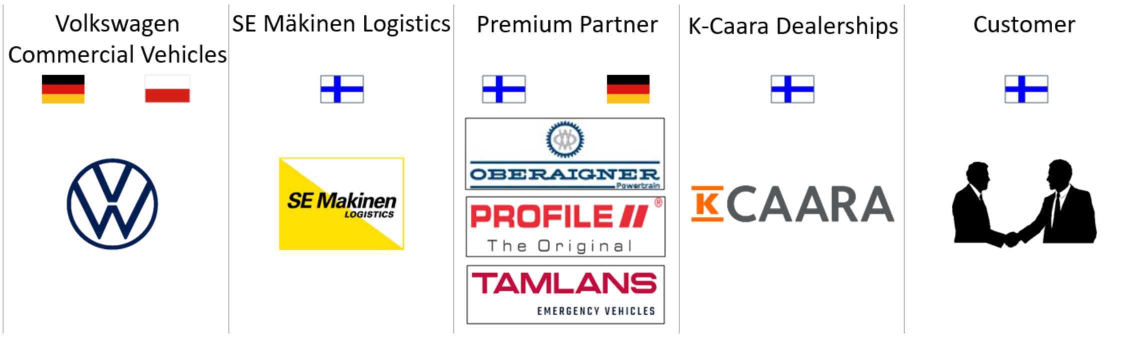

FIGURE 17. Top Level description supply chain of body converted Crafters

Starting with the supply chain stage on the left edge of Figure 17, Crafters are produced by VW CV. The company is headquartered in Hanover and hence, the German flag is shown in that phase of the supply chain. Furthermore, as already explained in the company presentation of VW CV in chapter 2.2, the Crafter is produced in Wrzesnia by VW Poznan GmbH. Consequently, the Polish flag is also added in the Figure.

The second section of the Figure includes the logistics company SE Mäkinen. They are responsible for all transport operations within Finland and check the physical appropriateness of Crafters after their arrival in Finland. For example, the tire pressure is examined and smaller surface issues are repaired. Furthermore, SE Mäkinen is responsible for the first registration of cars in Finland on behalf of K-Auto. The company is also capable of adding smaller accessorizes and body conversions like tow bars or air suspensions.

The central stage represents Premium Partners involved in the Crafter business in Finland. As explained in chapter 2.3., a Premium Partner is the highest certification level of VW body builders. In total, three Premium Partners are involved in the Finnish Crafter business. These are Profile, a body builder for emergency vehicles, Tamlans, a body builder for taxis and emergency vehicles and Oberaigner Automotive GmbH, a body builder that adds four-wheel drive to Crafters. Due to lower sales volumes of Crafters, four-wheel drive is not directly offered by VW CV and hence, provided by an external body builder. In general, sales figures of Premium Partners were not accessible due to compliance issues. In terms of their geographical location, Profile and Tamlans are both located in Finland, while Oberaigner is based in the near of Rostock, Germany.

The fourth section of the Figure represents the dealer network K-Caara of K-Auto. Body converted Crafters are also sold by other dealer groups authorized by the importer. The scope of this thesis is to detect improvement potential from K-Auto's point of view. Therefore, other dealer groups than K-Caara are not considered. Additionally, workshops for basic car as well as body conversion maintenance and repair are located at the same premises as the dealerships and build so-called Volkswagen Centres.

The last stage presented in the Figure are customers. However, they have not been interviewed during this project, but it is necessary to show their role as well, in order to illustrate a complete supply chain.

By considering Figure 18, the scope of the upcoming supply chain description is set. The purpose is to illustrate the information exchanges and transport operations between the supply chain stages, as presented by the plan, source and deliver process elements introduced in chapter 4.2.1. Furthermore, if these processes take place, the return operations between the supply chain stages shall be described and analysed. The internal manufacturing processes of VW CV and the Premium Partners are questioned in interviews superiorly, but are not going to be shown on a process element level, because it would extend the scope of this thesis. Furthermore, due to limited capacities, the suppliers networks of VW CV and Premium Partners are not considered.

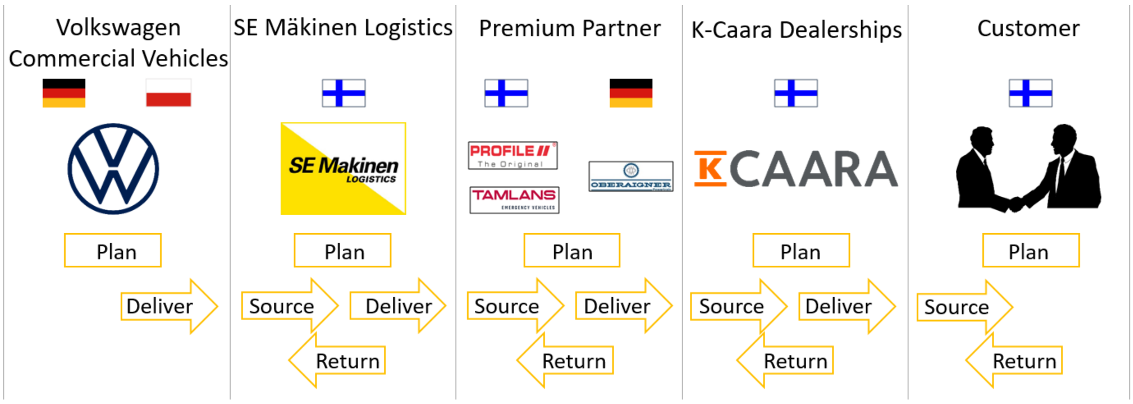

FIGURE 18. Scope of supply chain process analysis

6.1.2 Configuration Level by Expert Interviews

To create the process architecture definition as first step of the excluded process identification phase, presented in chapter 4.1, the configuration level as second step of SCOR, presented in chapter 4.2.1 is executed in the following. Interviews are conducted to question the previously stated process elements plan, source, make, deliver and return of each supply chain stakeholder. These interviews form the basis for examining the process steps in detail, which is the third step of SCOR model, presented in chapter 4.2.1.

To ensure a comprehensive and structured collection of process information, semi-standardized expert interviews are used, as introduced in chapter 5.1. The process elements serve as cornerstones to develop open-ended questions, which are slightly adopted to the individual interviewees.

The interview guideline begins with the plan process element to gain a first overview of the planning processes of each supply chain stakeholder. Thereby, it should become apparent how each supply chain stage is connected to its upstream and downstream stages. Referring to the connection, sourcing operations from upstream stages (P2), delivering operations to downstream stages (P4), returning from the downstream stage or returning back to the upstream stage (P5) and general administrative operations within the SC (P1) are questioned. The subcategory planning of manufacturing (P3) is merely seen as internal operations and therefore, is questioned at the end of this section. By questioning the plan process element in the beginning of the interview, the focus of the interview is determinable and some parts of the guideline are negligible in the following dialogue. For example, if no return activities back to an upstream stage due to damages or excessive deliveries have to be planned, the return source part of the guideline can be skipped.

After the plan process element has been reviewed, every execution process element, source, make, deliver and return, is considered in a separate section of the guideline. According to the SCOR-model illustrated in chapter 4.2.1., the process element return is subdivided in return source back to the upstream and return delivery from the downstream stage of the supply chain. This division is discussed in unique parts. To initially gather process-related and subsequently collect evaluative knowledge as described in chapter 5.2., each section starts with descriptive and ends with evaluating questions.

Thereby, the interview is divided in thematically homogenous parts, which support the stream of speech of the interviewee. For example, the participant explains how cars are transported in terms of the responsible company as well as applied means of transport and simultaneously describes the used systems for exchanging information about the physical transportation. The applied guideline is attached in Appendix 1.

Selection of interviewed experts

According to the literature introduced in chapter 5.2, chosen experts for collecting information should be directly engaged in the analysed processes. Furthermore, as stated in chapter 5.2., participants should be willing to provide the required information. Additionally, due to the fact that not all of them are able to speak English fluently, the language barrier has had to be considered in terms of this project. The experts were chosen under consultation of Mr. Samuli Aalto, who is aware of the language skills as well as the willingness of the interviewees to provide appropriate process-information. Initially, at least two experts should have been interviewed for the supply chain stages of K-Caara, VW CV, Premium Partners and SE Mäkinen. Referring to K-Caara as the in-house dealership network of the K-group, the VW Centres of Espoo and Tampere have been chosen because these dealers are contributing to sales a lot. It was assumed that the salespersons are capable of providing information concerning all process elements of SCOR including the return delivery process element.

In terms of the logistics service provider SE Mäkinen, an employee of the transport operations department as well one responsible for the storing activities of cars have been interviewed.

The Premium Partner Tamlans and Profile have been interviewed, because they produce bigger order volumes in comparison to Oberaigner. However, a couple of common appointments were held with Oberaigner referring to their after-sales services together with Mr. Aalto and Mr. Hyvönen. It would have been also possible to interview other body builders like Verhoomo Sorsa or Assistor, though the previously mentioned body builders are the most important players collaborating with K-Caara.

Regarding VW CV, it was possible to select interview partners based on past experiences of the author at the manufacturer. As part of the dual study programme in Industrial Engineering, an adjoining department of the international sales and the logistics department was passed through. Therefore, an interviewees responsible for sales business in Finland and an interviewee responsible for outbound logistics were easily identified.

Execution of Interviews

The interviews were scheduled for one and a half hour and were conducted via Microsoft Teams due to the current Corona pandemic. They were prepared according to the approached stakeholder at the different stages of the supply chain. The interviews were not recorded, but notes have been taken, which were worked up afterwards. The summaries are shown in Appendix 2 to 8.

The first interviews were conducted with K-Caara to set the focus of the subsequent meetings with the Premium Partners, the logistics company SE Mäkinen and VW CV according to perceived shortcomings of the dealerships. The project focuses on the improvement of supply chain processes from the perspective of the importer and therefore, concerns of K-Caara as the importer’s dealership network should be considered at first. All interviews were conducted with just a single person except for the one with the logistics company SE Mäkinen, where both experts have been interviewed at once due to language issues.

The collected knowledge is used to create the process architecture definition of the current supply chain of body converted Crafters in the next chapter 6.1.3.

6.1.3 Process Element Level - Informational processes

Adjustments of process visualization method

To complete the process architecture definition of the excluded process identification phase, the Process Element Level as third step of SCOR, introduced in chapter 4.2.1, is carried out. Instead of reproducing each SCOR process element questioned in the interviews, the gathered process information are structurally presented. The visualisation is divided in informational and physical processes, according to the different supply chain flows, as presented in chapter 3.2, of material, designated as physical processes, information and cash. In order to not exceed the scope of this thesis, the cash related flow is not considered. It is assumed that, in contrast to physical and informational processes, the cash flow affects body converted Crafters just secondarily.

The complexity and abstractness of the SCOR model does not contribute to comprehensibility of process visualization, but were crucial for structurally conducting the interviews. For example, the deliver process element equals the source process element of its downstream supply chain stage. If each element would be illustrated again, some information would be repetitively shown. Nevertheless, during the interviews, the double-checking of process perceptions helped to detect differing perceptions, which have been clarified afterwards. The process arrows of SCOR-configuration level explained in chapter 4.2.1. are applied to show the steps of each process in the following.

Furthermore, the processes are designated according to their flow type physical or informational processes. The latter one are marked with a capital I and physicals are labelled with a capital P. Additionally, to prevent confusion, the processes are marked with a digit and a headline is assigned to indicate, what it is about. For example, the first one is dealing with the informational process of order clarification. Consequently, it is designated as I1 – Order clarification.

Visualization of informational processes

The informational processes defined in the following of this chapter, are presented in Figure 19. As shown by I1 in the Figure, the visualization starts at the stage of K-Caara. Secondly, the informational supply chain processes of VW CV are described in terms of order placement leading to delivery date determination as indicated by I2 in the Figure. Thirdly, shown by I3 in Figure 19, the process architecture definition is going to deal with informational exchanges related to after-sales services of Crafter body conversions.

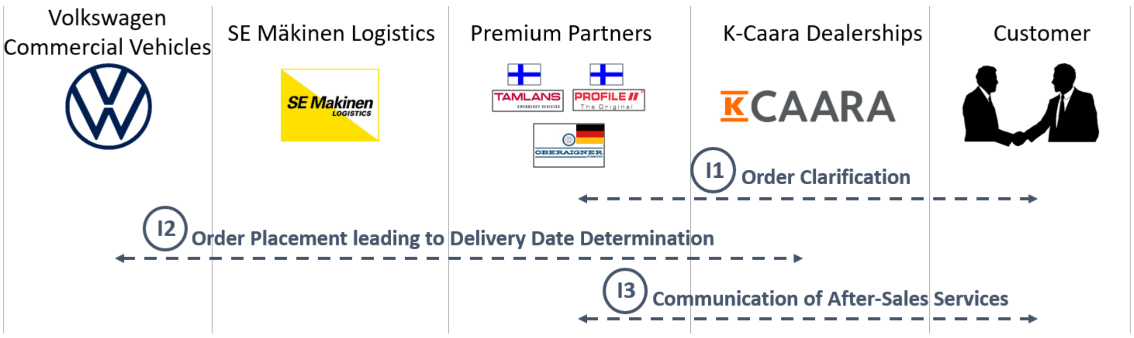

FIGURE 19. Informational supply chain processes of body converted Crafters

I1 - Order clarification

To start with the first stage of K-Caara, two types for ordering Crafters are distinguished. Crafters and their body conversions are ordered either based on a forecast developed by a board of K-Caara sales managers or based on concrete and binding customer orders. In terms of forecast order, K-Caara sales managers evaluate the number of required cars and body conversions in the next quarter under consideration of current sales trends. For example, even though a customer has not bindingly ordered a car yet, the possible future demand is considered to improve competitiveness of K-Caara. To ensure the sale of this car, just frequently demanded Crafters are ordered ahead. For example, Crafters equipped with an automatic gear box are demanded in many cases. The supply chain processes initiated by either a concrete customer or forecast order are quite similar. The only difference is the prioritization of cars at the manufacturer stage and the fact that the cars are stored at the dealerships for a longer time.

With regard to the second order type based on concrete and binding customer orders, the customer demand is received by a salesperson employed at K-Caara. The whole order clarification process is shown in Figure 20. In a first step, the salesperson checks if the required body converted vehicle is available in the in-house storage premises or storage premises of other dealerships in Finland via a system called Keista. Subsequently, if the converted cars are already in Finland, a transport operation is requested from SE Mäkinen via a system called SE Mäkinen Logistics Extranet as shown by process step 1.2. in Figure 20.

If the car and conversion have to be ordered newly, the supply chain is initiated. In the next step 1.3. presented in Figure 20, depending on the uniqueness of demanded body conversions, the salesperson either offers different conversions of Premium Partners or provides contact information of Premium Partners. The former case, where the salesperson works as a kind of consultant, is common if a specific car and body conversion is frequently requested or has already been requested by the customer. However, if the body conversions are rather unique, the Premium Partner is directly consulted. For example, cars for the local fire department are highly customized and therefore usually directly discussed with Premium Partners. Most of the material used to consult the customer is physically provided to K-Caara. For example, contact information are given by business cards or brochures and price lists are provided when a new body conversion has been developed newly. In the last step of this process, after a solution has been agreed on, the Premium Partner sends the information of body conversion to the dealer via Keista. In terms of public customers, it is also possible that the Premium Partner directly tries to win a public invitation to tender. In this case, the process starts at process step 1.4. and the Premium Partner informs K-Caara about the required number and specification of Crafter.

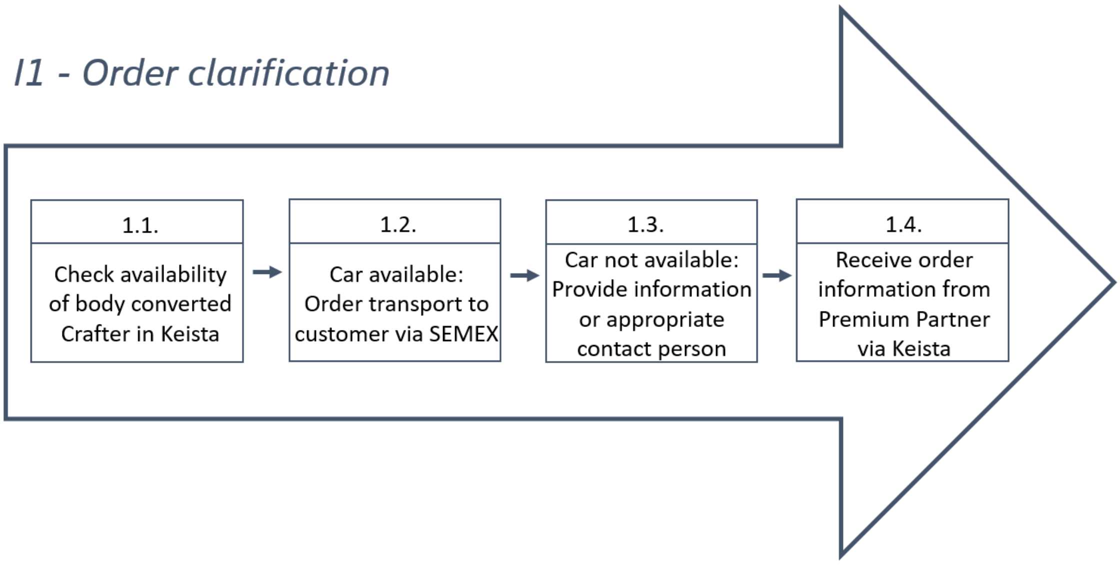

FIGURE 20. Process steps of I1 - Order clarification

I2 – Order placement leading to delivery date determination

After the order has been clarified, the dealer forwards the order information to the importer, that is responsible for the final order from VW CV. The required information are sent via Keista from the dealer to the importer. Afterwards, it is placed in a system called Nadin, as presented in process step 1.1. of Figure 21. Nadine is the global purchasing system of the VW group for importers and national dealerships, where all car orders and related information are documented. It is important to mention that just the importer is able to order cars in Nadin. Thereby, VW CV ensures that contact persons are known and that requirements of the market are met. For example, compared to Germany, the governmental warranty law could be different in the importing country and therefore, it is crucial that the importer acts as responsible seller of the cars (…). Moreover, some body conversions require specific preconditions of the car. For example, the ceiling of a Crafter is left out to extend the passenger compartment of a body converted ambulance vehicle. These required preconditions are considered by item codes, which indicate the needed specification of body conversion. The previously described placement of order information in Nadine is shown by process step 1.1. of Figure 21.

At VW CV stage, the order information is transferred from Nadine into a system called IFA. It is the factory system of the plants in Hanover and Poland and is the abbreviation of *Integrierte Fahrzeugabwicklung*. In contrast to Nadine, IFA entails more information and serves for the coordination of the whole manufacturing process in the factories of Hanover and Wrzesnia, while Nadine handles the communication between VW CV and the importer. After the car has been placed in IFA, a first delivery date is given by the system based on an automatically developed production schedule of the system, as shown by process step 1.2. of Figure 21. The importer forwards this information to the dealer, the logistics company SE Mäkinen and the Premium Partners via Keista. The customer is subsequently informed by the dealer about this rough delivery date. The informing of supply chain stakeholders is shown by process step 1.3. of Figure 21.

After a Crafter has been firmly scheduled for production, the customer and the other supply chain stakeholders are informed about the reliable delivery date. The reliability of delivery dates and availability of specific car modifications could be understood by considering four states of car orders in IFA, as illustrated in Table 2. (…)

TABLE 2. Different production states of cars in IFA

[redacted]

In order to be able to choose one process for further examination, it is useful to consider one state in detail. (…)

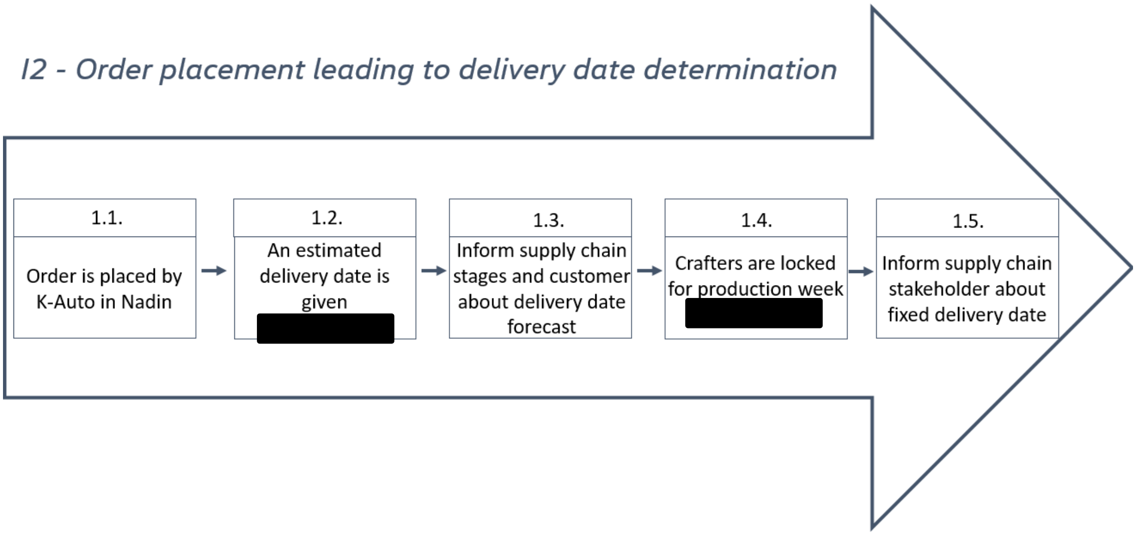

FIGURE 21. Process arrow of I2 - Order placement leading to delivery date determination

I3 – Communication of after-sales services

The next information exchange process to be considered is related to after-sales services of sold Crafters and their body conversions. In general, two after-sales channels can be distinguished. If more comprehensive repair operations are required, Crafters are directly brought to Premium Partners by the customer. For example, Premium Partners have launched own workshops in Vantaa to supply their customers in the south of Finland. Additionally, they have external partners in different regions to provide service coverage in the whole country. For instance, external partners are subcontracted in the regions of Österbotten, Eastern Finland and Lapland. If the customer decides to directly consult a Premium Partner or its external partners, the after-sales process does not concern K-Caara. Consequently, these informational exchange processes are not considered in terms of this thesis.

The second channel for maintenance and repair of body conversions is the K-Caara workshop network. These workshops are located at the same premises as the dealerships. The main business is the maintenance and repair of the basic car. However, to improve the customer satisfaction, the workshop network has started to support frequent body conversions as well. The after-sales communication of K-Caara is shown in Figure 22.

The communication between customer and workshop is currently done via phone or e-mail. Initially, the customer books an appointment at the workshop if a maintenance is necessary or a failure has been occurred. A newer process is related to so-called connected car devices. The connected car device is able to track the current state of cars and report to the workshop what specific kind of maintenance or repair operation is needed. Thereby, the service staff is able to contact the customer, clarify the issue and schedule an appointment according to the urgency of the issue. On the one hand, the customer service is improved and, on the other hand, the time of non-use due to maintenance is reduced, which is especially important for commercial customers. For example, in the past, the software of several cars has consistently reported a failure with the Ad-Blue system integrated in the diesel engines. By having used the connected car device, the failure history would have been shown and the workshops would have been aware that no urgent hardware defect exist. The appointment to maintain the software of the car could be scheduled according to the wishes of the customer. (…)

After the car has been brought to the workshop, the mentioned issue of the customer is inspected by the service staff. The after-sales related car information is visible in a system called VV-Auto.Aftersales. VV-Auto was the former name of K Auto Oy until 2018. If additional spare parts are required, the workshops are able to order spare parts from the Premium Partners via a system called ETKA, as indicated by process step 1.3. of Figure 22. It is the abbreviation for Electronical Teilekatalog and is the global purchasing system for spare parts of the VW Group. After the Crafter and body conversion has been maintained or repaired, the customer is informed via phone that the car can be picked up again presented by the last process step of Figure 22.

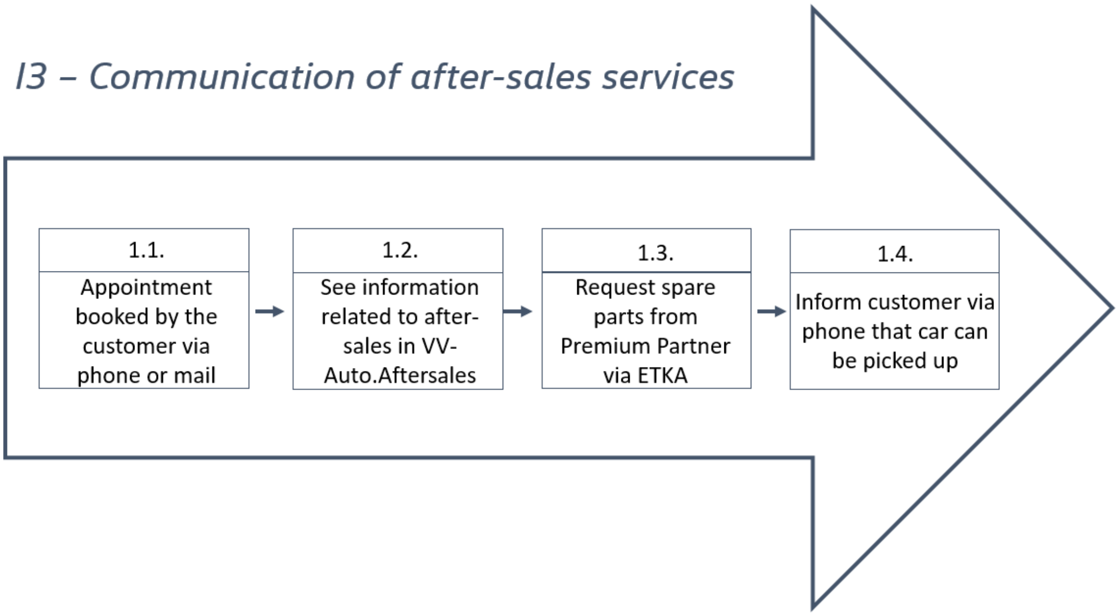

FIGURE 22. Process arrow of I3 - Communication of after-sales services

6.1.4 Process Element Level - Physical processes

In order to generate a better understanding of the physical processes, the informational processes that are directly related to physical transport of the vehicles are described first.

The central system for organizing all transport processes, where the logistics company SE Mäkinen is involved, is called SE Mäkinen Logistics Extranet (SEMEX). SEMEX is the system serving for the communication between SE Mäkinen, the Premium Partners and K-Caara. The current status of a car in the supply chain is visible in SEMEX and transport requests can be placed by the supply chain stakeholders. For example, a Premium Partner could report that a car has been completely converted and is ready for transportation to the next Premium Partner or K-Caara dealership.

SEMEX is connected to the logistics system of VW called ATLAS, the short form of Automobil-Abwicklungs-System. The system receives data of readily manufactured cars and their order specifications from the factory system IFA. (…).

Before Crafters are shipped to Finland, SE Mäkinen is informed about their estimated arrival dates via ATLAS connected to SEMEX.

In terms of the actual physical transportation processes, four processes are going to be illustrated as shown in Figure 23. At first, shown by digit P1 in Figure 23, the transportation process of Crafters from the factory in Wrzesnia, Poland, to the technical service centre of SE Mäkinen in Vantaa takes place. Then, the Premium Partner supply chain stage requires a subdivision due to location of Premium Partners in Finland and Germany. The transport processes within the Finnish part of supply chain, encompassing Finnish Premium Partners, the K-Caara dealerships and the Finnish customer, are dealt with secondly, shown by digit P2. The transport process starting in Finland to the Premium Partner Oberaigner in Germany will be illustrated thirdly, shown by digit P3. Fourthly, the reverse logistics operation from Oberaigner back to Finland is defined, as indicated by digit P4 in the Figure.

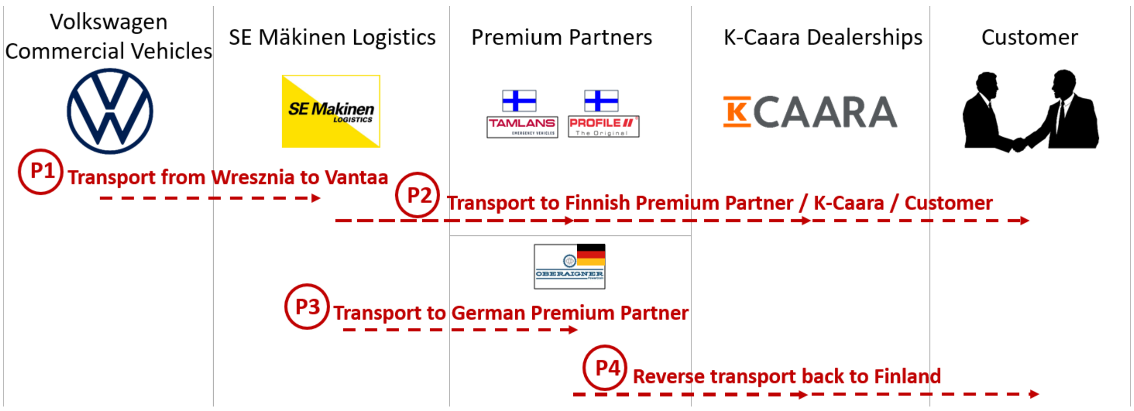

FIGURE 23. Physical supply chain processes of body converted Crafter

P1 – Transport from Wrzesnia to Vantaa

The first physical delivery process of Crafters marks the transport from Poland to Finland via Germany, starting at the Crafter factory in Wrzesnia. In general, outbound transport operations are not part of each brand of VW group individually. Instead, a common logistics company of the VW group, the so-called Konzernlogistik GmbH & Co. OHG, takes care of all transport operations to a foreign country. Additionally, the Konzernlogistik is responsible for the transport operations between different VW plants. For example, in terms of the former e-Crafter production process, a Crafter was firstly produced in Wrzesnia and subsequently transported to the plant in Hanover for adding the electric power train. A special feature of VW Konzernlogistik is that they have own ships for carrying cars at their disposal. However, the shipment to Finland is organized by subcontracting the shipment (…).

After Crafters have been produced, they are stored at the factory premises in Wrzesnia until their transportation on trains to Travemünde, as shown by the process step 1.1. and 1.2. of Figure 24. In Travemünde, the Crafters are stored temporarily. (…). Cars of various brands are shipped at once from Travemünde to Vuosaari harbour to reduce delivery and handle costs. After the Crafters have been arrived at Vuosaari harbour, they are moved to SE Mäkinen's technical service centre in Vantaa, which is approximately 30 kilometres away. The cars are transported on special trucks with various loading arrangements to carry vehicles of different sizes. Due to the size of Crafter, two or at most three Crafters are transported at once.

At the technical service centre of SE Mäkinen in Vantaa, two operations take place. Firstly, a so-called pre-delivery inspection (PDI) is done and, secondly, the Crafters are registered in Finland. In terms of PDI, it is checked if all required documents have been sent or have been physically delivered. Additionally, the physical appropriateness of cars is inspected. For instance, the exterior and interior surfaces are audited for dents or scratches and the functionality of specific parts such as direction indicators is inspected. This operation is just mentioned at this point, but not included in Figure 24, because the in-house make operations are just secondly considered in this project, as stated in the SCOR top level description in chapter 6.1.1.

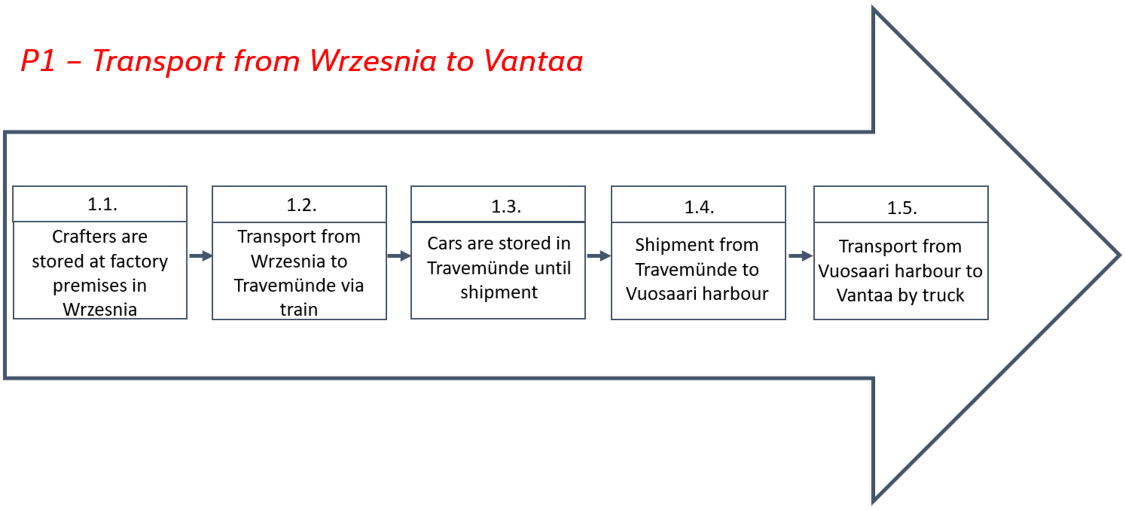

FIGURE 24. Process arrow of P1 - Transport from Wrzesnia to Vantaa

P2 – Transport operations within Finland

After successful PDI and registration, Crafters are transported to Premium Partners by SE Mäkinen. SE Mäkinen takes care of transports from Premium Partners to K-Caara and additionally, of transports between several body builders if more than one conversion is demanded. Usually, all body builders are located in Finland and hence, the cars are transported on trucks by SE Mäkinen and delivery information are exchanged via SEMEX. The transportation process, where two Premium Partners are involved and the Crafter is delivered to K-Caara and afterwards to the end-customer is shown in Figure 25. Customers could also pick up their cars at the premises of the Premium Partner. Consequently, depending on the stage of the Premium Partner, the process steps 1.3., 1.4. and maybe 1.2. would be not applied. Furthermore, it is also possible that the customer picks up the Crafter from K-Caara on its own. The transportation operations of SE Mäkinen within Finland are flexibly organized, according to the interviewees. It could be argued that no real process exists and SE Mäkinen works solely on demand. However, to visualize the supply chain completely, the business operations is taken into account.

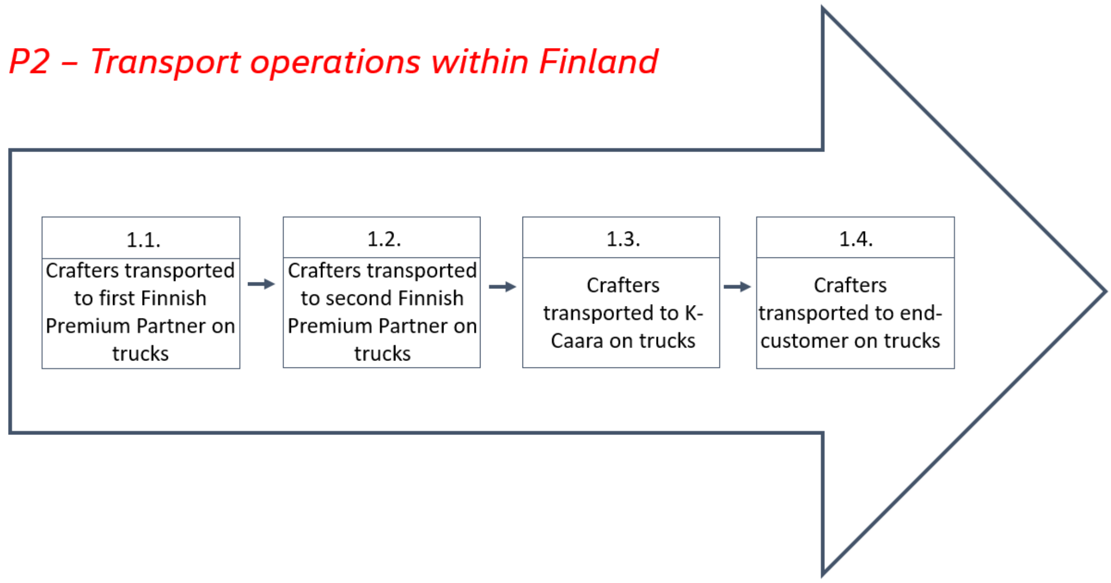

FIGURE 25. Process arrow of P2 - Transport operations within Finland

The Premium Partner Oberaigner Automotive GmbH located in the near of Rostock, Germany, is a specific case for the supply chain operations of the Crafter. The company is responsible for adding the four-wheel drive, also known as 4Motion or 4x4 technology, to the Crafter. Therefore, the 4Motion Crafters are shipped back to Germany, subsequently converted by Oberaigner and again shipped back to Finland. The whole shipment operations to Germany and back to Finland are on behalf of and organized by SE Mäkinen. The delivery process of SE Mäkinen to Oberaigner is shown in Figure 26. It starts with reserving a place at a ship of (…). Then, according to the delivery date of (…), the Crafters are brought to Vuosaari harbour by truck. In the next step, the cars are shipped from Vuosaari harbour to Travemünde by (…). Finally, they are transported from Travemünde to the Oberaigner premises by truck on behalf of a smaller logistics company called (…), which is part of the SE Mäkinen Logistics Oy corporate family.

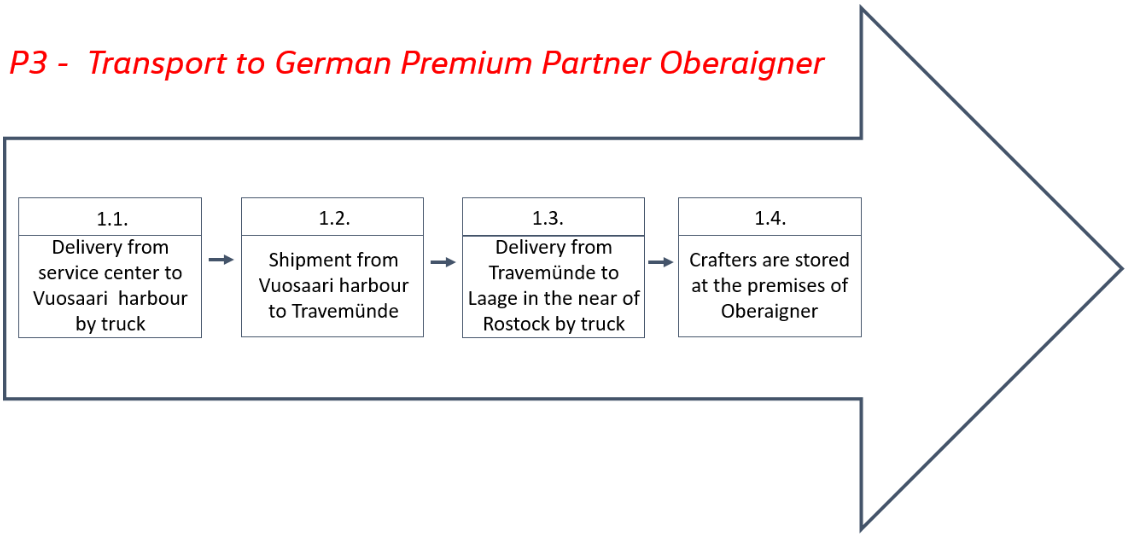

FIGURE 26. Process arrow of P3 - Transport to German Premium Partner Oberaigner

P4 – Reverse transport back to Finland

In order to illustrate the delivery process from Oberaigner in Germany back to Finland, the delivery process is shown in Figure 27. The process element encompasses four process steps. After the four-wheel drive has been added, the Crafter is stored at the premises of Oberaigner until its delivery to Travemünde. The cars are transported again by the logistics service provider (…) from Rostock to Travemünde. Afterwards, the cars are shipped to Vuosaari harbour and picked up by SE Mäkinen at that place. Lastly, they are either directly delivered to a K-Caara dealership or transported to further Premium Partners to get additional body conversions.

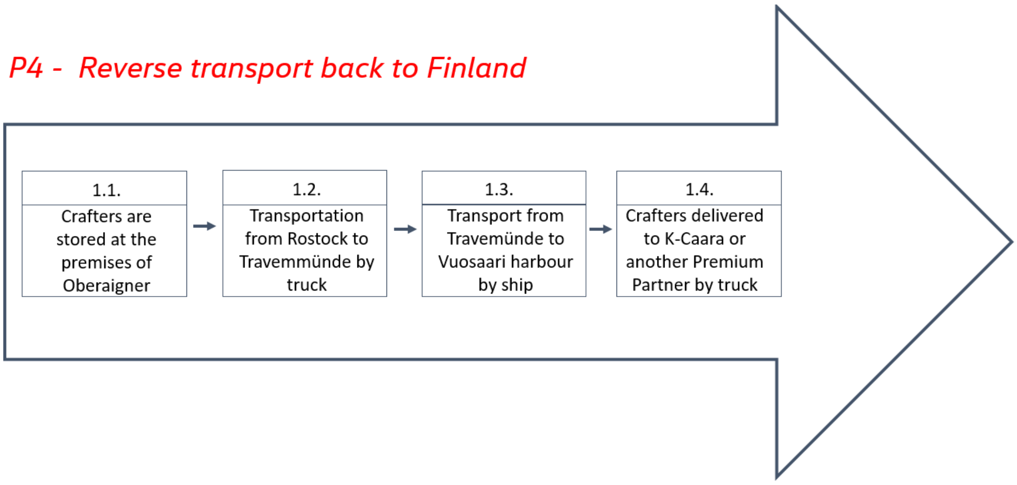

FIGURE 27. Process arrow P4 - Reverse transport back to Finland

6.2 Process Selection Applied for Body Converted Crafter

Adjustment of process portfolio

In this chapter, the second step of the excluded process identification phase, process selection, is executed. Therefore, the process portfolio, theoretically introduced in chapter 4.2.2, is applied to illustrate the previously described processes according to their need of improvement. The processes are evaluated based on the criteria strategic importance, health and feasibility, explained in chapter 4.2.2.

To assess the processes in terms of strategic importance and health more precisely, the process portfolio's x-axis and y-axis are extended by a scale of numerical values. A grading scale starting at 1 and ending at 5 is added in both cases. In terms of strategic importance, 1 indicates the least and 5 the highest strategic importance. Regarding health, 1 indicates the least and 5 the greatest need to improve the health of the process. To follow the structure of the presented process portfolio in chapter 4.2.2, where the selection focus is set in the upper left quadrant of the portfolio, the scale at the x-axis starts with 5 and ends with 1, as shown in Figure 28. The values 2, 3 and 4 express intermediate steps between the extrema on both axes. The feasibility criterion was adjusted in terms of its colours. To ensure readability of the model, the feasibility assessed as medium is shown by a darkly framed bubble.

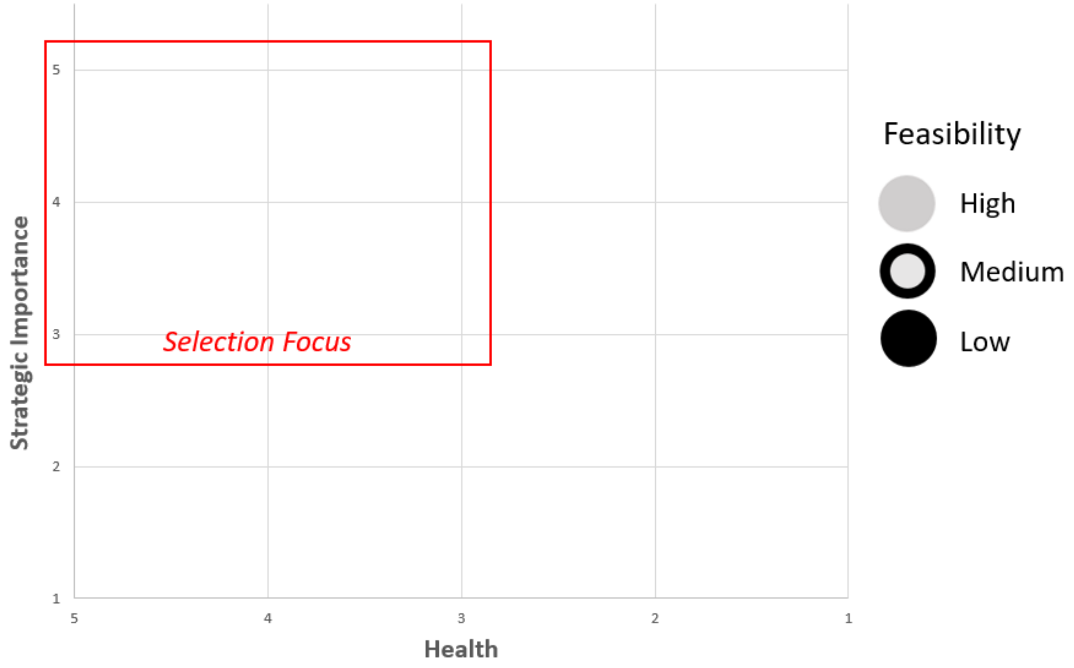

FIGURE 28. Template of adjusted Process Portfolio

The criteria strategic importance and feasibility are directly assessed without subcategories. The health criterion, in contrast, is evaluated separately in terms of the process performance dimensions time and cost, which were introduced in chapter 4.2.2 at first. The process performance dimension of flexibility is not assessed, because the current performance of supply chain processes is measured, instead of testing an upscaling scenario of the supply chain. Furthermore, the quality dimension would have been measured in monetary units to assess the impact of quality issues. For example, missing information in a system, which leads to additional work of another phone call, has to be evaluated differently than scratches in a front sheet leading to a window change. The quality dimension would then directly overlap with the cost dimension, where the potential to improve profitability is measured. Consequently, at this stage of selecting a process to work on, the improvement potential in terms of throughput time and costs to be saved is evaluated. In order to consider the price sensitiveness of commercial customers, it has been decided to weight the criteria of throughput time with 30% and the score of costs to-be saved with 70% of the total health score. Consequently, the total score of the health criterion was calculated as follows:

EQUATION 1. Score of health criterion

$$\text{Score Health} = \text{Score(Time)}*0.3 + \text{Score(Costs)}*0.7 \quad (1)$$

Classification of processes in process portfolio

The executed process evaluation is shown in Figure 29. The criteria have been evaluated on the basis of gathered process information collected in the expert interviews. Furthermore, some elements have been deepened by consulting further employees of logistics and sales of VW CV and K-Auto. It has to be stated that, even though the interviewees shown in chapter 6.1.2 were preselected by Mr. Alto, it is not possible to exclude false process perceptions or consciously made false statements. Consequently, the process evaluation is prone to be subjectively affected. Furthermore, due to complexity of supply chain processes, it was not possible to determine the financial improvement potential of each process in detail. The process portfolio aims to detect improvement areas and to structurally select a process to work on. The fallibility of the method is acknowledged.

FIGURE 29. Process portfolio used for process selection

Beginning with the selection focus in the upper left quadrant of the process portfolio, the physical transportation processes P3 and P4 related to four-wheel drive conversion by Oberaigner in Germany, are most urgent to be worked on. In terms of strategic importance, the four-wheel drive conversion is crucial, because (…) To improve the market share of Crafters, it is important to provide a model with four-wheel drive (…).

Both processes are detected as most urgent to work on, because it has become apparent that other cars are directly delivered to Oberaigner without being firstly registered in the importing country. The example of MAN TGE, which is also produced in Wrzesnia by VW CV on behalf of MAN, was stated. In the following, the background of the current process and of the MAN process should be clarified.

If this transportation process could be applied for four-wheel drive of Crafters, it is assumed that the processes P3 and P4 are eliminated and the process P1, delivery from Poland to Finland, has to be adjusted. The feasibility to adjust the physical transportation processes P3 and P4 is assessed with the best grade, because the processes are on behalf of SE Mäkinen, contracted by K-Auto.

Informational process I3 - After-Sales Communication

The second most urgent process to work on is the informational process of after-sales communication. After-sales services have a share of approximately 20% of K-Auto’s net sales (Kesko, 2021), which shall be further improved in future. For example, the (…). Therefore, the strategic importance of this area is assessed with the highest score of five.

Due to long delivery times of spare parts for body conversions, the time dimension of health is assessed as in need of improvement with five. According to the interviewed Premium Partner (…), spare part deliveries could extend the maintenance time one or two weeks, because the parts are firstly ordered from the Premium Partner, which potentially has to order the required components from its suppliers.

The cost dimension of after-sales communication is assessed with three, because efforts to clarify the exact issue of a body conversion are usually high. The workshop staff is not able to see in in VV-Auto.Aftersakes which specific conversion has been added to a car and where the spare parts come from. Thereby, it is not always clear, where spare parts have to be ordered and who is going to be invoiced if the detected issues concern the warranty of a body conversion. It has to be stated that this does not apply to Premium Partners mainly dealt with in this project. However, the information was given during the interview and therefore, should be included in the results of this project. By applying the equation (1) to calculate the score of health, after-sales communication is assessed with 3.6, as visible in the process portfolio in Figure 29.

The feasibility of after-sales communication is assessed as high, because it is on behalf of K-Auto, even though privacy policies have to be considered in terms of the conversion history. For example, it is not possible to show invoices paid by the customer to the workshop staff.

Informational process I2 – Order placement leading to delivery date

Order placement leading to delivery date determination was assessed with a low feasibility, because the standardized order process is in control of the VW Group. In long term, changes could be requested, but their implementation cannot be reliably secured.

In terms of strategic importance and health, the process has been evaluated with three in both criteria. On the one hand, reliable delivery times are crucial for satisfied customers. However, on the other hand, the order process itself does not provide much space for strategic improvement of Crafters, because (…).

It would have also been possible to evaluate this process regarding health and strategic importance well with one, because it could be argued that the process just represents the functionality of other parts of the supply chain. However, to highlight the issues mentioned in the interviews, the process is worse evaluated. According to the interviews with K-Caara salespersons, (…).

Informational Process I1 – Order Clarification

Commercial customers frequently request unique and highly customized solutions, that require high amounts of consultation and collaboration efforts of K-Caara and Premium Partners. Consequently, the highest score of five has been given in terms of strategic importance.

In terms of health, throughput time depends on complexity of orders. For example, a single Crafter with a frequently demanded body conversion does not require so much clarification efforts like a highly customized tender of 15 Crafters. The cost potential is difficult to measure as well. At this point, a separate project would be required to analyse order requests and its related efforts of the previous year in detail. Hence, it could be analysed, where order requests were insufficiently processed. Moreover, collaboration strategies could be developed for special order requests like specific public tendering procedures. Even though the general collaboration was assessed good by the process participants and consequently, the time as well as cost dimension is assessed with one. Further research in this process should be done under consideration of the strategic importance, but would extend the scope of this thesis.

Feasibility of order clarification is assessed as high, because the collaboration of Premium Partners and K-Caara solely depends on themselves. For example, an online workshop could be held to talk about applied practices to clarify customer orders.

Physical process P1 – Transport from Wrzesnia to Vantaa

According to the employee of VW CV's logistics department, the transport operations of cars produced in plants of the VW Group, are usually organized by Konzernlogistik. Theoretically, it is possible to use an own logistics service provider. Skoda, for instance, subcontracts another company for its car transports from Czech Republic to Germany. The advantage is that the transports are executed more quickly in comparison to the Konzernlogistik, because the Konzernlogistik

(…). Thereby, Crafter delivery times could vary (…) as well, depending on the workload of Konzernlogistik and its subcontracted companies. Thus, taking all above stated information in mind, the transportation process from Poland to Finland on behalf of the Konzernlogistik is evaluated with four in the time dimension and one, the best, in the cost dimension. In total, by applying the equation (1) to calculate the score of health, the transport process is assessed with 1.9.

The strategic importance of this process is neither high nor low and therefore assessed with three on the y-axis. The delivery process is assessed as medium with regard to feasibility.

Physical process P2 - Transport within Finland

The physical transportation processes as well as informational exchanges related to transportation processes within Finland were satisfactorily evaluated by all interviewed supply chain stakeholders. The health dimensions of time and cost are therefore both assessed best by the score of one. In terms of strategic importance, reliable and faultless deliveries are generally important, but (…). The strategic importance is therefore assessed with two. The feasibility of transportation processes is evaluated as high, because the logistics company SE Mäkinen works on behalf of K-Auto.

6.3 Improvement Potential - Crafter equipped with Four-Wheel Drive

6.3.1 Process Discovery – Four-Wheel Drive Body Conversion

In the following of this chapter, the processes P3 and P4, which have been identified as most urgent to work on in the process portfolio (see Figure 29), are discovered in detail, according the process discovery phase of BPM lifecycle, described in chapter 4.3.

To equip a Crafter with four-wheel drive, the informational processes I1 and I2 as well as the physical P1, P3 and P4 take place. To illustrate their interdependency clearly, the processes are shown in Figure 30 again.

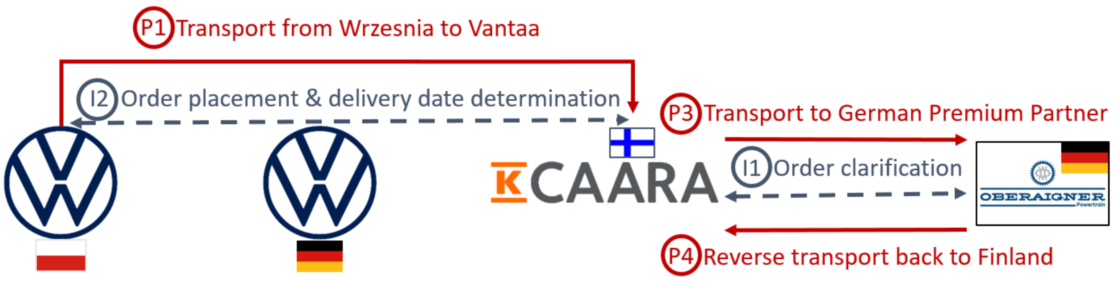

FIGURE 30. Interdependency of processes to add four-wheel drive conversion in Germany

According to K-Auto, the reason why a Crafter is not directly brought to Oberaigner Automotive GmbH in Germany is rooted in a tax-related issue. From a tax-related view, both VW CV as well as VW Poznan GmbH generate revenue with a product that does not change its property and is directly delivered to the importer as end-customer. This is called a chain transaction, where at least three parties are involved and two of them generate revenue with a product, that does not change its property. In terms of a chain transaction, value-added tax has to be paid at the end-point of delivery, which is Finland in the current Crafter four-wheel drive process (…). As a registered Finnish company, the importer is able to deduct input tax in Finland and therefore, the process is not problematic. If the cars were directly delivered to Oberaigner, the delivery would end at the stage of

Oberaigner in Germany, as presented in Figure 31. Consequently, K-Auto assumes that they have to pay value-added tax in Germany, where they are not tax-deductible.

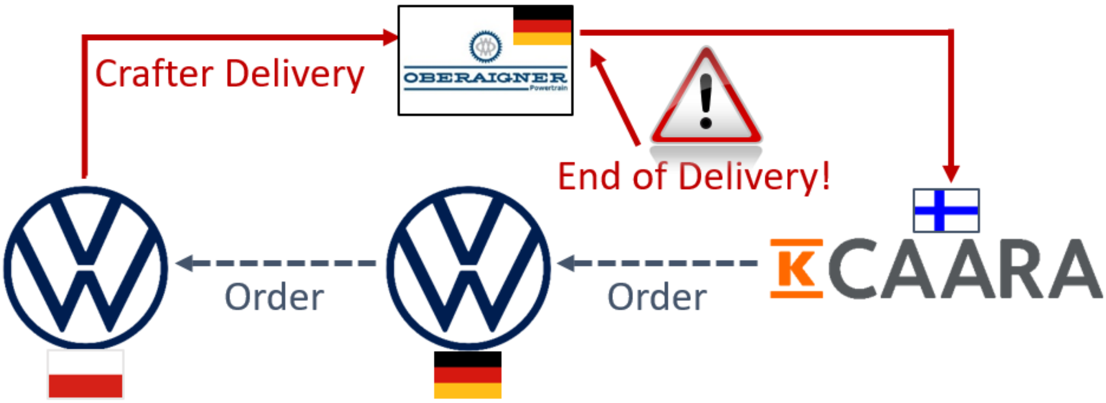

FIGURE 31. Illustration of avoided direct delivery process to Oberaigner

To evaluate if a process adjustment is economic, the costs have been gathered by VW CV's finance department, which is responsible for logistic costs invoiced to importers. Furthermore, to investigate the throughput time, the throughput times have been questioned by an employee of Konzernlogistik. The costs invoiced by SE Mäkinen to K-Auto were provided by an employee of K-Auto. Both shares of throughput time and transportation costs are illustratively shown in the following Figure 32. The detailed cost and throughput share of each process step is shown in Appendix 3, where the process arrows are extended by a process card according to the theory presented in chapter 4.3 and illustrated in Figure 15.

[redacted]

FIGURE 32. Share of transportation cost and throughput time four-wheel drive

Contemporary, (…) % of all transportation costs related to four-wheel drive body conversion were caused by the transport process P1 from Wrzesnia to Vantaa. In contrast, (…) % of all transportation costs were rooted in the Oberaigner processes P3 and P4, shown in Figure 30. Due to confidentiality, the cost structure is expressed proportionately, instead of in total numbers. With regard to throughput time of the process, the transport process from Wrzesnia to Vantaa requires (…) % of total throughput time on average, while the transport to Germany and back to Finland requires just (…) % of the whole throughput time on average.

Both, the transportation costs as well as throughput time can be explained by transport volumes. In terms of transport process P1, Crafters are transported in high volumes with other brands of the VW Group by the Konzernlogistik. Thereby, the delivery costs are held low per car. However, high transport batches cause longer throughput times. For example, regarding train transport from Wrzesnia to Travemünde, (…).

6.3.2 Process Redesign – Four-Wheel Drive Body Conversion

Because a potential benchmark has been detected, the benchmark was analysed by conducting a workshop with two employees of MAN. The first one worked in the operational sales department, that is responsible for invoicing of cars to importers, and the second one was an expert for value-added tax in Europe. In this project, process redesign phase, introduced in chapter 4.5, is done before process analysis phase, presented in chapter 4.4, because the potential benchmark was firstly verified and subsequently analysed regarding cost savings.

The applied process for MAN TGE is illustrated in Figure 33. By considering the Figure, it becomes apparent that the TGE is delivered from Wrzesnia to premises of MAN in Germany. At the premises of MAN in Germany, the importer starts already being responsible for the transport of the car to Oberaigner and subsequently to its own premises in Finland. Thereby, the previously explained chain transaction, where at least three parties are involved, is broken down. From a tax-related view, this is because the importer solely interacts with MAN Germany, instead of both MAN Germany, from which the car is ordered and MAN Poland, where the car is produced (…).

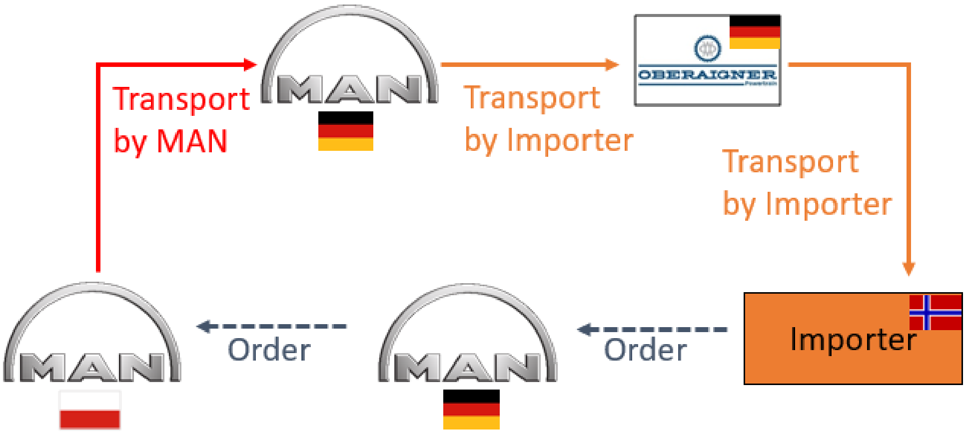

FIGURE 33. Benchmark of MAN in Norway

6.3.3 Process Analysis – Four-Wheel Drive Body Conversion

After the MAN process benchmark has been clarified, a meeting with an employee of the logistics departments of VW CV has been scheduled to verify, whether the process could be applied for the Crafter, or whether any obstacles exist, which have not been considered yet. It has become apparent that this kind of transport operation is common practice in the VW Group. If a body conversion is demanded, which is not provided in the country of the importer, the affected cars are controlled by so-called redirection transports. Redirection transports take place if cars are directly brought from their production plant to a body builder, which is not located in the country of the importer. (…). K-Auto prefers to use body builders located in its own country to assure smooth after-sales services. The process to use a foreign body builder is not common yet.

If the concept of redirection transport is applied for Crafters equipped with four-wheel drive, the Crafter will be firstly delivered to Neuseddin, in the near of Berlin, where a logistics hub of the VW Group is located. Subsequently, the car will be picked up and delivered to Oberaigner in Laage by the German logistics company, which is part of SE Mäkinen’s corporate family. Afterwards, the Crafter will be converted and finally transported to Finland.

In total, by applying the concept of redirection transport for Crafter four-wheel drive conversion, the transportation costs of this specific configuration have been reduced by (…) %. It was not possible to safe the total amount of delivery expenses of (…) %, caused by the double transportation processes P3 to Germany and P4 back to Finland, because an additional fee in terms of redirection transports is invoiced to the importer. The total cost reduction is shown in Figure 34. The former costs of the transport from Wrzesnia to Vantaa are shown in the darkest colour and are still invoiced. Additionally, the fee of redirection transports, the detour to Neuseddin, is invoiced, which equals (…) % of the former costs. The share of this fee is shown by the brighter colour framed in black. The cost reduction of (…) % is shown in grey.

[redacted]

FIGURE 34. Reduction of transportation costs per car due to redirection transport

With regard to throughput time, it is assumed to safe approximately (…) % of it. However, the total delivery times are measurable, after the new process has been taken place for a while.

The process implementation phase presented in chapter 4.6 is not included in this thesis by a separate chapter, because the process implementation does not require further efforts. The only speciality of this process is that it has to be initiated by a separate document, which is attached in Appendix 4. This document is sent to the department of order management at VW CV, in order to secure that the concept of redirection transports is applied for four-wheel drive of Crafters.

Another benefit of the redirection transport process for K-Auto is that it offers new possibilities to use Premium Partners in foreign countries. Even though after-sales services are probably easier to organize if cars are converted in Finland, the reduction of logistics cost improves the attractiveness of using a foreign body builder. In this respect, a further project, where customer demand of foreign body conversions is questioned, could be beneficial for K-Auto.

7 DISCUSSION AND CONCLUSION

The purpose of this project was to, firstly, illustrate the supply chain of body converted Crafters and to, secondly, detect improvement potential in it. Referring to supply chain illustration, the use of SCOR in combination with semi-standardized expert interviews was useful to structurally gather process information. However, a reference model is rather abstract and hence, does not suit for a clear process visualization very well. This is why a more simplified model, the division in physical and informational processes, was necessary and used properly.

In order to relate to the research questions presented in the introduction (see chapter 1.2), the questions are going to be answered briefly under reference to the concerned chapters of this thesis:

1) Which theoretical models can be used to illustrate and analyse the complexity of supply chain processes?

The BPM lifecycle, presented in chapter 4.1, was used as framework for this project. The process architecture definition of BPM's excluded phase was done by the SCOR model, whose theoretical basis can be seen in chapter 4.2.1. The subsequent process selection step of the excluded phase is executed by a process portfolio as shown in chapter 4.2.2. The following BPM phases of discovery, analysis, redesign and partly implementation, shown in chapter 4.3 - 4.6, were used to guide the analysis of one supply chain element in detail.

2) How can the process information be collected in a structured manner?

Process information have been structurally collected by expert interviews with a semi-standardized guideline. The theoretical background of expert interviews is visible in chapter 5.1. and of semi-standardized interviews in chapter 5.2. In this project, the guideline has been developed based on the process elements of the Supply Chain Operations Reference model, as presented in chapter 6.1.2.

3) Who is involved in the supply chain of body converted Crafters?

Five supply chain stages can be distinguished on a superior level, as shown in chapter 6.1.1: VW CV, SE Mäkinen Logistics, Premium Partners, the K-Caara dealer network and the end-customer. Furthermore, presented in chapter 6.1.4, VW CV subcontracts the VW Poznan GmbH for production of Crafters and the Konzernlogistik GmbH as logistics service provider. The Konzernlogistik GmbH assigns (…). SE Mäkinen collaborates with a logistics company (…) in Germany.

4) Which processes exist in the supply chain of body converted Crafters?

In the former supply chain of body converted Crafters, three informational, as shown in chapter 6.1.3, and four physical processes, presented in chapter 6.1.4. have been identified.

5) To what extent can improvement potential be detected in the supply chain of body converted Crafters?

The project has reduced transportation costs of Crafters equipped with four-wheel drive by (…) %, as shown in the chapters 6.3.1. – 6.3.3. Moreover, it could become beneficial to use foreign body builders in the Finnish market.

Furthermore, the current after-sales communication has been identified as possible improvement area, as shown in chapter 6.2. The workshop staff is not able to see which body builder is accountable for a body conversion yet, leading to (…). Moreover, in terms of after-sales, purchasing of spare parts for body conversions requires long delivery times of up to 10 days.

Additionally, (…), as described in chapter 6.2. This directly refers to the semiconductor crisis, presented in the introduction of this thesis.

Outlook

If the concept of redirection transport is further deepened, a review could be initiated about using further body builders in Europe and their impact on customer value. Even though K-Auto prefers working with domestic body builders, the reduction of transportation costs in this thesis broadened the scope of applicable body builders. As a result, the competitive position of foreign companies increased.

Furthermore, this project can be the basis for quantification of the proposed supply chain improvement areas. To set it in the theoretical context of this thesis, the process identification phase has been carried out successfully. Prospectively, the proposed improvement areas have to be conducted through the remaining phases of BPM lifecycle, as it has been done regarding Crafter four-wheel drive conversion.

One possible starting point could be to evaluate if storing of frequently demanded spare parts is a measure to reduce flow-through times of after-sales services. Hence, an analysis of most frequently required spare parts and their delivery times could be carried out. Subsequently, warehousing costs of the most used spare parts could be compared to their impact on after-sales flow-through times for each K-Caara workshop in Finland. Furthermore, referring to after-sales of body conversions, a solution should be developed to make the body conversion history accessible for the workshop staff in VV-Auto.Aftersales. Therefore, an interface could be created to show the data of the sales system Keista adaptably in VV-Auto.Aftersales.

As shown in the introduction of this thesis, supply chains have a major impact on the financial state of a company. In this project, the financial impact was already visible by working on just a single supply chain part, the four-wheel drive conversion. In future, further potential results will be achieved, if the involved parties collaborate interdisciplinary -logistics, sales, finance- to improve one of the core elements of their business, the supply chain.

8 REFERENCES

Aalto, S., After Sales Manager at K-Auto. 2021a. Interview on 02.02.2021. Interviewer Böttcher, M. Via Microsoft Teams in Vantaa/Hanover.

AMAG Automobil und Motoren AG, N.d. Beratung & Kauf Occasionen. Website: Read on 20.04.2021. https://www.volkswagen-nutzfahrzeuge.ch/de/beratung-kauf/occasionen.html

Barbosa, C. & Azevedo, A., 2018. Hybrid modelling of MTO/ETO manufacturing environments for performance assessment. *International Journal of Production Research* , 11 January , pp. 5147-5171.

Bogner, A., Littig, B. & Menz, W., 2014. *Interviews mit Experten.* 1. Edition. Wiesbaden: Springer.

Bolstorff, P. A., Rosenbaum, R. G. & Poluha, R. G., 2007. *Spitzenleistungen im Supply Chain Management - Ein Praxishandbuch zur Optimierung mit SCOR.* 1. Edition. Berlin:Springer Berlin.

Christopher, M., 2016. *Logistics and Supply Chain Management.* 5. Edition. London: Financial Time Prentice Hall.

Council of Supply Chain Management Professionals, 2020. What is Supply Chain Management?. Read on: 01.05.2021. https://cscmp.org/CSCMP/Certify/Fundamentals/What_is_Supply_Chain_Management.aspx?WebsiteKey=0b3f453d-bd90-4121-83cf-172a90b226a9

Deutschlandfunk (Ed.), 2021. *Dieselgate und die Folgen: Die schleppende Aufarbeitung des VW-Diesel-Skandals. Released on 19.04.2021.* Read on 04.05.2021. https://www.deutschlandfunk.de/dieselgate-und-die-folgen-die-schleppende-aufarbeitung-des.724.de.html?dram:article_id=495928

(…)

Dumas, M., La Rosa, M., Mendling, J. & Reijers, H., 2018. *Fundamentals of Business Process Management.* 2. Edition. Berlin: Springer.

EABPM, E. A. o. B. P. M., 2014. *Business Process Management BPM Common Body of Knowledge.* 2. Edition. Wettenberg: Dr. Götz Schmidt.

Edwards, R. & Holland, J., 2013. *What is Qualitative Interviewing?.* 1. Edition. London: Bloomsbury Academic.

Erenay, B., Gürsel, S. A. & Celikbilek, C., 2015. *A Fuzzy Approach for a Supply Chain Network Design Problem. Conference Paper. Proceedings of 26th Annual Production and Operations Management Society Conference. Washington DC*

Eshkenazi, A., 2014. *Supply Chain Council to Merge with APICS. Released on 09.05.2014.* Read on 03.05.2021. https://www.apics.org/apics-for-individuals/apics-magazine-home/magazine-detail-page/2014/05/02/supply-chain-council-to-merge-with-apics

Fiedler, M., 2018. *Lean Construction - Das Managementhandbuch: Agile Methoden und Lean Management im Bauwesen.* 1. Edition. Wiesbaden: Springer Gabler.

Flick, U., 2017. *Qualitative Sozialforschung: Eine Einführung.* 8. Edition. Hamburg: Rowohlt Taschenbuch Verlag.

Frankfurter Allgemeine Zeitung (Ed.), 2020. VW nimmt das Rennen mit Tesla in der Elektromobilität auf. Released on 14.11.2020. Read on 05.05.2021 https://www.faz.net/aktuell/wirtschaft/auto-verkehr/vw-investiert-35-milliarden-euro-in-elektromobilitaet-17051526.html

Gadatsch, A., 2020. *Grundkurs Geschäftsprozess-Management - Anayse, Modellierung, Optimierung und Controlling von Prozessen.* 9. Edition. Wiesbaden: Springer.

Gulledge, T., Kessler, T. & Cavusoglu, T., 2001. *Intelligence, Aligning the Supply Chain Operations Reference (SCOR) Model with Enterprise Applications.* Portland: Institute of Electrical and Electronics Engineers (IEEE).

Ha, A. Y. & Tang, C., 2017. *Handbook of Information Exchange in Supply Chain Management.* 1. Edition. Basel: Springer International Publishing.

Handelsblatt (Ed.), 2021. *Chip-Mangel und drohender Shutdown: Die Autoindustrie kämpft an zwei Fronten.* Released on 19.02.2021. Read on 05.05.2021 https://www.handelsblatt.com/unternehmen/industrie/vw-daimler-und-co-chip-mangel-und-drohender-shutdown-die-autoindustrie-kaempft-an-zwei-fronten-/26827978.html?ticket=ST-523119-cnSPynOfaTFKxfxR4DiX-ap5

Hannoversche Allgemeine Zeitung, 2021. *MAngel an Mikrochips: Volkswagen Nutzfahrzeuge stoppt Crafter-Produktion.* Released on 09.04.2021. Read on 05.05.2021. Requires access right. https://www.haz.de/Nachrichten/Wirtschaft/Niedersachsen/Volkswagen-Nutzfahrzeuge-VWN-stoppt-Crafter-Produktion-wegen-Chip-Mangels

Heise (Ed.), 2021. *VW-Markenchef: Halbleiter-Mangel bleibt "Top-Thema".* Released on 01.05.2021. Read on 05.05.2021. https://www.heise.de/news/VW-Markenchef-Halbleiter-Mangel-bleibt-Top-Thema-6033555.html

Helfferich, C., 2019. Leitfaden- und Experteninterviews. In: N. Baur & J. Blasius, 1. Edition. *Handbuch Methoden der empirischen Sozialforschung .* Wiesbaden: Springer Verlag für Sozialwissenschaften, pp. 669-686.

Hilgers, M., 2016. *Einsatzoptimierte Fahrzeuge, Aufbauten und Anhänger.* 1. Edition. Wiesbaden: Springer Fachmedien Wiesbaden.

Kesko, 2021. *Kesko Annual Report: Kesko's Direction 2020.* [PDF]. Released on 19.03.2021. Read on 22.04.2021. https://www.kesko.fi/globalassets/03-sijoittaja/raporttikeskus/2021/q1/kesko_annual_report_2020_keskos_direction_final.pdf

Kesko, n.d.. *Kesko in brief.* Read on 22.04.2021. https://www.kesko.fi/en/company/

Khan, S. A. R. & Yu, Z., 2019. *Strategic Supply Chain Management.* 1. Edition. Basel: Springer International Publishing.

Knössl, T., 2013. Logistikorientierte Wertstromanalyse . In: W. Günthner & J. Boppert, Hrsg. *Lean Logistics: Methodisches Vorgehen und praktische Anwendung in der Automobilbranche .* Berlin Heidelberg: Springer Vieweg , pp. 135-144.

Koether, R. & Meier, K.-J., 2017. *Lean Production für die variantenreiche Einzelfertigung: Flexibilität wird zum neuen Standard.* 1. Edition. Wiesbaden: Gabler.

Kosieradzka, A. & Rostek, K., 2021. *Process Management and Organizational Process Maturity.* 1. Edition. London: Palgrave Macmillan.

Liebetruth, T., 2020. *Prozessmanagement in Einkauf und Logistik.* 2. Edition. Wiesbaden: Gabler Verlag.

Ludanek, H., 2017. Fahrzeuganforderungen bei leichten Nutzfahrzeugen für den inner- und außerstädtischen Lieferverkehr. In: A. Piskun, Hrsg. *Karosseriebautage Hamburg 2017.* Wiesbaden: Springer Vieweg, pp. 163-176.

McKinsey & Company, 2020. *Corona und andere Krisen: Lieferketten werden sich global dramatisch verändern.* [Press Release] Released on 06.08.2020. Read on 07.05.2021. https://www.mckinsey.de/news/presse/2020-08-06-global-value-chains

Handelsblatt (Ed.), 2021. *VW-Aktie steigt nach guten Jahreszahlen kräftig - Porsche verdient am besten.* Released on 16.03.2021. Read on 09.05.2021. https://www.handelsblatt.com/unternehmen/industrie/jahresbilanz-vw-aktie-steigt-nach-guten-jahreszahlen-kraeftig-porsche-verdient-am-besten/

Nagurney, A. & Li, D., 2016. *Competing on Supply Chain Quality - A Network Economics Perspective.* 1. Edition. Basel: Springer International Publishing Switzerland.

(…)

Niederberger, M. & Wassermann, S., 2015. *Methoden der Experten- und Stakeholdereinbindung in der sozialwissenschaftlichen Forschung.* 1. Edition. Wiesbaden: Springer.

Pfohl, H.-C. & Gomm, M., 2009. Supply chain finance: optimizing financial flows in supply chains. *Logistics Research* , 1. December , pp. 149-161.

Röhr, K., 2017. *Operative Exzellenz in Retailbanken: Innovative und industrieorientierte Konzepte für das Bankgeschäft.* 1. Edition. Wiesbaden: Gabler.

Ryan, F., Coughlan, M. & Cronin, P., 2009 . Interviewing in qualitative research. *International Journal of Therapie and Rehabilitation* , June , pp. 309-314.

Schmelzer, H. & Sesselmann, W., 2010. *Geschäftsprozessmanagement in der Praxis: Kunden zufrieden stellen - Produktivität steigern - Wert erhöhen.* 7. Edition. Müncher: Hanser.

(…)

Singh, R. & Ramdeo, S., 2020. *Leading Organizational Development and Change: Principles and Contextual Perspectives.* 1. Edition. London: Palgrave Macmillan.

Supply Chain Council , 2012. *Supply Chain Operations Reference Model Revision.* [PDF]. Released on October 2021. Read on 21.03.2021. https://www.academia.edu/29275319/Supply_Chain_Operations_Reference_Model_Revision_11_0

Tampere University of Applied Sciences, 2019. *Thesis at TAMK (student's guide).* Released on 25.02.2019. Updated on 05.05.2021. Read on 06.05.2021. https://www.tuni.fi/studentsguide/handbook/tamk?search=thesis&page=3104

Tarver, E., 2020. *Value Chain vs. Supply Chain: What's the Difference?.* Updated on 24.03.2020. Read on 22.02.2021. https://www.investopedia.com/ask/answers/043015/what-difference-between-value-chain-and-supply-chain.asp

Teixeira, P., 2021. *The Bullwhip Effect and How to Better Handle Food Crises.* [Blog]. Released on 20.03.2021. Read on 27.04.2021. https://mycorena.com/the-bullwhip-effect-and-how-to-better-handle-food-crises

Volkswagen Group, 2018. *Volkswagen Poznan GmbH - Volkswagen Nutzfahrzeuge Werke Poznan, Swarzedz, Wrzesnia und Komponenten Werk Giesserei.* [Press release]. Released on 01.03.2018. Read on 22.04.2021. https://www.volkswagen-newsroom.com/de/pressemitteilungen/volkswagen-poznan-gmbh-volkswagen-nutzfahrzeuge-werke-poznan-swarzedz-wrzesnia-und-komponenten-werk-giesserei-1992

Volkswagen Group. 2021a. Auf- & Umbauten für Volkswagen Nutzfahrzeuge. Read on: 22.04.2021 https://umbauportal.de/jctumbau/web/guest/umbauten

Volkswagen Group. 2021b. *Die Zukunft in der Hand. Geschäftsbericht 2020. Released on 16.03.2021.* Wolfsburg: Volkswagen AG.

Volkswagen Commercial Vehicles. 2018. *Das PartnerSystem. Neue Vorteile für Aufbauhersteller. [PDF].* Released on June.2021. Read on: 22.04.2021. https://umbauportal.de/jctumbau/documents/10156/70336/Volkswagen-Nutzfahrzeuge-Partnersystem-Juni-2018.pdf/

Volkswagen Commercial Vehicles, 2021a. *Konfigurieren Sie Ihr Fahrzeug.* Read on: 22.04.2021 https://www.volkswagen-nutzfahrzeuge.de/de/konfigurator.html

Volkswagen Commercial Vehicles, 2021b. *Med. Transporte und Feuerwehren.* Read on: 22.04.2021 https://www.volkswagen-nutzfahrzeuge.de/de/modelle/branchenloesungen-und-umbauten/med-transporte-und-feuerwehren.html

Volkswagen Commercial Vehicles. 2021c. Modelle und Konfigurator. Read on 22.04.2021. https://www.volkswagen-nutzfahrzeuge.de/de/modelle.html

Volkswagen Commercial Vehicles, 2021d. Unternehmen. Read on: 21.04.2021 https://www.volkswagen-nutzfahrzeuge.de/de/marke-und-erlebnis/unternehmen.html

Von dem Berge, B., 2020. Teilstandardisierte Experteninterviews . In: M. Tausendpfund, 1. Edition. *Fortgeschrittene Analyseverfahren in den Sozialwissenschaften .* Wiesbaden: Springer Fachmedien , pp. 275-300.

Werner, H., 2020. *Supply Chain Management: Grundlagen, Strategien, Instrumente und Controlling.* 7. Edition. Wiesbaden: Springer Gabler.

Wübbenhorst, K., 2018. *Gabler Wirtschaftslexikon Interview.* Released on 15.02.2018. Read on 22.03.2021. https://wirtschaftslexikon.gabler.de/definition/interview-41483/version-264847

Zeit (Ed.), 2021. *Chipmangel: Kleines Bauteil, große Wirkung*. Released on 28.01.2021. Read on 04.05.2021. https://www.zeit.de/mobilitaet/2021-01/chipmangel-halbleiter-autoindustrie-china-taiwan-silizium?utm_referrer=https%3A%2F%2Fwww.google.de%2F

Zijm, H., Klumpp, M., Regattieri, A. & Heragu, S., 2019. *Operations, logistics and supply chain management.* 1. Edition. Cham: Springer.

9 APPENDICES

Appendix 1. Semi-Standardized SCOR Guideline to conduct interviews

Guideline to structurally question supply chain processes of body converted Crafter		
Background: The following questions are developed based on the supply chain operations reference model. Each part deals with one process element presented in the reference model.		
Name of interviewee: XXX	Company: XXX	Date: YY.YY.YYYY

1.	**Plan**
1.1.	Could you describe how your services are demanded by other stages of the supply chain? (P1 – Plan Supply Chain)
1.2.	Could you describe how you demand other services of the supply chain? (P1 – Plan Supply Chain) We do not demand other services. We work as subcontractor for SE Mäkinen.
1.3.	How are you informed when Crafters or body converted Crafters will arrive at your supply chain stage? (P2 – Plan Source)
1.4.	How do you organize the delivery, after your services have been completed? (P4 – Plan Deliver)
1.5.	How are the maintenance operations of body converted Crafters organized at your stage? (P5 – Plan Return Deliver)
1.6.	How do you organize the return of defective products back to an upstream stage? (P5 - Plan Return Source)
1.7.	(How do you organize your manufacturing operations?) (P3 – Plan Manufacturing)
1.8.	How do you evaluate the planning processes of the supply chain?
2.	**Source**
2.1.	By which means of transport are Crafters brought to your supply chain stage?
2.2.	Could you describe the qualitative condition of Crafters coming from an upstream stage?
2.3.	How do you evaluate the reliability of transports coming from an upstream stage?
3.	**Deliver**
3.1.	By which means of transport are Crafters brought to the next supply chain stage?
3.2.	How much time does the delivery process to the next supply chain stage take?
3.3.	How do you evaluate the transport process to the next supply chain stage?
4.	**Return Source**
4.1.	Could you describe how Crafters are transported back to an upstream stage?
4.2.	How much time does the transport process from an upstream stage take?
4.3.	How do you evaluate the process if Crafters have to be returned to an upstream stage?
5.	**Return Deliver**
5.1.	Could you describe how Crafters are returned to your supply chain stage?
5.2.	How much time does it take to deliver the Crafter back to your supply chain stage?
5.3.	How do you evaluate the process of returning Crafters to your supply chain stage?
6.	**Make**
6.1.	Could you briefly describe the services and operations you provide in the supply chain?

Appendix 2. Expert Interview with salesperson of Espoo

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Appendix 3. Expert Interview with salesperson of Tampere

[redacted]

[redacted]

[redacted]

[redacted]

Appendix 4. Expert Interview with Premium Partner Profile

[redacted]

[redacted]

[redacted]

Appendix 5. Expert Interview with Premium Partner Tamlans

[redacted]

[redacted]

[redacted]

Appendix 6. Expert Interview with SE Mäkinen

[redacted]

[redacted]

[redacted]

Appendix 7. Expert Interview with the sales employee of VW CV

[redacted]

[redacted]

[redacted]

Appendix 8. Expert Interview with logistics employee of Konzernlogistik

[redacted]

[redacted]

[redacted]

Appendix 9. Detailed cost and throughput share of each process step

[redacted]

Appendix 10. Order sheet for Redirection Transport

[redacted]

[redacted]