LAPPEENRANTA UNIVERSITY OF TECHNOLOGY
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WORKING CAPITAL MANAGEMENT IN THE VALUE CHAIN OF AUTOMOTIVE INDUSTRY

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ABSTRACT

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The objective of this Master's thesis is to examine working capital management in the automotive industry in years 2006-2008. The study is conducted by the analysis of financial statements. The sample consists of 65 companies that represent different stages in the value chain of automotive industry beginning from raw material suppliers and ending to car dealers. Working capital management is studied by the cash conversion cycle (CCC).

The results show that the average CCC of the value chain is 67 days. Car manufacturers had the longest CCC, 106 days, whereas the CCC of oil companies was the shortest, 22 days. The findings suggest that the cycle time of working capital usually follows the cycle time of inventories, since the changes in cycle times of accounts receivable and payable compensate each other. Improvements in working capital management could be achieved by sharing more accurate information in the chain for example about inventory levels and order points of customer. It could also be discussed within the automotive industry, if the long credit periods, which tie up working capital, are really needed. New technologies enable faster payments, which would reduce the cash conversion cycles, improve the profitability of companies, and increase the competitiveness of the value chain. Working capital should not be reduced at the expense of value chain partners, because nowadays the competition is rather between the value chains than between the companies.

Similar research design is applied earlier to study working capital management in the value chain of pulp and paper industry. Even if the industries and the structures of the chains differ from each other, results were surprisingly similar. In future research, working capital management in other industries' value chains could still be studied and compared to previous studies. ICT industry, for example, could be an interesting object.

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Tämän diplomityön tavoitteena on tarkastella käyttöpääoman hallintaa autoteollisuuden arvoketjussa vuosina 2006-2008. Tutkimuksessa analysoitiin 65 autoteollisuuden arvoketjussa toimivan yrityksen tilinpäätöstietoja. Tarkastellut yritykset toimivat eri tasoilla arvoketjussa, joka alkaa raaka-ainetoimittajista ja päättyy autokauppiaisiin. Käyttöpääoman hallintaa arvioitiin laskemalla käyttöpääoman ja sen komponenttien kiertoaikoja.

Keskimääräinen käyttöpääoman kiertoaika autoteollisuuden arvoketjussa oli 67 päivää. Pisin kiertoaika oli autonvalmistajilla, 106 päivää, ja lyhin öljy-yhtiöillä, 22 päivää. Tulokset osoittavat käyttöpääoman kiertoajan seuraavan useimmiten varastojen kiertoaikaa, sillä myyntisaamisissa ja ostoveloissa tapahtuvat muutokset kumoavat toisensa. Käyttöpääoman hallintaa voitaisiin tehostaa parantamalla tiedonjakoa ketjussa esimerkiksi antamalla täsmällisempiä tietoja varastotasoista ja tilauspisteistä. Autoteollisuudessa toimivat yritykset voisivat myös tarkastella maksuaikojen vaikutuksia käyttöpääomaan ja pohtia, ovatko käyttöpääomaa sitovat pitkät maksuajat tarpeellisia. Uusien teknologioiden mahdollistamat nopeammat maksut lyhentäisivät käyttöpääoman kiertoaikaa ja sitä kautta parantaisivat sekä yrityksen kannattavuutta että koko ketjun kilpailukykyä. Käyttöpääoman kiertoaikaa ei tulisi lyhentää muiden arvoketjun toimijoiden kustannuksella, sillä tämän päivän liiketoimintaympäristöissä kilpailua käydään pikemminkin arvoketjujen kuin yritysten välillä.

Samanlaista tutkimusasetelmaa on aiemmin käytetty käyttöpääoman tarkastelemiseen paperiteollisuuden arvoketjussa. Teollisuudenalojen rakenteellisista eroavaisuuksista huolimatta tulokset olivat yllättävän samankaltaisia. Jatkotutkimuksen kohteena olisi mielenkiintoista selvittää käyttöpääoman hallintaa vielä jonkin muun teollisuudenalan, kuten esimerkiksi ICT-teollisuuden, arvoketjussa.

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Lotta Lind

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

CCC	Cash Conversion Cycle
COGS	Cost of Goods Sold
C2C	Cash-to-Cash Cycle
DIO	Days Inventory Outstanding
DPO	Days Accounts Payable Outstanding
DSO	Days Accounts Receivable Outstanding
EBIT	Earnings Before Interest and Taxes
EOQ	Economic Order Quantity
GICS	Global Industry Classification Standard
ICT	Information and Communication Technology
JIT	Just In Time
M&A	Mergers and Acquisitions
OEM	Original Equipment Manufacturer
ROI	Return On Investment

1 INTRODUCTION

1.1 Background

Working capital management is an essential part of short-term finance of a firm. With an efficient working capital management a company can release capital for more strategic objectives, reduce financial costs and improve profitability. During the recent financial crisis, many companies suffered from the consequences of their poor working capital management and were unable to keep their business moving because of the lack of working capital. According to Mullins (2009, p. 5), especially during the times of recession companies should pay more attention to cash flow than to profitability in order to be able to stay in the business. Companies can survive even if they fail to earn profit, but not without sufficient level of cash.

The recent financial crisis had major effects on the automotive industry also, but in fact, the industry was facing profitability problems before the crisis as well and suffered from the raised pressure on costs and competition. The situation has aroused an interest in improving working capital management in the automotive industry. Companies see it as an important part of management at the present moment. This was stated also in the annual report of year 2009 by BMW Group (2010): “Stringent working capital management is a further key parameter for managing the business”.

In previous academic literature, process-related working capital management is mostly considered from the perspective of an individual company. The literature lacks the perspective of the value chain. However, the value chain approach enables a broader understanding of the industry: how do the actions in other parts of the chain affect our business, how is the value created to end customer, how the value activities of our company fit into the value chains of our customers and suppliers, and what is our company’s position in the entire value chain. Working capital management of a firm is affected by the actions of its customers and suppliers, and therefore studying it in a wider context is essential.

The interest towards working capital management in the automotive industry is described also by the fact that the initiative for the topic of this thesis came from professionals in the automotive industry. The thesis is a result of a cooperative project between the Cost Management research group at Lappeenranta University of Technology and a German, internationally operating automotive supplier that produces and delivers metal-based parts to the largest automotive manufacturers in the world.

1.2 Research questions and limitations

The objective of this thesis is to examine the working capital management in the value chain of automotive industry in years 2006-2008. The research problem of the thesis is divided into three research questions as follows:

- *What are the ways to manage working capital in the value chain?*
- *How the working capital is managed in the value chain of automotive industry?*
- *What can be done to improve the working capital management in the value chain of automotive industry?*

The first research question is studied in the theoretical part of the thesis, where the previous literature on value chain perspective and working capital management are studied. The second research question focuses on the results of the study. The third research question is based on the findings from previous research questions. The objective is to develop recommendations for a single firm and for the automotive industry about working capital management basing on the results of the study.

Working capital can be defined from the operational perspective (inventories plus accounts receivable less accounts payable) or from the financial view (current assets less current liabilities). In this thesis, working capital is studied from the operational perspective because the value chain framework is adopted. Financial markets and financial instruments are not discussed. The data for the research is

collected from the financial statements. In this study, only publicly available data is used, which limits the companies that can be included in the sample.

1.3 Methods and data

This empirical study of automotive industry is conducted by analyzing financial statements. By the analysis of financial statements, it is possible to calculate key figures that can be compared to the figures of other firms or targets that have been set. The analysis of financial statements also includes studying the changes in key figures during the observation period and analyzing the causality affecting these changes. The analysis is more effective when the results can be compared to the figures of other companies in the same industry or to the average figures of the industry. (Niskanen and Niskanen 2003, p. 8)

This study could be defined as archival research. Moers (2007) defines archival data as data, for which the original purpose for gathering was not academic research. He has criticized the archival research approach because of uncritical usage of databases where scholars have easy access. In this study this problem is tackled by using only official financial statements and annual reports instead of databases. The financial statements have been collected from public sources: from firms' web sites, and some have been found in the German Company Register database, which is provided by Bundesanzeiger and where many German companies have to publish their financial reports. The financial figures for the CCC were collected carefully by hands during the fall 2010.

In this thesis, the cash conversion cycle (CCC) is used to study process-related working capital management in the value chain of automotive industry. CCC is the length of the time a firm has funds tied up in working capital and it consists of three components: number of days inventory outstanding (DIO), number of days accounts receivable outstanding (DSO) and number of days accounts payable outstanding (DPO). Data for the study has been collected from the publicly available financial statements of 65 international and Central European firms for each year of the 2006-2008 period. The firms operate on the different stages in the

value chain of the automotive industry. The value chain used in this thesis does not comprise of all real world steps that are needed for producing and delivering a car for an end customer but focuses on the three main elements of the car: steel, plastics and electronics. The structure of the chain is based on previous literature and the discussions with the professionals working in the automotive industry.

1.4 Structure

The structure of the thesis is shown in the figure 1.

Chapter	Title	Contents	
Chapter 1	Introduction	Background, research questions, methods and data, the structure of the study	
Chapter 2	Value chain	Definitions of the value chain of an organization and the value chain of an industry, advantages of value chain perspective	theoretical
Chapter 3	Working capital management	Definition of working capital, management of working capital and its components, cash conversion cycle	
Chapter 4	The value chain of automotive industry	Introduction to the automotive industry, description of research design and procedure, defining the value chain of automotive industry, description of the sample	
Chapter 5	Results and analysis	Results and analysis of cash conversion cycles and components, comparisons to previous studies, results on company level, calculations of the amount and interest costs of working capital, future research	empirical
Chapter 6	Conclusions	Conclusions from the study, recommendations for an individual firm, recommendations for the automotive industry	

Figure 1. The structure of the thesis.

The thesis is divided into two parts: theoretical and empirical. The theoretical part comprises of two chapters, where previous literature of value chain and working capital management is discussed. The purpose of these chapters is to provide understanding and tools for the further analysis of the current situation of working capital management in the value chain of automotive industry and for developing recommendations for the industry. The empirical part of the thesis describes the value chain of the study, research design and procedure, results of the study and

the analysis of results, and finally, conclusions from the study and recommendations for a single firm and for the automotive industry.

2 VALUE CHAIN

Firm's products are the results of engagement of many different activities (Carpenter and Sanders 2009, p. 111). The model of firm's value-creating-activities, value chain, was developed and presented in relation to competitive strategy by Michael Porter (1985). According to Johnson et al. (2008, p. 110), value chain describes the activities that together create value, i.e. product or service, to the customer. In this chapter, the concept of value chain is studied. Depending on the context, value chain has many differing definitions and can be applied in several different cases. To understand the origins of the value chain thinking, Porter's definition of the generic value chain and the basics of the value chain of an individual company are presented, but the focus in the chapter and in this thesis is on the perspective of an overall value chain of an industry.

2.1 Porter's model of value chain

Porter (1985, p. 33) introduced the value chain as a basic tool for analyzing the sources of competitive advantage by examining all activities a firm performs and the interaction between the activities. In the value chain, a firm is divided into its strategically relevant activities, which enables the understanding of the behavior of costs and potential sources of differentiation.

The generic value chain of an organization is shown in figure 2. Activities in the value chain are divided into two distinct group: primary and support activities. Primary activities are directly part of the creation or delivery of the product. Linked to each group of primary activities, there are support activities that help improve the efficiency of primary activities. Primary activities of the value chain include inbound logistics, operations, outbound logistics, marketing and sales, and service. Support activities consider firm infrastructure, human resource management, technology development and procurement. In addition to value chain activities, the value chain consists of a margin, which is defined as the

difference between total value and the collective costs that arise from performing the value activities. (Porter 1985, p. 33-37; Johnson et al. 2008, p. 110-111)

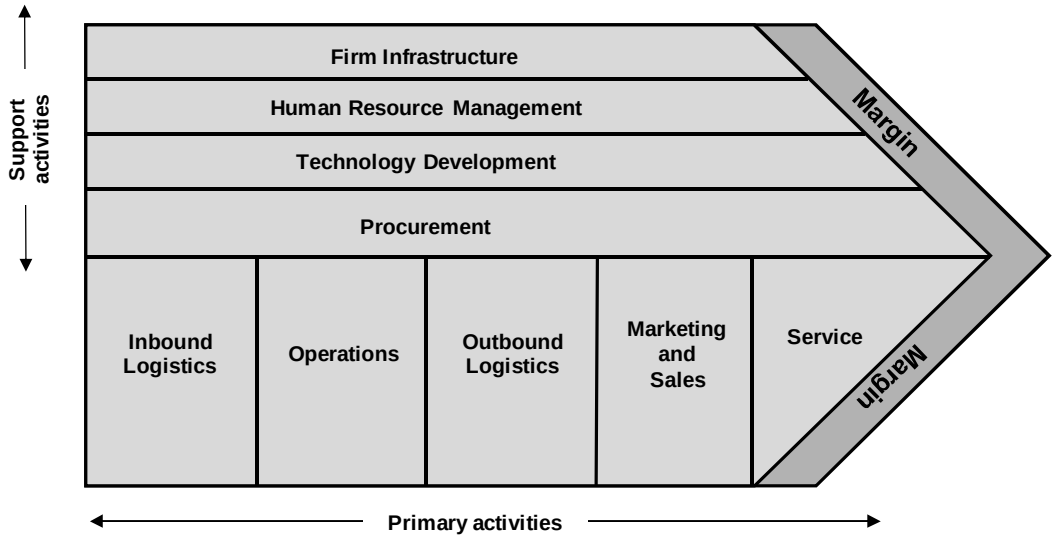


Figure 2. The value chain with primary and support activities. (Porter 1985, p. 37)

Inbound logistics consist of activities that are concerned with receiving, storing and distributing inputs, whereas operations can be defined as activities that transform these inputs into the final form of product. These activies include for example machining, packaging, assembly, equipment maintenance and testing. Outbound logistics contain activities related to collecting, storing and distributing the product to buyers such as warehousing of finished goods, material handling and order processing. Marketing and sales step induces buyers to purchase the product by advertising, promoting and pricing it. The last step of primary activities, service, provides activities to enhance or maintain the product. Such activities are for instance installation, repair, training and parts supply. (Porter 1985, p. 40)

The primary activities in the value chain are enhanced by support activities. Despite the term support activities, these operations together with primary operations of the firm also provide important potential for competitive advantage (Carpenter and Sanders 2009, p. 111). Procurement includes the processes that are

used for purchasing inputs to produce products. These purchased items do not include only raw materials and supplies, but also assets such as machinery, laboratory and office equipment, and buildings. Technology development refers to all value activities: also know-how is considered as technology in this context. Technologies can be directly related to the product, like R&D or product design, to processes, like process development, or to a particular resource, like raw material improvement. Human resource management supports other activities of the firm – both primary and support - by recruiting, hiring, training and developing personnel. Firm infrastructure includes for example formal systems of planning, finance, quality control, information management and general management. (Porter 1985, p. 41-42; Johnson et al. 2008, p. 111)

2.2 Value chain of an organization

Value chain approach is originally used for company's internal scanning: to analyze organization itself (Wheelen and Hunger 2002, p. 84). Johnson et al. (2008, p. 110) see value chain as a helpful concept in understanding which activities undertaken by the company create important value and which do not. Carpenter and Sanders (2009, p. 111) view value chain analysis as a possibility to make choices about emphasizing, de-emphasizing, and outsourcing internal functions. At every step of the value chain, different mix of resources and capabilities is required. Different firms make different choices of the mix of resources and capabilities, and therefore it is possible that their set of resources and competences vary a lot – even when operating in the same industry. (Barney and Hesterly 2006, p. 83) To create value, firm should search for better or differerent ways of performing its activities than its competitors (Carpenter and Sanders 2009, p. 112). According to Drury (2008, p. 552), competitive advantage is gained when a firm is able to perform value chain activities more efficiently and at a lower cost than its competitors. Consequently the understanding of the performance of value chain activities and the interaction between them is essential.

By analyzing value chain to define organization's strategic position, there are two different approaches: the value chain can be seen as a generic description of activities, or the value chain can be examined in terms of the cost and value activities. When seeing the value chain as a description of activities, managers may be able to find possible clusters of activities in particular areas of value chain that provide benefit to customers and see the actitivities, where their business is especially good and where the improvement is required. The role of different activities should also be considered by managers. When viewing value chain in terms of cost and value of activities, it is possible to identify areas to focus on to develop a more profitable business model. (Johnson et al. 2008, p.111)

2.3 Value chain of an industry

These days, only a few companies contain all the value-adding activities of a product, i.e. take care of the whole value chain of a product. Usually, a firm has a specific role in a wider network of activities that adds value to the final customer. (Wheelen and Hunger 2002, p. 84; Johnson et al. 2008, p. 111) Initially, the concept of value chain was defined to study processes within one firm. However, it can also be examined as a value chain of the whole industry by extending the chain to contain all upstream and downstream stages as well. In this wider context, the individual firms are seen as role players and the overall value chain, or value network, is a result from the value chains of suppliers, the firm itself, the distribution channel and the end customer. (Lamming 1993, p. 90-91)

The value chain of an industry, or value network, is defined as a set of interorganisational links and relationships that are necessarily needed when creating a product or service (Johnson et al. 2008, p. 111). A value network is formed, when organisations operating in the same industry supply, distribute and buy from or compete with each other and therefore create a wider group of value generation. Value network or value system contains and combines value chains of supply, distribution and customers. (Lynch 2006, p. 203-205) This chain of companies could also be called value system (Porter 1985, p. 34) or value stream (Gordon 2010, p. 12). According to Chivaka (2007, p. 24), an industry value chain

consists of all the value creating activities within an industry beginning with the basic raw material and ending with the delivery to end customer.

The value chain of most industries can be divided into two parts: upstream and downstream. Upstream activities add value early in the value chain (Lynch 2006, p. 473). Suppliers provide inputs where another company then adds value. After the value is added, these inputs are transferred to the customer - either the end customer or another business - in downstream. (Normann and Ramirez 1993, p. 65) According to Lynch (2006, p. 475), upstream activities are mainly processing standardised products from raw materials, and in downstream, intermediate products are used to manufacture differentiated products that meet the customer needs. Figure 3 describes the value network.

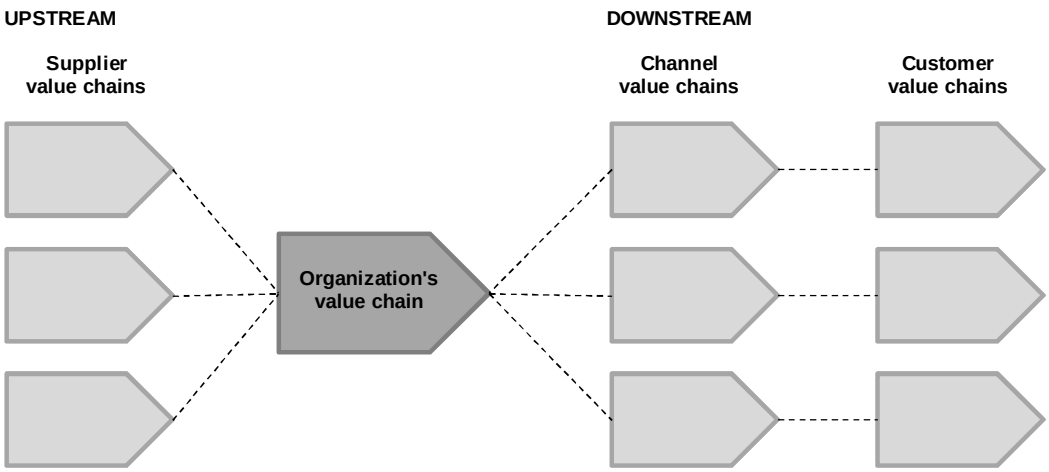


Figure 3. The value network. (Adapted from Johnson et al. 2008, p. 114)

Supply chain is often considered as a synoym for value chain of an industry and some theoretical perspectives of supply chains can also be applied when examining value chains or value networks. Lamb et al. (2009, p. 404) define the company's supply chain as the chain of all the companies operating in upstream or downstream flows of a product, beginning from the initial suppliers in so called "point of origin" and ending at the ultimate customer in "point of consumption". This view is relatively wide, whereas Mentzer et al. (2001, p. 2) state that a supply chain or a basic supply chain is formed of a company and its immeadiate suppliers

and customers only. An extended supply chain would then include the suppliers of suppliers and the customers of customers also, and an ultimate supply chain can be seen as the overall chain involving all steps from raw materials to end customer.

As Croom et al. (2000, p. 69) show in their article, the term supply chain management has various definitions depending on the perspective. Most definitions, however, agree with supply chain management focusing on the external environment of the firm. Also many of the definitions consider the supply chain as an overall network from raw materials to end customer. Both chains, supply and value chain, can be described as series of integrated and dependent processes that transform specifications to finished products, but the supply chain is considered only as a sub-set in wider value chain (Al-Mudimigh et al. 2004, p. 311). Also the focus between the chains differ: according to Tan (2001, p. 39), the interest in the supply chain is on operations, materials and logistics, whereas the interest in value chain management are on the customer and the information flow including financial aspects (Al-Mudimigh et al. 2004, p. 311-312).

Firms working in the same industry make different choices about which stages in the overall industry value chain they want to operate at (Barney and Hesterly 2006, p. 83). For the value chain analysis, Wheelen and Hunger (2002, p. 84) suggest a firm should analyze its product's location in the overall value chain where the firm may have only a little part. They also highlight, that even if the firm works in both, upstream and downstream, in the industry value chain, it usually has a so-called center of gravity, which can be defined as a part of the chain where the most important activities and competencies of the company are situated. Usually this center of gravity also lies at a point where a company started its business in history.

As stated earlier, a firm usually has only a small part in the larger value system. Moreover, all the companies have their own set of resources and capabilities and they make their own choices of which markets to focus on and which suppliers to

cooperate with. Therefore every firm has their unique overall value chain which differs from the other companies' value chains even when the companies operate in the same industry. (Shank and Govindarajan 1992, p. 180) Also the firm can be part of many different chains and its position within these chains can vary a lot: the same company can be seen as a supplier in one chain but as a customer, partner or competitor in another chain. This phenomenon describes the network nature of supply and value chains. (Mentzer et al. 2001, p. 7) The view of Blackman and Holland (2006, p. 82) also supports the network approach: they state that manufacturing process nowadays is not a set of separate operations but a whole process across the supply chain.

2.4 Advantages of value chain perspective

Hergert and Morris (1989) and Shank and Govindarajan (1993, p. 49-53, 58), who introduced the value chain analysis, argue that decisions should be analyzed in wider context of the value chain, not just from the perspective of the company and its closest suppliers and customers. By analyzing the whole chain, it can be determined exactly in which parts of the chain it is possible to enhance customer value or reduce costs. Wider value chain analysis is essential also for understanding how the industry works: how actions in other stages of the chain affect the company, how the value of the final product consists of value created in each stage, and how the value activities of the company fit into the value chains of customers and suppliers. On the other hand, it should also be considered, that each value chain stage incurs costs, generates revenues and ties up assets in the process. According to Normann and Ramirez (1993, p. 65-66), the most successful companies in their strategic analysis do not focus on the company or even on the industry, but on the entire value-creating system. In this system, the actors work together to produce value to end customer.

Also Johnson et al. (2008, p. 111-114) state, that considering the wider network instead of the organization alone is essential in understanding the whole process to improve customer value. The quality of the final product and its value to the end customer are influenced by not only the manufacturing company itself, but also all

the other actors in the value network. The managers should understand how the strategic capabilities of their organization fit into the wider value network. To develop this understanding, four key issues should be discussed: what are the activities that are centrally important to an organization's strategic capability, what are the more profitable parts in the value network, make or buy decisions for a particular activity or component, and decision related to partnering.

When the stages of the overall value chain have been identified, it is possible to evaluate the added value and its cost at each stage. The functionality of the overall chain as a value-adding process is dependent on the interaction within and between the stages. (Lamming 1993, p. 91) It is not only the suppliers and customers, who affect the firm's value activities, but also the actions of suppliers' suppliers and customers' customers that can have a significant impact on a company's business. To gain competitive advantage, a firm has to understand not only the part of the value chain it operates at, but also the entire value delivery system (Shank and Govindarajan 1993, p. 51).

Porter (1985, p. 99) stated that sustainable competitive advantage can be achieved either by reducing the costs of the value chain or by reconfiguring the value chain the company operates at. When choosing the method of reducing costs, a firm should consider following procedures (Shank and Govindarajan 1993, p. 60): reducing the costs of an activity while holding the value constant, increasing the value of an activity while holding the costs constant, or reducing assets of an activity while holding costs and revenue constant. In turn, if a firm is willing to gain competitive advantage by reconfiguring the value chain, the following issues should be contemplated: the ways to perform activities differently or even eliminate their necessity, reordering or regrouping of a group of linked value activities, and consequences of coalitions with other firms to costs (Porter 1985, p. 110). According to Shank and Govindarajan (1993), it is important that decisions made by companies reduce the total value chain costs instead of just reallocating them in the chain. To do so, management of structural and executional costs is

essential. Dekker (2003) suggests that cost data should be integrated in the supply chain and costs should be managed through collaboration.

An advantage of value chain perspective in cost analysis and cost management is that it includes both - suppliers and customers - as a source of costs along the value chain of one product (Chivaka 2007, p. 27). In cost accounting, the value chain perspective can be applied as value stream costing. Value stream costing is seen as an effective and simple method, that enables identifying cause and effect relationships between costs and activities. The method integrates conceptually with lean management philosophy, which supports the elimination of waste and the reduction of costs and cycle time. Lean management, as well as value stream costing, aims to continuously improve customer satisfaction while reducing the activities that do not add value. (Gordon 2010, p. 11-12) According to Horngren et al. (2009, p. 747), to succeed in lean production, companies are required to focus on the entire value chain to reduce inventories, lead times, and waste.

According to Lind and Thrane (2010, p. 66), information from value chain accounting analysis can be used to compare different value chains and to estimate the attractiveness of different value chain parts. Based on this information, a company can make choices about the value chain it wants to be part of. Optimizing the value chain the company is involved in, is important, but being a part of the most successful value chain might be even more important. The company can use the information from value chain analysis also when improving its position within the value chain. The efforts could be focused on the attractive parts of the value chain and operations in unattractive parts of the chain could be de-integrated. In the wider chain, which includes third parties such as competitors and regulators, the most important managerial issues concern consequences of indirect effects, dynamics, and learning. Risk and opportunities should be discussed in wider context, such as analyzing the risks from suppliers' suppliers, since these factors affect also on the business of a company.

3 WORKING CAPITAL MANAGEMENT

Working capital management is an essential part of short-term finance of a firm. Especially during the recent financial crisis, the importance of working capital management was highlighted by many companies. Working capital management is an important source of liquidity and value enhancement, but attention should be also paid to it on the good times – not only when facing problems (Buchmann 2009, p. 350). In this chapter, the definition of working capital, its one measure - cash conversion cycle -, and the management of working capital components, are discussed.

3.1 Working capital

Working capital is a part of a firm's current assets. Depending on the source, working capital can be defined in different ways. Operational view for working capital studies only capital tied up in processes, whereas according to the financial view, working capital is defined as a difference between current assets and current liabilities. In this thesis, working capital is studied from the operational perspective.

A typical way to sort the assets of a firm is to divide them into two distinct areas: fixed and current assets. The fixed assets are comprised for example of the plant and equipment of a company, while the working capital refers to a firm's current assets. A firm's current assets are considered as those assets that are expected to be able to turn into cash within one year. In addition to cash itself, a firm's primary current assets consist of short-term marketable securities, accounts receivable and inventories of raw materials and finished goods. One remarkable difference between fixed capital and working capital is the fact that working capital components – inventories, receivables, and payables – can be decreased or increased in small units. Plant and equipment are always purchased as a whole. Also typical for working capital is that it is possible to transform its components quickly into other assets (Mao 1976, p. 183, 209; Levy and Sarnat 1994, p. 180)

A firm's current assets circulate amongst distinct balance sheet accounts. The working capital cycle of a typical manufacturing firm is described in Figure 4. When a firm purchases raw materials, it pays for them in cash or on credit, which creates accounts payable. In a firm, cash is also used to other purposes: to pay the costs of producing products and other operations, such as marketing and distribution, but in this thesis, this aspect is not studied because the focus is on process-related working capital. Furthermore, working capital includes the cost of inventories: raw materials from raw material inventories are used in the production process, partially completed products form the work-in-progress inventories, and finished products are then carried as inventories until they are sold to customers. Accounts receivable are created, when finished goods from inventories are sold to customers on credit. Naturally, the customers may also pay in cash instead of credit. When the collection of receivables is carried out, cash is brought to the firm and the circulation process starts from the beginning. (Hampton 1976, p. 125; Arnold 1998, p. 558)

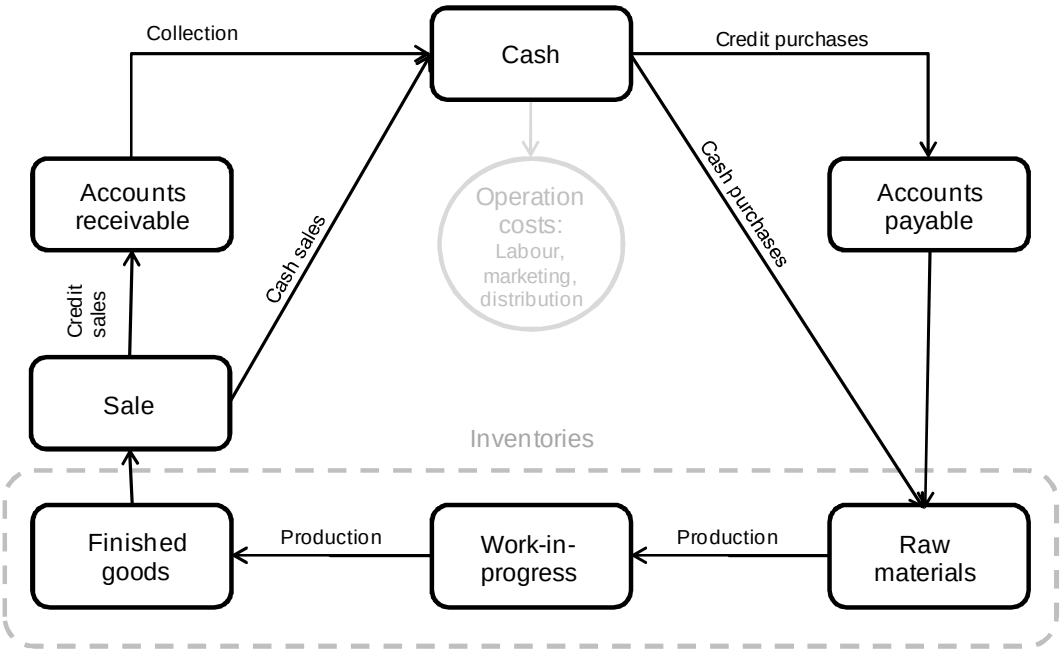


Figure 4. Working capital cycle. (Adapted from Arnold 1998, p. 559; Levy and Sarnat 1994, p. 181)

Working capital can be defined from the operational perspective or from the financial view. From the financial view, the working capital is calculated as current assets less current liabilities (Levy and Sarnat 1994, p. 180). This view is applied in many sources when discussing working capital, and the term net working capital is used. From operational perspective, working capital is calculated as shown in equation 1.

$$\textit{Working capital} = \textit{Inventories} + \textit{Accounts receivable} - \textit{Accounts payable} \quad (1)$$

The estimation of optimal working capital is a challenging task. Successful working capital management requires the right balance between liquidity and profitability. To be able to pay salaries and other payments when needed, sufficient level of liquidity is required. At the same time, a company's inventories need to be big enough in order to avoid disruptions in production and keep customers satisfied. On the other hand, if inventories were too large, profit would be lost because of extra holding costs and interest costs of the capital involved. Large inventories may also lead to losses through deterioration. (Mott 2005, p. 231; Arnold 1998, p. 541)

The amount of working capital a company needs is affected by several factors, such as the size of a firm, firm's activities, availability of credit, and attitudes towards profits and risks. Small firms suffer more from the failures of a few customers to pay in time than larger firms that have cash flows from more sources, and therefore the need for working capital in larger firms might be lower when compared to total assets or sales. Companies that are required to keep large inventories or use relatively light credit terms need more working capital than companies whose business is based on services or sales made in cash. The amount needed for working capital is greater also among the companies that do not have the possibility to easily get credit from banks. Furthermore, the amount of working capital depends on the profit and risk policies of the firm. In case a company is willing to keep more working capital than needed, the profits are reduced since working capital, as all funds, has a cost. On the other hand, in this

situation, the risk of liquidity problems is also lower. (Hampton 1976, p. 129) A company can cover its need of working capital partly on short- and long-term liabilities and partly on equity. (Yritystutkimusneuvottelukunta 1999, p. 60).

The working capital of a firm is not constant during the entire operating year. Working capital can be seen consisting of two components: permanent and variable working capital. For permanent working capital, the current assets required continually during the entire year are considered. It represents the minimum of cash, receivables and inventory, which is needed to carry on operations at any time. Variable working capital, in turn, represents the additional assets that are required at different times of the year, depending on differences in sales. Inventories have to be on certain levels in order to support peak selling periods, and after high sales periods, the receivables are higher than usual. Figure 5 describes the needs of permanent and variable working capital for different firms. The sales of company A are stable throughout the year, but company B has a period of growth.

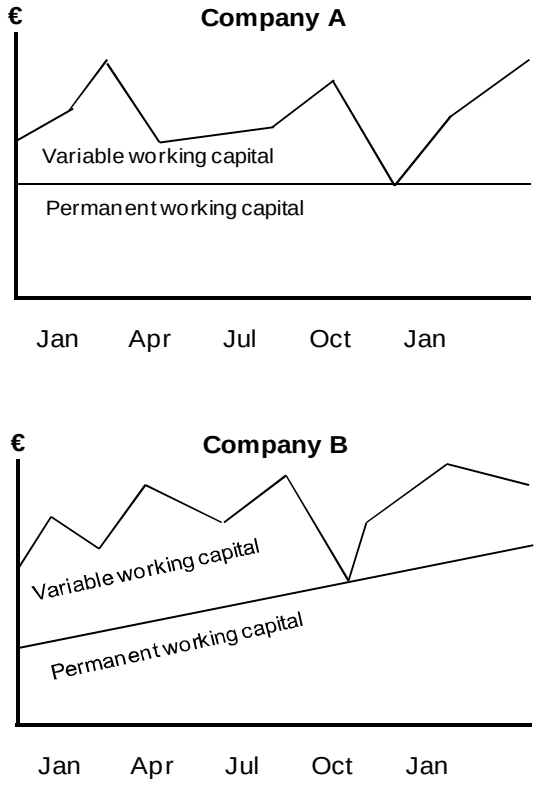


Figure 5. Permanent and variable working capital. (Hampton 1976, p. 126)

In case of company A, permanent working capital stays constant during the year, and the need of working capital depends on the changes in variable working capital. If the company is in a growth situation, like company B in the example, also the need for permanent working capital is increasing. Variable working capital shows how the seasonal and cyclical factors affect the working capital requirements. In most firms, the demand does not remain the same during the entire year, but fluctuates in cycles or after seasons. The changes in sales have an effect in variable working capital. The sales can be affected by usual seasonal reasons or by economical cycles like recession. (Hampton 1976, p. 126-127)

Working capital is considered an investment similar to investments in property for a firm. Inventories and accounts receivable represent capital tied-up that could be earning interest if invested in shares for example. Firms that allow customers to make purchases on credit usually acquire goods and services on credit as well. Accounts payable offsets the capital needed to finance inventories and accounts receivable. In the value chain context the accounts receivable of supplier are equivalent to the accounts payable of its customer.

3.2 Management of working capital

Especially during times of recession, the importance of working capital management increases in many companies. This results for example from the problems in getting external financing. With tightened management of working capital components, it is possible to release cash for more strategic objectives. At the same time, another advantage of working capital management is its effect on business processes, which become more effective and lead to positive effects also in cost aspects. (Buchmann 2009, p. 350) Also Mullins (2009, p. 5) highlights the significance of working capital management: the lack of working capital leads to serious problems despite the profitability of the company.

In literature, working capital management has received less attention than issues related to long-term investments and financing decisions, but still, working capital management makes a major part of financial manager’s work (Richards and

Laughlin 1980, p. 32). Working capital components – inventories, accounts receivable and accounts payable – usually form a siginificant portion of firm's total assets, and therefore the working capital management of the firm has a remarkable effect on its profitability. In many firms, working capital management should be an important part in financial management. (Deloof 2003, p. 573) However, despite the importance of working capital management, in many firms it is still undervalued or not considered consistent enough (Buchmann 2009, p. 350).

Working capital management consists of the management of working capital components. To manage working capital successfully, cooperation in the management of components is important even if each of them form their own entity. Management of each component is studied later in chapters 3.4-3.6.

3.3 Cash conversion cycle

Developed by Richards and Laughlin (1980), Cash Conversion Cycle (CCC), also known as Cash-to-Cash Cycle (C2C), has been used in many previous studies to measure working capital management (e.g. Deloof 2003; Hutchison et al. 2007; Ulbrich et al. 2008). CCC presents the length (days) of time a firm has funds tied up in working capital starting from the payment of purchases to supplier and ending when remittance of sales is received from customers. In other words, the CCC represents the time period, which is required to receive from customer sales a unit of money that was used to pay the raw material purchases to a supplier. Figure 6 shows the cash conversion cycle graphically.

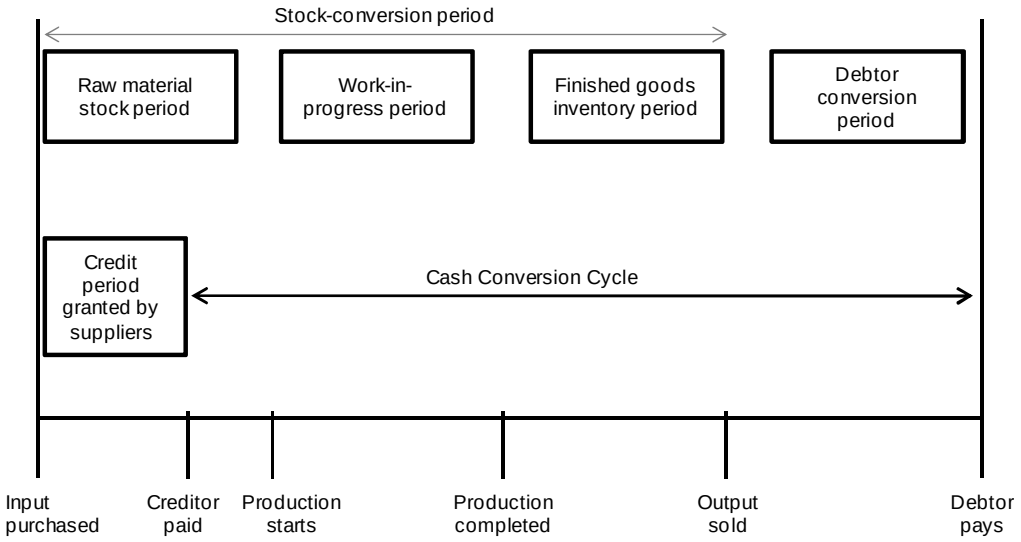


Figure 6. Cash Conversion Cycle. (Arnold 1998, p. 561)

The CCC consists of the cycle times of inventories, accounts receivable and accounts payable. The definition of CCC is shown in equation 2.

$$CCC = DIO + DSO - DPO \tag{2}$$

where *CCC* = cash conversion cycle,
DIO = days inventory outstanding,
DSO = days accounts receivable outstanding, and
DPO = days accounts payable outstanding.

According to terms used in figure 6, CCC can also be defined as the sum of stock-conversion period and debtor conversion period less credit period granted by suppliers. Further the working capital components DIO, DSO and DPO are calculated as follows:

$$DIO = \frac{inventory \cdot 365}{sales} \tag{3}$$

$$DSO = \frac{accounts\ receivable \cdot 365}{sales} \quad (4)$$

$$DPO = \frac{accounts\ payable \cdot 365}{sales} \quad (5)$$

Traditionally, the cost of goods sold (COGS) has been used as a denominator when calculating the cycle times for inventory and accounts payables (Yritystutkimusneuvottelukunta 1999, p. 60-61). In this study, the CCC actually indicates "the number of "days sales" the company has to finance its working capital under ceteris paribus conditions" (Shin and Soenen 1998, p. 38). When the value of sales is used as denominator instead of COGS, turnover time is shorter for the most part for companies because the value of sales is normally more than the value of COGS. However, sales is used as denominator as COGS is not available in public sources.

The previous literature of working capital management has concluded that companies can increase their profitability by shortening the CCC (e.g. Shin and Soenen 1998; Deloof 2003; Lazaridis and Tryfonidis 2006). Strong negative relations have been found between the cash conversion cycle and corporate profitability, as well as between gross operating income and the components of cash conversion cycle. These results indicate that value for shareholders could be created by reducing DSO and DIO to a reasonable minimum. (Deloof 2003, p. 585)

On the other hand, there are also arguments against the short CCC. Long cycle time of inventories reduce the risk of delivery interruptions, price fluctuations and business losses due to scarcity of products (Blinder and Maccini 1991; Wang 2002), and a company can sometimes achieve higher sales and strengthen its customer relationships with a generous trade credit policy (Long et al. 1993; Deloof and Jegers 1996; Shah 2009).

In previous academic literature, working capital is mostly considered from the perspective of an individual company. The literature lacks the perspective of the value chain. The proper cycle time of working capital and its components is even more difficult to adjust if the perspective of the whole value chain is taken. Attempts to tighten the payment periods of the big actor create liquidity pressures on the other companies of the value chain (Blackman and Holland 2006). On the other hand, if there is a strong dominant player in a value chain, it could finance weak subcontractors and customers by adjusting payment periods and credit terms (Saranga 2009). Working capital has been considered from the value chain perspective in a few studies only. Saranga (2009, p. 717) has found empirical evidence that efficient working capital management results in higher operational efficiencies in the value chain of the auto component industry. Pirttilä et al. (2010) studied the cycle times of working capital in the pulp and paper industry and found out that the working capital management is more efficient in the downstream, closer to the end customer.

Analyzing CCC in a wider value chain context instead of an individual company helps firms in negotiation for payment terms with customers and suppliers. Companies that use CCC data have better negotiating positions with their customers and suppliers. When considering the situation of the entire value chain in the CCC analysis, firms can create plans together for balancing the chain to improve profits and obtain overall efficiencies for all parties in the chain. Using CCC as a benchmark can be done for example by comparing CCC variables of the company and its competitors to analyze the company's position in the industry, quantifying the value of changing one day for each variable, and determining and analyzing the CCC variables of key suppliers and customers. (Hutchison et al. 2007, p. 42-44)

3.4 Management of inventories

In a manufacturing firm, it is assumed that inventories represent half of current assets. Inventory is also the component of working capital that can be best affected by a firm itself. Therefore, in working capital management the control

and management of inventories is a crucial element. (Mott 2005, p. 242) Also Rafuse (1996, p. 59) argues, that the companies that are willing to reduce working capital should focus on stock reduction.

Inventory management related to working capital cycle is shown in Figure 9.

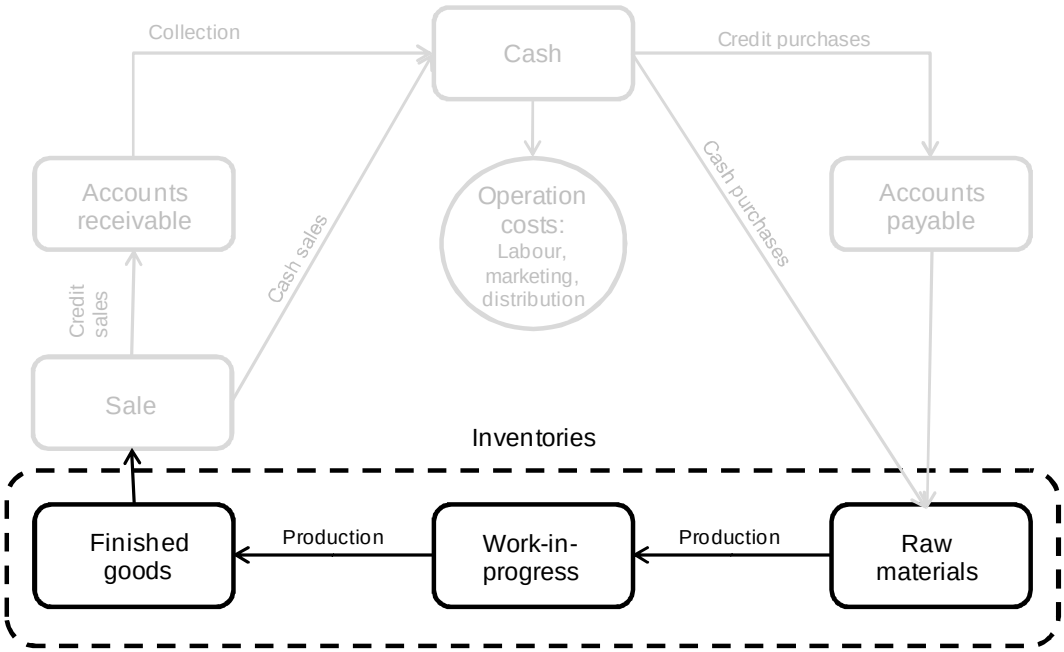


Figure 7. Management of inventories in working capital cycle.

There are three possible types of inventories in a typical manufacturing firm: inventories of raw materials, work-in-progress and finished goods. Raw materials are goods that have not yet been taken to production in a firm. Work-in-progress includes materials that are already in the production process, but have not been completed yet and are therefore not ready to be sold. The inventory of finished goods is for completed products that can be sold to customers. (Hampton 1976, p. 173) Typically, the more finished the product is, the more working capital is tied up in the inventory.

The size of inventory is affected by several factors: it depends on the predictability of sales and production, the length of time required by production, and the nature of the product. If the product is perishable by nature, stock levels

are held low, whereas other types of products are held in stock in order to offer better choice for customers. (Arnold 1998, p. 576)

It is challenging for a firm to find the right balance between the costs of holding inventories and costs arising from low inventory levels. Holding inventories at high levels ties up working capital and increases additional storage and insurance costs. Also the risk of obsolescence and deterioration is higher. On the other hand, by holding larger stocks, a company can ensure that its production is not disturbed because of lack of materials, which keep their customers satisfied. In addition, gaining remarkable discounts through purchasing in large quantities is attractive to some companies and leads to higher level of inventories. Through this procedure, a firm is able to increase its profits as long as the costs of holding larger inventories are less than the amount of discount. When inventory level is held low, orders need to be done more often, which leads to higher administration costs and more physical handling of the goods. Administration costs come from extra work, such as typing and checking ordering forms, accepting and checking arrived goods, and checking the invoices. There is also a risk of stock-outs, which may cause losses of sales and profits in short period, and loss of goodwill in the long-run. (Arnold 1998, p. 576; Mott 2005, p. 243; Hampton 1976, p. 173-176)

To balance the conflicting factors related to the management of inventories, many models for managing inventories have been developed. The purpose of these models is to assist in finding the optimal level for inventory. For example, economic order quantity (EOQ) is used to calculate the inventory level where the total inventory holding costs and ordering costs are in minimum, and Just-in-time (JIT) is based on long-term contracts with suppliers and deliveries exactly in needed amounts and times. (Mott 2005, p. 243-244) However, in this thesis working capital management is studied as a whole, and therefore the deeper discussion of inventory management models is left out of the study.

3.5 Management of accounts receivable

Many firms sell on credit instead of requiring immediate payments from their customers. These amounts are carried on the balance sheet under accounts receivable. Which customers are worth giving credit, what are the payment terms and how are the late payments followed up, are the issues relating to management of accounts receivable. (Hampton 1976, p. 154; Mott 2005, p. 236) Figure 10 represents the management of accounts receivables in working capital cycle.

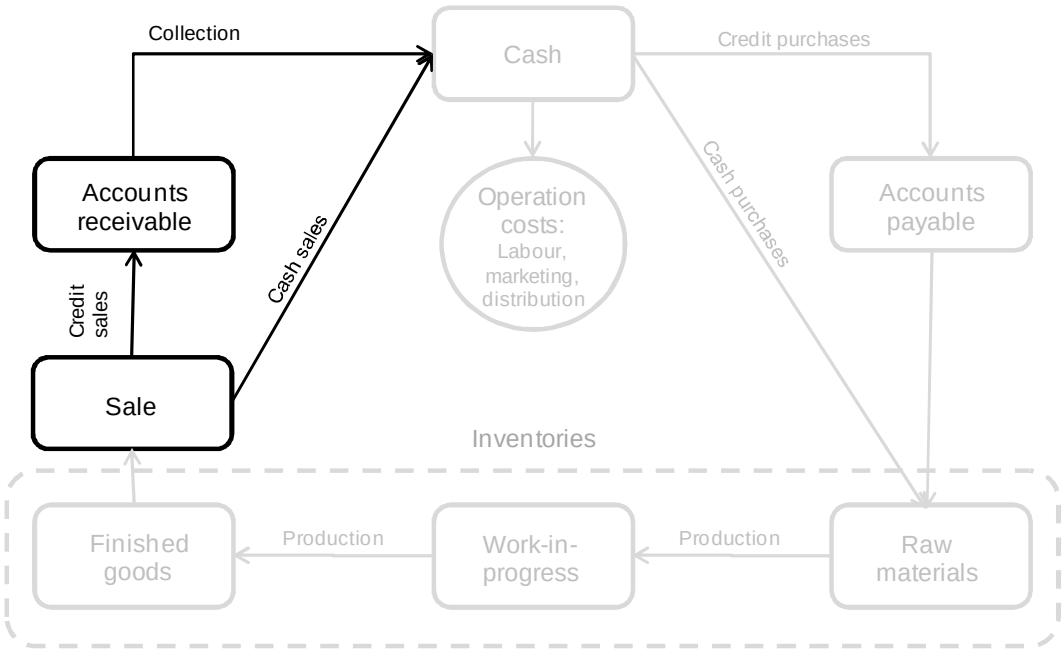


Figure 8. Management of accounts receivables in working capital cycle.

By giving credit to customers, a company seeks to achieve growth in sales, increase profits and meet competition. The generous credit terms may be used as a part of marketing, but they might be also required by customers. If competitors permit sales on credit, to be able to stay in the competition the firm is also required to do so. For this reason, it is usual, that the credit terms are similar throughout the whole industry. All these goals of accepting credit purchases from customers aim at the larger flow of operating revenue. (Hampton 1976, p. 155-156; Mott 2005, p. 237) Trade credit has become an ordinary part of business. Its advantage is its availability to companies regardless of size. Especially for small

firms it may be essential because the possibilities for other kind of finance are limited. (Arnold 1998, p. 508)

Before trade crediting a customer, the credit rating of the customer company should be checked, for example, by employing an external credit agency or by the firm's own staff. Creditworthiness can be evaluated as well by talking with customer's other suppliers and by calculating and analyzing the key financial figures from customer's annual report. (Mott 2005, p. 237)

Credit terms a firm offers may vary a lot depending on the customer. Very high risk customers may be required to pay cash upon delivery or in some cases even in advance, before delivery. However, usually payment terms of a company follow industry practices and discounts are offered for early payments and cash payments for example. This is one way to control the risks of bad debts, but at the same time the company's need for borrowed capital is reduced as well. (Levy and Sarnat 1994, p. 194-195) Besides traditions within the industry, other factors determining the payment terms are bargaining power of the two parties and the type of product (Arnold 1998, p. 509). Payment terms may also differ a lot depending on the examined region. For example, payment periods of Belgian firms compared to the payment periods in the USA are relatively longer. (Deloof 2003, p. 574)

Besides the question of granting credit, the credit policy in a firm includes another important issue: collection of receivables. The procedures on how to deal with customers that "stretch" their payables have to be considered in a firm. This could be done by strongly worded letter or phone call, or turning customer over to a professional collection agency, but probably in most firms the changes in future credit terms are the main tool of controlling delinquent accounts. In future purchases the credit terms can be tightened or the amount of credit purchases will be limited. (Levy and Sarnat 1994, p. 196-197) There are different ways of collecting and dealing with accounts receivable. In some firms, the whole credit-administration process is carried out internally, but some firms turn to specialized

financial intermediaries, factors, who take care of the entire process. When using factoring services, a firm sells its accounts receivable to a financial institution. In a typical factoring process, after receiving an order from customer, the manufacturer passes it to the factor. Assessment of credit risks and credit-granting decisions are made by factor. Depending on the type of factoring, credit risk can be born by the firm itself or by the factor. Besides factoring, also other kinds of policies for the management of accounts receivable exist. For example, general corporate credit, accounts receivable secured debt, captive finance subsidiary, and credit insurances are possible when dealing with accounts receivable. (Mian and Smith 1992, p. 195-199)

As well as the management of inventories, the management of accounts receivables needs to be in balance: if the collection policy of a firm is stringent, it may reduce bad debts and the resources tied up in receivables, but at the same time, it probably affects sales negatively as well. On the other hand, profits from credit sales do not benefit a firm unless the account is collected. (Levy and Sarnat 1994, p. 196-197)

3.6 Management of accounts payable

The management of accounts payable is the other side of the management of accounts receivable. Especially when examining the working capital management from the perspective of value chain, accounts payable of one firm are accounts receivable of another firm. Accounts payable in the working capital cycle can be seen in figure 9.

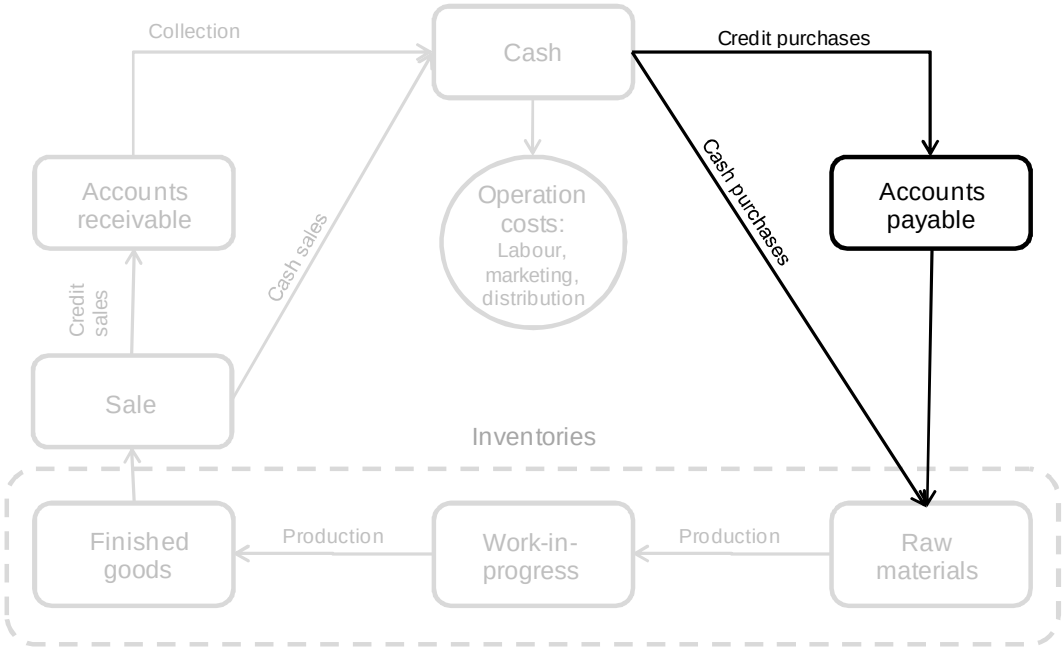


Figure 9. Management of accounts payable in working capital cycle.

Accounts payable are debts owed to customers from goods and services, and the logic of payment terms is similar as described in the previous chapter. From the perspective of an individual company, the best way to deal with their accounts payable is to take the full credit period if no financial incentives are offered. If a firm makes payments earlier than required, it loses profits, because the need for financed working capital increases. In case discounts are offered, the situation should be analyzed by calculating the effective annual rate of interest earned by the discount. If it is more than the cost of capital used up by the early payment, the discount should be taken. (Mott 2005, p. 241)

From another point of view, delaying payments to the supplier, the quality of product bought can be assessed before paying. A firm can also use it as an inexpensive and flexible source of financing. But then again, paying late may become costly if the supplier offers discounts for early payment. The traditional view on accounts payable has been that more profitable firms pay their bills faster. On the other hand, speeding up the payments to the suppliers may lead to increase of profitability because of the substantial discounts offered for prompt payment. (Deloof 2003, p. 574, 580, 585)

3.7 Challenges in working capital management

As described earlier, there are several trade-offs related to the management of each working capital component. Therefore the management of working capital as a whole is also a complicated task, since there are many factors that need to be considered and balanced. For example, companies have to make decisions whether to make small orders and keep low inventory levels to avoid tying up working capital, or to take advantage of discounts and purchase in bigger quantities. Higher inventory levels reduce the risk of stock-outs and enable uninterrupted production, which increase the customer satisfaction, but large inventories also tie up working capital and increases costs. Granting credit to customers can be part of marketing and may lead to higher sales, but at the same time working capital is tied up in the accounts receivable. When dealing with accounts payable, it has to be considered if the discounts of early payments should be taken advantage of, or should the companies use the long credit periods and decrease the need for financed working capital.

The challenge of working capital management as a whole is finding the right balance between the management of each working capital component. Is there enough communication between the operations that affect firm's working capital management? Working capital should be managed in cooperation within a company even if the management of its different components can be considered as individual tasks. In order to achieve the most efficient ways to manage working capital, the managers responsible for purchasing, inventories, sales, and production should together find the optimal level for firm's working capital.

4 THE VALUE CHAIN OF AUTOMOTIVE INDUSTRY

In the empirical part of the thesis, working capital management is studied in the value chain of the automotive industry. This chapter introduces the automotive industry from the global and European perspective, discusses auto component industry as an independent part of automotive industry, and describes the research design and the process of forming the value chain for the study.

4.1 Automotive industry

Automotive industry is one of the largest manufacturing industries in the world. It has been one of industries with the biggest influence – not only through its products but also through its way of making things. (Donnelly et al. 2002, 30) Even if the basic concept of the automobile has not changed much in last hundred years (MacDuffie and Fujimoto 2010, p. 23), for example the mass production system, which was made famous by american Henry Ford in the first decade of 20th century, changed the way of thinking radically and has then been applied in other industries as well. The origins of the automotive industry lie, however, in Western Europe. The automotive industry started in Germany and France late in the 19th century, where at that time craft production was the dominating technique of vehicle manufacturing. In craft production, each product was individually and collectively unique, and they were made by skilled craftsmen. The manufacturing of parts and the assembly of the car took a long time. On the other hand, the personal requirements of each customer could be considered. Naturally, this affected the price of the final product: at that time, only the wealthy could afford the motor vehicles and until the end of 19th century, cars were mainly specialist products instead of industrial products. (Lamming 1993, p. 1-4)

Nowadays, global automotive industry can be divided into three main areas - USA, Japan and Western Europe - which produce the major part of total output: more than two thirds of the world’s automotive sales volume comes from these areas (Becker 2006, p. 12). Even if the strong nationality has traditionally been descriptive for the industry via so-called national champions, the automotive

industry still can be said to be the most globalised industry in the world. Besides the three main producing areas, in the recent decades the growth and progress of the industry has been remarkable in the other parts of the world, such as South America and Asia, especially India and China. (Donnelly et al. 2002, p. 30)

The recent financial crisis had major effects also on the automotive industry, but, in fact, the industry was facing serious problems, for example in profitability, already before the crisis and suffered from the raised pressure on costs and competition. Becker (2006, p. 9) notes that in past years or even decades the growth of the three biggest global volume markets have shown little growth and have sometimes even been shrinking, and the manufacturers are trying to defend their own market segments or trying to enlarge them at the expense of their competitors. Other current issues in today's automotive industry are the advancing Asian competition, the growing overcapacity, the costs due to growing model diversity, the tougher price competition, and the manufacturer's willingness to pass losses on to their suppliers (Becker 2006, p. 11). Also meeting the requirements of customers and regulatory demands related to emissions and other environmental factors, as well as managing the complexity of the product, play a significant role in the present automotive industry (MacDuffie and Fujimoto 2010, p. 23-25). Intensified competition in the industry has also led to new forms of cooperation between car manufacturers, where the cooperation occurs between direct competitors in the market (Becker 2006, p. 33).

Within the European economy, the automotive industry is seen as a significant strategic industry. Various companies operating in automotive industry are originally from Europe. Descriptive for the industry is the large size and international ownership of manufacturers and suppliers. In addition, there is also a great amount of small and medium-sized enterprises that operate on the lower tiers in the industry as a supplier for car manufacturers and their suppliers. (Heneric et al. 2005, p. 18)

Among the three main automotive manufacturing areas, Western Europe has been considered as the weakest (Donnelly et al. 2002, p. 30). European companies have traditionally been concentrating in the European market while the other major global car manufacturers have been operating globally in the automotive industry. (McIvor et al. 1998, p. 87-88)

German automotive industry has a long history: for many, it is the birthplace of the automobile. Today it is the largest volume market in Europe. In addition to a small number of global car manufacturers, such as BMW and Volkswagen, many family-owned small and medium-sized suppliers operate in the industry. (Becker 2006, p. 12; ACEA 2011) In year 2008, Germany produced 6 million cars and commercial vehicles, which makes it the largest producer in Europe. Globally more vehicles were produced than in Germany only in Japan (11 million), China (9 million) and the USA (8 million). (OICA 2009)

4.2 Auto component industry

In the automotive industry, the basic design of many complex components is standardized. National and international agreements of standardized components created the basis for the auto component industry, which can be seen as a separate, identifiable industry within the boundaries of automotive industry. The borders between automotive and auto component industries are inconsistent, and defining the end of the automotive industry and beginning of the auto component industry is not easy. (Lamming 1993, p. 2) However, auto component industry can be examined as its own entity.

In the automotive industry, the distinction of the supplying industry to three tiers, is widely used. The group of companies forming each tier operates in the different part of the value chain of automotive industry. Tier 1 suppliers deliver directly to final vehicle assemblers, whereas tier 2 and tier 3 suppliers operate in the earlier parts of the chain.

The companies in tier 3 typically supply engineered materials and special services, such as rolls of sheet steel or surface treatments. Their products are simple, exactly specified standard parts, which are often developed by the purchaser. The level of technology, the development activity and installation activity are low. The second tier suppliers, in turn, produce value-adding parts, which are more complex than the products of third tier suppliers. Their installation activity is low as well, but the competence of technological development is high. They develop product innovations, but at their own risk. Together with automotive manufacturers, the companies in tier 1 design, manufacture and deliver complicated automobile systems or modules, such as significant interior or drive train units. Tier 1 suppliers are often responsible for the finished assembly, product development and continued technology innovation. In many cases, the tasks of tier 1 suppliers used to be core business of automotive manufacturers and performed only by them, but in recent times more and more tasks are transformed from car manufacturers to suppliers. (Henerick et al. 2005, p. 19; Becker 2006, p. 163-165)

In the last decades, there have been some significant changes in the structure of the automotive industry as well as in the relationships between car manufacturers and their suppliers. Besides outsourcing some former core businesses to suppliers by purchasing assembled subsystems instead of individual components, also the number of suppliers was reduced remarkably. With the remaining suppliers the nature of relationships changed: the partnership thinking became the basis of the relationship. Some years later, cost pressures caused disagreements in the relationship between car manufacturers and suppliers. The relationship worsened especially in year 2004 because of reinforced attempts by car manufacturers to pass extra costs onto suppliers. (McIvor et al. 1998, p. 88-92; Becker 2006, p. 37-38, 163)

4.3 Research design and procedure

This empirical study of the automotive industry is conducted by analyzing financial statements. The study could be defined as archival research. Archival

data is defined as data, for which the original purpose for gathering was not academic research, and the approach has been criticized because of uncritical usage of databases where scholars have an easy access (Moers 2007). In this study this problem is tackled by using only official financial statements and annual reports instead of databases. In case of a group, consolidated financial statements were used. All the financial statements used in the study have been collected from public sources: from firms' web sites, and some have been found in the German Company Register database, which is free of charge and where many German companies publish their financial reports. The financial figures for the CCC were collected carefully by hands during the fall 2010. This ensures that all data of companies is collected similarly.

The research sample presents the value chain of the automotive industry and it has been constructed from the financial statements of 65 international and Central European firms for each year of the 2006-2008 period. Consequences of remarkable mergers and acquisitions (M&A) have been considered in the figures. Three companies in the value chain of this study went through significant changes during the observation period: Daimler, Evonik and Arcelor Mittal. In these cases restated figures from the report of the following year were used instead of the figures of current year. Car manufacturer Daimler sold its Chrysler division in 2007 and therefore the data of year 2006 was collected in restated form from Daimler's annual report 2007. Evonik Industries, which is placed in the stage of rubber and plastics in this study, was formed in 2007 after the restructuring of the mining and technology group RAG. The figures of the year 2006 were restated in the annual report of year 2007. The global steel company ArcelorMittal was formed in 2006 as a merger of Arcelor and Mittal Steel. Moreover, in this case the restated figures for the year 2006 were taken from the annual report 2007 of ArcelorMittal.

The balance sheet accounts under the analysis in this study are inventories, accounts receivable and accounts payable. The value of inventories does not include advance payments. Accounts receivable and payable only include trade-

related current accounts receivable and payable. In case of car manufacturers, the current receivables from financial services were added to trade receivables as the financial services are an important part of their business nowadays.

During the data collection, some problems occurred. Car manufacturers Ford and Fiat, for example, had to be left out of the study because long- and short-term liabilities were not presented separately in the balance sheets. Also the availability of data caused few problems: for example, system supplier Delphi and chemical company Rhodia could not be included in the sample, because reports for each year of the observation period were not found. Some companies could not be taken into sample because they were part of a group, which could not be located in the stage where the subsidiary would have fit.

It should be considered that the results are based on the figures in companies' financial statements, which only describe the situation at the end of a fiscal year and it might not reflect a firm's typical situation during the year. Especially in case of companies with a strong seasonal demand, the financial figures might be very different depending on the observation moment. Also the companies in the value chain have different fiscal years, which might have its effect on the figures. For most of the companies, the fiscal year ends in the end of calendar year, but for example, the end of fiscal year for some Japanese companies is at the end of March. Besides this, companies can plan within certain boundaries, what information and how they want to show that information in their financial reports.

Process-related working capital management is studied by cash conversion cycle. Cash conversion cycle and its components were defined in chapter 3.3, and the results of the study are presented in chapter 5.

4.4 The structure of the value chain of automotive industry

The first step in forming the value chain of automotive industry was to define its structure. The models of value chain presented in literature offered a ground for the value chain construction. Wheelen and Hunger (2002, p. 84) have presented a

typical value chain for a manufactured product that describes the complete manufacturing process via different steps from raw materials to retailer. In the article by Blackman and Holland (2006, p. 83), the physical supply chain was illustrated by describing what steps have been taken before the end customer receives the car, the final product of the process. Heneric et al. (2005, p. 20) have described the automotive value chain beginning from the supplying industry that delivers parts to car manufacturers, also called as Original Equipment Manufacturers (OEM), and ending to the end customer via retail channel.

Adapted from the discussions with professionals working in the automotive industry, and the chains mentioned above, the structure of the value chain of automotive industry for this study was defined. It is shown in the Figure 10 with the three other chains mentioned in this chapter.

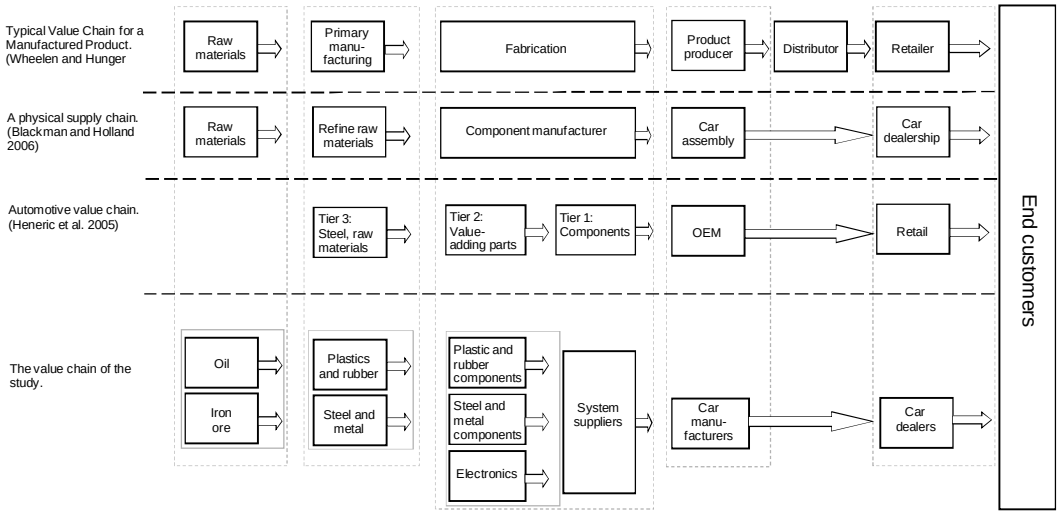


Figure 10. Defining of the value chain of the study.

The value chain of the study contains 10 stages that represent the main elements needed for producing and delivering a car to an end customer. Differing from the usual definition of automotive value chain, the upstream of the chain begins with the raw materials of steel and plastics: iron ore and oil. Usually in the automotive industry, the term “raw material” refers to steel and other materials that are already refined. In this study, the starting point is one step further away because

the interest in the chain is focused on the upstream. The refined raw materials, plastics and rubber and steel and metal, are on the second step of the chain. The last stages in upstream are plastic and rubber components, steel and metal components, and electronics. These companies supply smaller parts, like bearings or gaskets, to system suppliers. The stage of system suppliers is at the center point of the chain. These companies make complete systems and parts to deliver to car manufacturers in downstream, which then take care of the assembly of the final product, the car. Finished cars reach end customers via car dealers. System suppliers were chosen to be the center point of the chain because it enables seeing the supplying industry from the wider perspective. In many studies of the automotive industry, the interest has been on car manufacturers. In this study, the industry is shown from a different point of view.

Besides stages, upstream and downstream, the value chain of the automotive industry can also be reviewed through different levels as in Figure 11.

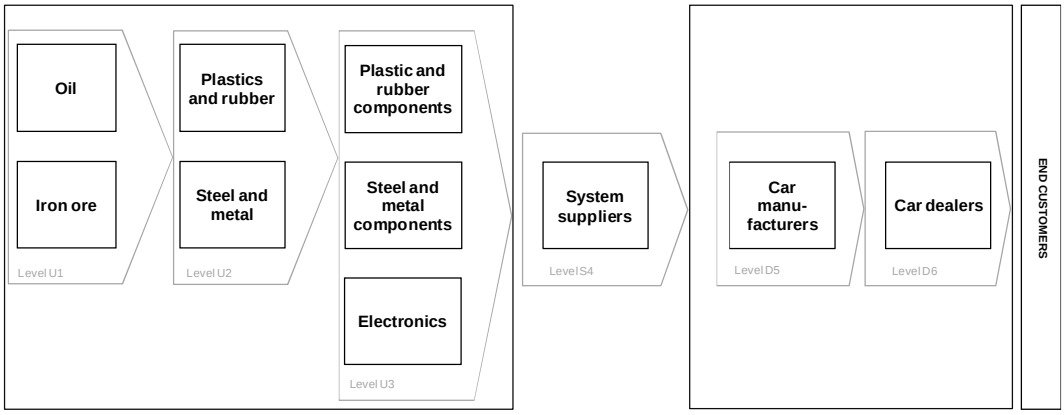


Figure 11. Stages and levels in the value chain of automotive industry.

First, second and third tier suppliers are established concepts in the automotive industry, but because the oil and iron ore are not usually included in the definition of automotive industry, in this study the term level is used to describe the groups of stages that can be seen operating at the same step of the value chain. Hence, the value chain of automotive industry includes six different levels. Levels in upstream consist of two or three stages, but the system suppliers and the stages in downstream form their own one-stage-levels.

The created value chain of the automotive industry does not comprise of all the real world stages that are required for producing and delivering a car to an end customer, but the focus is on the three main elements of the car: steel and metal, plastics and rubber, and electronics. The upstream side lacks for example the stages related to textiles and softwares. On the downstream side, the stages of independent garages and spare part shops that could be considered as customers of system suppliers, as well as car rentals and leasing companies, were left out of the analysis because of the lack of data that is public and detailed enough.

As stated earlier in the value chain theory, firms may operate in more than one stage. In this thesis, the firms are placed in the stages from the system supplier's point of view. For example, many companies in the stage of system suppliers are integrated companies and they could be considered operating in earlier component stage too. Furthermore, the activities in the chain do not necessarily always follow the structure of the chain strictly: for example companies in the steel stage might deliver their products as a supplier not only to the following stage, but also directly to the system suppliers. This phenomenon was also described by Becker (2006, p. 164) in a supply pyramide of automotive manufacturers and the supplying companies on different levels. Besides business relationships, the pyramide describes the size of different levels of the chain: the number of companies operating on the lower levels in the industry is higher than the number of system suppliers and car manufacturers on the top of the pyramide. The supply pyramid is shown in figure 12.

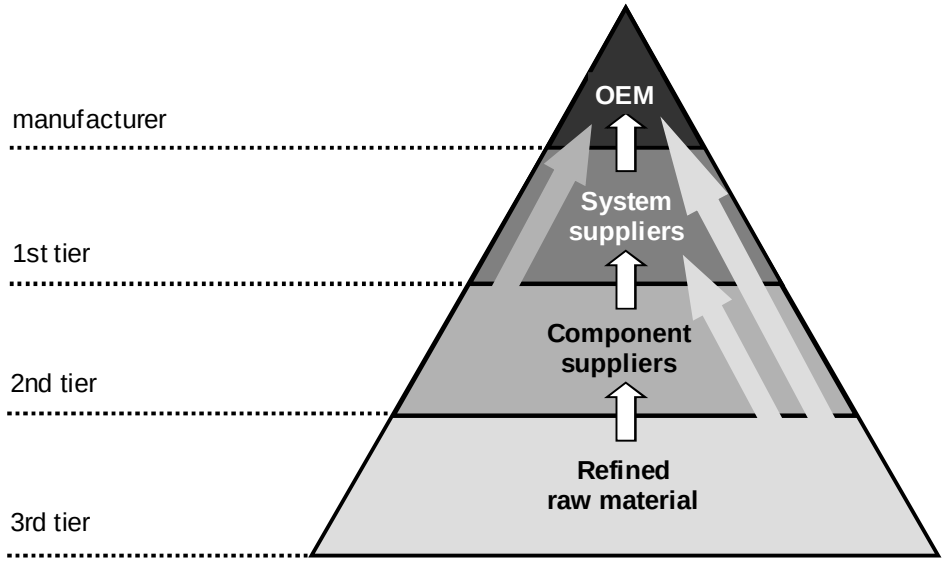


Figure 12. Supply pyramid. (Adapted from Becker 2006, p. 164)

It was also stated by Becker (2006, p. 165) that in the automotive industry, individual suppliers could be positioned in various levels in the supply pyramid. This results from a broad product programs of these companies: with one product the company may be seen for instance as a system supplier while the other product would locate the company in the stage of component suppliers.

The analysis of the automotive industry indicates that the value chain of automotive industry has a strong network nature. There is trading not only between companies at different levels of the chain according to figure 12, but also within the levels between stages and even within one stage. The complete picture of the relationships between companies in the real world value chain of the automotive industry would be complicated to illustrate.

4.5 The companies in the value chain of automotive industry

After defining the structure of the value chain, companies considered at each stage of the chain were chosen. The companies were selected based on the Top 100 Automotive Suppliers Global Ranking (Automobilproduktion 2010) and the discussions with professionals working in the automotive industry. There were two main requirements for the companies: the financial statements have to be

provided in public and the yearly sales of the company have to be more than 100 million Euros in order to ensure the higher degree of homogeneity of stages. The value chain of automotive industry with the companies is shown in Figure 13.

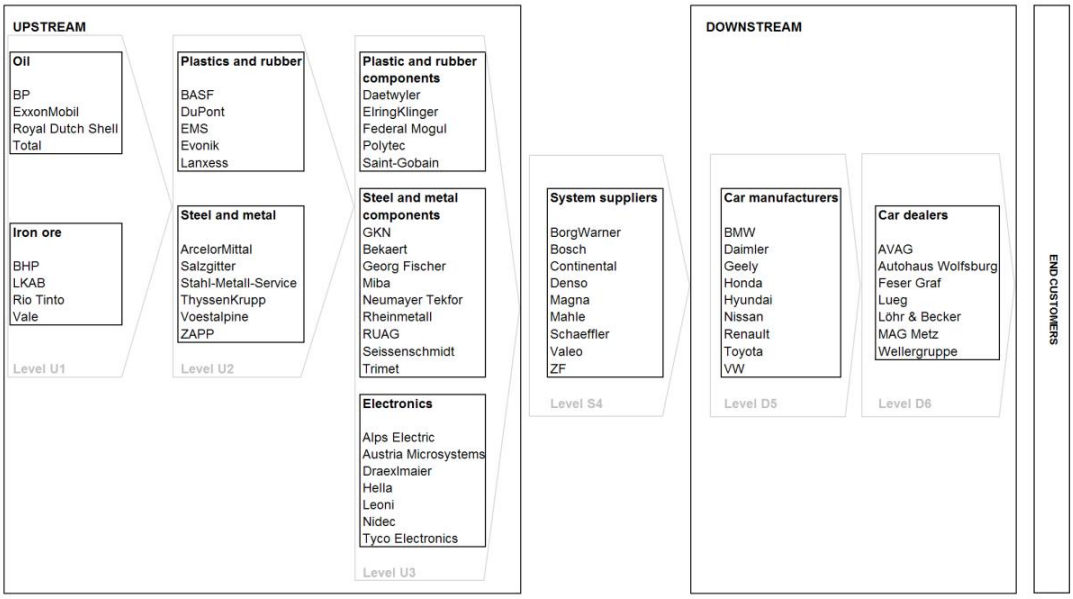


Figure 13. The value chain of automotive industry with companies.

The structure and the companies of the chain have been defined from the system supplier point of view to industry. This perspective enables more detailed view to the upstream part of the chain. Placing companies to the different levels is not always unambiguous: companies with a broad product program may be seen for instance as system suppliers with one of their products, while the other product would locate them in the component suppliers' stage. The companies can be placed at different levels, depending on the point of view to industry. Moreover, many companies preferably consider themselves operating on the level of system suppliers, closer to car manufacturers, even if their products do not support the view. Some of the stages include companies, for which the automotive industry is not the primary market. The number of these kinds of companies in the automotive industry, and especially in the stage of electronics, has increased lately, as the variety of options offered to customers has become wider (Chandra and Grabis 2007, p. 283).

In the European automotive industry, the traditional strong concentration within the national borders can still be seen. In this value chain especially the upstream part, except iron ore and oil, has a strong national and regional focus. On the other hand, Germany is the leading European country in the automotive industry and therefore the focus in this chain is reasonable and it is descriptive for the situation in real world. The supplying part of the chain (levels U2, U3 and S4) covers the most meaningful companies of the automotive business well: 24 out of 41 companies in the stages of plastics and rubber, steel and metal, plastic and rubber components, steel and metal components, electronics and system suppliers are ranked in the list of top 100 Automotive suppliers 2010 (Automobilproduktion 2010). It is typical in the automotive industry, that besides some big actors, the earlier levels of the value chain include a lot of small and medium-sized companies, and therefore the sample can be considered representative. The companies of the chain that are listed on the top 100 ranking are shown in Figure 14.

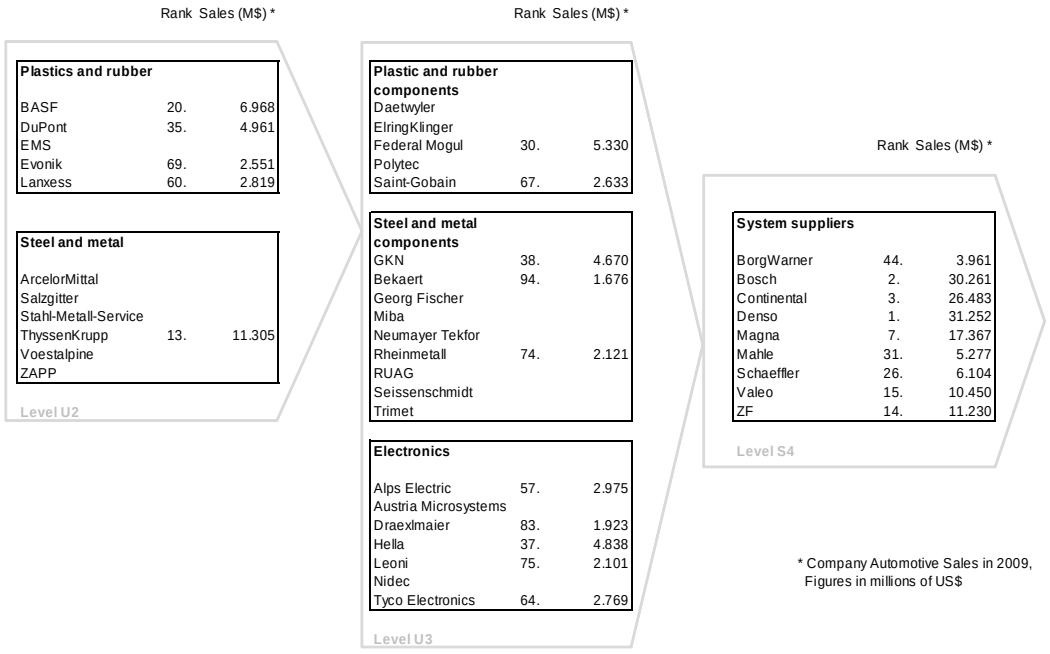


Figure 14. Rankings and automotive sales of companies of the chain in Top 100 Ranking of automotive suppliers.

The car manufacturers, in turn, operate more globally. The companies in the stage, except for Geely, are included in top 15 in the world ranking of car manufacturers in year 2009 (see Table 1). Geely, as a relatively new company in the automotive industry represents the new genre of car manufacturers from Asia and is placed 27 in the ranking. The companies in the stage of car dealers operate mainly nationally.

Table 1. World ranking of car manufacturers and the total amount of motor vehicles produced in 2009. (OICA 2010)

World motor vehicle production 2009		
Rank	**Group**	**Total**
1.	Toyota	7.234.439
2.	GM	6.459.053
3.	Volkswagen	6.067.208
4.	Ford	4.685.394
5.	Hyundai	4.645.776
6.	PSA	3.042.311
7.	Honda	3.012.637
8.	Nissan	2.744.562
9.	Fiat	2.460.222
10.	Suzuki	2.387.537
11.	Renault	2.296.009
12.	Daimler	1.447.953
13.	Chana Automobile	1.425.777
14.	BMW	1.258.417
15.	Mazda	984.520
...	...	...
27.	Geely	330.275
...	...	...
	Total	60.499.159

4.6 Descriptive data

Table 2 presents the descriptive statistics of the sample: the number of firms, the range of assets and sales in 2008, the change percentage of sales from the year 2006 to 2008, and the proportion of working capital of total assets of each stage.

The total assets and sales of each firm were converted to euros by the yearly average rate course released by the European Central Bank.

Table 2. Descriptive statistics on sample.

	The number of firms	Total assets 2008 (M€) max	Total assets 2008 (M€) min	Sales 2008 (M€) max	Sales 2008 (M€) min	Change of sales 2006-08 (%)	Working capital % of total assets[1]
Oil	4	192011	118310	312478	179976	15 %	8 %
Iron ore	4	60932	3778	40437	2405	70 %	8 %
Plastics and rubber	5	50860	1058	62304	947	10 %	37 %
Steel and metal	6	90742	34	84947	143	48 %	21 %
Plastic and rubber components	5	43395	765	43800	658	5 %	24 %
Steel and metal components	9	5107	115	5496	175	8 %	21 %
Electronics	7	14686	307	10086	185	-3 %	21 %
System suppliers	9	46761	3173	45127	3579	3 %	18 %
Car manufacturers	9	190628	993	134661	420	-8 %	20 %
Car dealers	7	327	86	1217	278	5 %	41 %

[1] Average of the years 2006 – 2008.

The number of firms varies between stages from four (oil and iron ore) to nine (steel and metal components, system suppliers, and car manufacturers). The focus in the chain is around the stage of system suppliers also when measured with the number of companies in the stages, whereas the low number of oil and iron ore companies is explained by them being more like an extension to actual automotive industry.

When examining the sales figures within the sample, the stages of oil and car manufacturers have the highest maximum sales. The maximums of the total assets were highest in these stages. This describes the situation in the real world well, where these businesses are in a remarkable role and companies operating in these stages are very large.

During the observation period the change of sales varies from 70 % growth to a reduction of 8 %. The growth has been most remarkable in iron ore, and steel and metal. The difficulties amongst car manufacturing business and the effects of reduced demand can be noticed, as the sales in the stage of car manufacturers have been reduced by 8 %. The sales of the electronics stage have been reduced as well in the observation period, but in all the other stages the change percentage of sales is positive which means that the other stages have been able to grow their sales from year 2006 to year 2008.

The great increase of sales of iron ore and steel and metal stages can be partially explained by extraordinary sales in the year 2008. At both stages, firms have made acquisitions besides organic growth. The companies in iron ore stage have strengthened existing business units or entered new mineral business during the observation period. For example, Rio Tinto acquired the Alcan Inc. in 2007 to become the global leader in aluminum. Mergers and acquisitions have been made in the stage of steel and metal too. For example, after the merger of Arcelor and Mittal Steel in year 2006, the group has made about forty acquisition transactions until 2009. Above all, it must be remembered that besides the automotive industry, these stages are suppliers in many other industries that were growing until the fourth quarter of 2008.

Except for the level U1, the proportion of working capital of total assets in the other stages varied from 18% to 41% during the observation period. In these stages, it is worthwhile to pay attention to the decrease of tied-up working capital, as it would lead to the improvement of return on investment (ROI) ceteris paribus. In this context, the ceteris paribus means that there should not be causality between decrease of working capital and operating profit. Improvement of ROI by this procedure is real, unlike, for example, the change of production equipment from company-owned to leased.

5 RESULTS AND ANALYSIS

5.1 Cash conversion cycles in the value chain of automotive industry

To analyze working capital management in the value chain of automotive industry in years 2006-2008, the CCC and its components were calculated for each year of the observed period. Figure 15 shows the average values of CCC and its components in days at every stage and level of the value chain. Difference Δ is calculated between years 2008 and 2006.

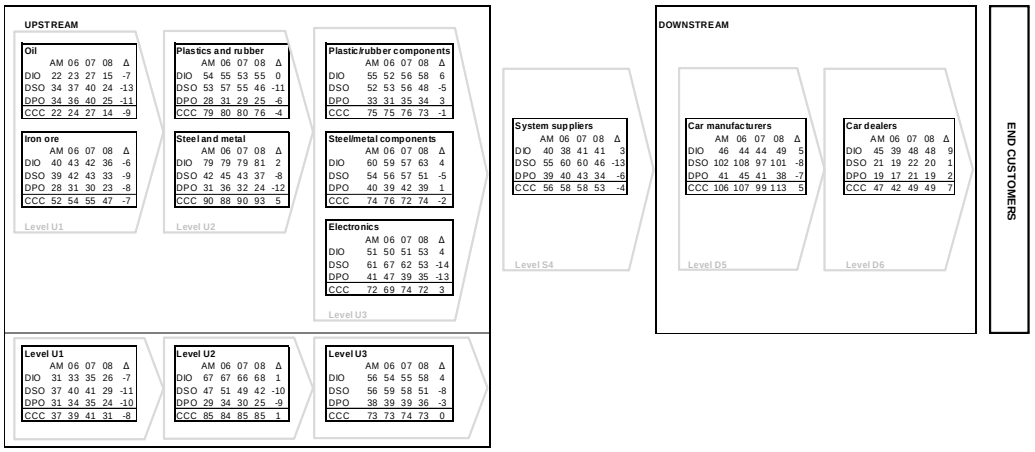


Figure 15. Cash conversion cycles of the value chain of automotive industry in 2006-2008.

The results of the analysis show that the value chain of automotive industry ties up working capital: The CCC was positive at each stage of the value chain. The average CCC of the average of value chain stages was 67 days, while the average of the sample was 70 days. There are only slight differences in the averages of CCC between years 2006 and 2008, which indicates that the relation between sales and working capital can be considered constant (CCC was defined as working capital/sales). This was seen when studying the CCC in the value chain of pulp and paper industry too (Pirttilä et al. 2010), and it indicates that in both value chains, working capital can be forecasted by the sales.

In the study of the pulp and paper industry, it was found that the stages closer to end customer have shorter turnover times than the stages in upstream. In the value chain of automotive industry the situation was different: the average CCC of downstream was 77 days, while the average of upstream was 66 days. Also the stage with the shortest CCC in the automotive value chain, oil, is in upstream on the first level of the chain. On the other hand, plastics take only a small piece of the world's oil supply while the majority of oil is used for energy. Therefore in most cases oil is actually closer to the end customer. Besides the short CCC of oil stage, the other outlier of the chain was the high CCC of car manufacturers in downstream. Car manufacturers' long CCCs were due to the long cycle time of accounts receivable. This is because the financing business of car manufacturers requires long credit periods. If the DSO of car manufacturers did not include the receivables of their financing business, their CCC would be significantly lower (approximately 50-75 days) and the same conclusion of shorter CCC at the stages closer to end customers could be achieved. Car manufacturers can be seen working as a bank towards end customers by paying their own bills relatively fast compared to the cycle times of their accounts receivable.

When comparing the stages of the automotive value chain to each other, there is a notable difference between the maximum and minimum CCC: 84 days, which is almost three months. Car manufacturers had the highest CCC, 106 days, which is due to their accounts receivable that mainly consist of receivables from their financing business. The CCC of car manufacturers could be shortened, but it would require arrangements in the financing and leasing business, which seems to be profitable for the car manufacturers. For example, the EBIT margin of Volkswagen Financial Services was 8.7%, while the margin of the Group was 5.6% in the year 2008. It was also stated by Hans Dieter Pötsch, member of the management board of Volkswagen Group, that the financial services are seen as an important part of their business: providing this service to customers gives a company a chance to cover another important part in the automotive value chain. Financing and automobiles are also seen inseparable: for example in Germany, only every third customer pays for their new vehicle in cash. (Volkswagen Group

2009, p. 36) As shown in table 3, it can be seen that within the sample of the study, in most cases the EBIT-% from car manufacturers' financing business were more than the profit of the group. Geely is not included in the table, because it did not present business segment information in its annual reports. Table 3 shows if the group or the segment of financial services had better profit margin in each year of the observation period. The comparison shows that in 17 of 24 cases, which is 71 %, the profitability of car manufacturer's financing business is better than the profitability of the group.

Table 3. Comparison between the EBIT margins of the group and the financing segment of the group.

	2006	**2007**	**2008**
BMW	Group	Group	Group
Daimler	Group	Group	Financing
Honda	Financing	Financing	Financing
Hyundai	Financing	Financing	Financing
Nissan	Financing	Financing	Financing
Renault	Financing	Financing	Financing
Toyota	Financing	Group	Group
VW	Financing	Financing	Financing

Oil companies, in turn, had clearly the lowest CCC, 22 days, which results from the short cycle time of their inventories. The first level of the chain, U1, as a whole differed significantly from the other levels by having not only the lowest CCC, but also the biggest changes in each component of CCC: its components had been shortened 7-11 days from year 2006 to 2008. These stages, which are not usually considered in the automotive value chain, operate also in many other industries and therefore the automotive industry does not affect them as much as the other stages in the chain.

5.2 Days accounts receivable and payable outstanding

Even if the CCC remained roughly the same during the observation period at each stage in the value chain of automotive industry, the components of CCC varied a

lot. This was not shown in CCC, because usually the variations of DSO and DPO offset each other. The change that occurred, resulted from the change in inventories. For example in the stage of electronics, the DSO shortened 14 days but at the same time the DPO shortened 13 days as well. Therefore the change of CCC, 3 days, is mainly affected by the lengthened cycle time of inventories. Also among the supplying industry (levels U2, U3 and S4), the differences in CCC between the levels were caused by the cycle times of inventories. The difference in CCC between system suppliers and level U3 was 17 days, whereas the difference in DIO was 16 days. Between the levels U3 and U2 the difference of CCC was 12 days, which is the same as the difference in DIO. The average figures of DSO and DPO were almost the same on level U3 as on level S4. It seems that on these supplier levels payment terms are relatively established.

In most stages the changes of DSO and DPO were both negative, which means that the cycle times of accounts receivable and accounts payable shortened during the observation period in these stages. The changes of DSO and DPO in the stage of car dealers were positive. Only in the stages of plastic and rubber components and steel and metal components the development of DSO and DPO led to different directions: both stages have been able to reduce their DSO by 5 days while the DPO was prolonged by 1-3 days. The finding of the reduced DSO and DPO in the most stages of the chain could indicate that the tightened payment terms required by a supplier affect the credit terms given to a customer: in other words, when a company is required to pay faster to its suppliers, it also wants to get faster payments from its customers.

The negative direction of the change may also be a consequence of the profitability problems that the automotive industry has been facing in recent years: at all stages, except for car dealers, the DSO has been shortened by 5-14 days. The system suppliers, for example, have been able to reduce their DSO by 22 %. This indicates that in the value chain of automotive industry, companies have paid attention to the management of accounts receivable and focused on collecting payments from their customers. One reason behind this might be the

difficulties in having external financing. It seems that none of the stages really received benefits from shortening their DSO as the trend was dominant in the whole value chain, but overall, this reduced the need for invested working capital in the value chain. Another explaining factor for this phenomenon could be the increased use of factoring services. By selling accounts receivable to a third party, the DSO of a firm looks shorter even if the payment terms given to a customer were generous.

5.3 Days inventory outstanding

The traditional view on working capital management has been that inventories could be financed with accounts payable. When comparing the components of the CCC to each other, it can be seen that the only stages that have been able to finance their inventories with accounts payable are oil and system suppliers (excluding the last year of the observation period). The cycle times of inventories have lengthened 2-9 days or remained almost the same in the observation period, except for the level U1 that has been able to shorten their DIO by 7 days from year 2006 to year 2008. It is possible, that in this period the making of sales forecasts has become more difficult and therefore the inventories tied up more working capital in year 2008 than in year 2006.

DSO and DPO depend on the payment terms negotiated with the customers and suppliers. If the firm is willing to shorten the CCC, the component it can best affect by itself is the DIO. Of course, depending on the contracts between companies, DIO can also be affected by a customer, if for example a certain level of inventories is required by them. Excluding the level U1, turnover times of inventories were longer in upstream than in system suppliers stage and downstream. System suppliers were in fact having a relatively short DIO, 40 days. Its suppliers, in turn, kept their inventories 16 (level U3) or even 27 (level U2) days longer. This might reflect the information flow in the chain: system suppliers may be getting sales forecasts from their customers, which enables system suppliers to manage their inventories based on that information, but the information is not transferred to the lower levels in the chain. This could indicate

that the relationship between car manufacturers and system suppliers might be based more on the partnership while there is more traditional purchasing between system suppliers and their suppliers.

There could be also other explanations for the longer cycle times of inventories in upstream. The products of level U2 and U3 are more standard which enables mass production and leads to bigger inventories. Furthermore, the number of companies operating on each level has its influence: in the real world, there are fewer companies operating on the stage of system suppliers than on the stages on earlier levels in the chain. System suppliers can choose their suppliers from the larger group of companies than car manufacturers. On the other hand, on the stages that operate as suppliers for system suppliers, reliability of delivery might create competitive advantage for the companies that are able to supply goods for their customers when needed. These factors might also explain the longer cycle times of inventories in these stages. The weakened demand in the automotive industry can also be seen in the value chain, as the inventories in downstream, in the stage of system suppliers and on level U3 have increased during the observation period. Levels U1 and U2 also operate in other industries and their manufacturing process (processing industry) differs from the other stages (batch production).

5.4 Comparing the results to previous studies

The results of this study compared to the study of pulp and paper industry (Pirttilä et al. 2010) indicate that the average of CCC of pulp and paper industry in years 2004-2008 was 63 days, while the average cash conversion cycle of automotive value chain in years 2006-2008 was 4 days longer. The difference is surprisingly small, even if the end commodities of automotive industry are products that end customers are buying, whereas the end commodities of pulp and paper industry are used also to support the product. It can be considered that the difference would be very small if the structure of value chains would be more uniform. In the value chain of pulp and paper industry, 2-3 of 4 downstream stages have a direct relationship to end customers while in the value chain of automotive industry, only one stage has a direct relationship to end customers. In addition, in the value

chain of the pulp and paper industry, all the downstream stages were customers of pulp and paper stage, which was the center point of the study. In the value chain of the automotive industry, only the car manufacturers in downstream were customers of system suppliers. Moreover, the value chain of automotive industry was more in the form of a chain and constisted of sequential and parallel stages, whereas the stages in the value chain of pulp and paper industry were more independent. Both studies have indicated that companies acting in downstream have shorter cycle times of working capital than upstream companies.

The results of the automotive study were also compared to the figures of working capital studies by REL/CFO magazine (2010, 2009, 2008a, 2008b, 2007a, 2007b). CFO Magazine has published the working capital performance studies of REL consultancy since fiscal year 1997 (Karaian, 2008). Annual studies include 1000 largest European and 1000 largest US American public companies representing different industries. REL classifies companies according to the Standard & Poor's global industry classification standard (GICS). The comparison was made by collecting industry level figures from the same period from the yearly working capital scorecard publications of Europe and the United States. Exact similar stages and levels as defined in this study were not available in the REL/CFO studies, where iron ore and steel and metal stages are combined to metals and mining, and the figures of level U3 and system suppliers are mainly shown in auto components industry. The stage of car dealers was not defined in the REL/CFO study.

The number of firms included to the structured sample varies from 259 to 270. The average CCC of the REL/CFO study calculated for the period of 2006-2008 is 58 days, while the average cash conversion cycles of this study is 67. The difference of the results is mainly the consequence of a different way of dealing with the accounts receivable of car manufacturers. In this study, short-term accounts receivable of financial services are included in the analysis. The REL/CFO study does not include accounts receivable of financial services in the figures of year 2008 while in the figures of years 2006 and 2007, both long-term

and short-term accounts receivable of financial services are considered. On the other hand, it can be noticed that more firms at the steel and metal stage are included in the REL/CFO study, which increases the CCC because of the longer inventory cycle time than in iron ore. Similar effect can be seen existing in auto components industry. More component suppliers than system suppliers are included in the industry. The oil and chemical companies' cash conversion cycle times are similar in both studies. The cash conversion cycles and components according to the REL/CFO studies are shown in figure 16. The similarities of the results confirm that this study reflects the real world value chain of the automotive industry.

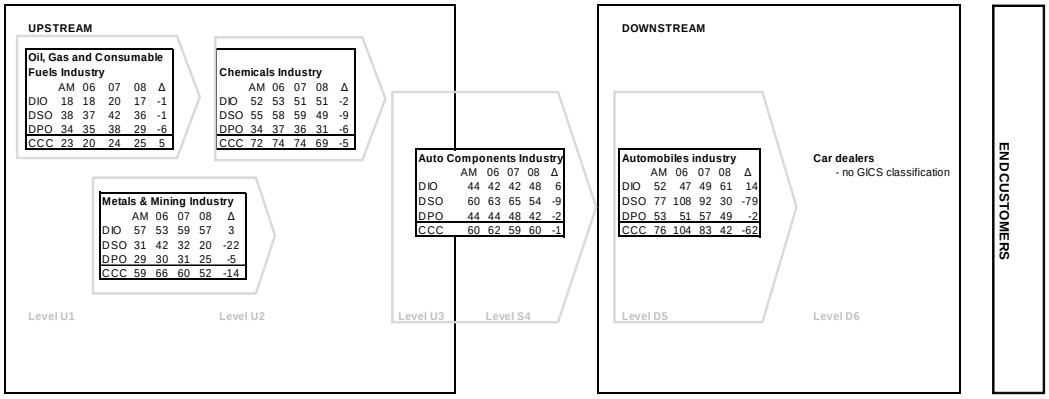


Figure 16. Cash conversion cycles and components according to the study of REL/CFO.

In the study of Ulbrich et al. (2008), the CCC of five car manufacturers and twelve first-tier automotive suppliers was examined in the period of 2001-2004. The results of their study showed that in this period, the car manufacturers managed their working capital more efficient in each component of CCC than the suppliers. When comparing the results of the study by Ulbrich et al. (2008) to the results of this study, it seems that the suppliers have been able to improve their working capital management from year 2004. In this study, the DIO of system suppliers was even shorter than the DIO of car manufacturers. On the other hand, the results of suppliers might not be comparable with the stage of system suppliers, since many of the companies Ulbrich et al. (2008) considered as first-tier suppliers are placed on level U3 in this study of automotive value chain.

5.5 Results on company level

In addition to analyzing stages and levels, the CCC and its components were also analyzed in the company level. The focus in this analysis was on the system suppliers and on the companies closest to them. The results on company level for CCC and its each component are shown in appendixes 1-4. The most dispersion on the average CCC of companies occurred in the stages of car manufacturers, system suppliers and electronics, where the differences between the longest and the shortest CCC were 83-173 days. The dispersion was the least in the beginning of the chain, in the stages of oil, iron ore, and plastics and rubber, but still the differences were surprisingly long, 21-24 days. Naturally, it has to be noticed, that the most remarkable dispersions occurred in the stages where the number of companies was the highest, whereas the stages with the least dispersion have also the lowest number of companies.

In the stage of system suppliers, the differences in CCC between the companies resulted from inventories and accounts payable. The DIO of German companies – Bosch, Continental, Mahle, Schaeffler Group, and ZF Friedrichshafen – was longer (39-69 days) than the DIO of other companies in the stage (23-32 days). The difference between the German and the other companies was partly seen in the DPO as well: German companies, excluding Continental, paid their bills pretty fast (18-34 days) compared to the others (39-68 days). It can be conjectured, if the reason for this lies in the German automotive industry or in the German business culture, or if it is affected by some other factor. Short DPO is often seen as a sign of a profitable company, but on the other hand it might reflect the tight payment terms set by their suppliers, which could be caused because of former financial difficulties. Anyhow, in DSO this kind of difference between German and other system suppliers can not be seen. Comparing the system suppliers' DPO and DSO results to existing payment terms used in the industry, it can be stated that the results describe real world payment terms relatively well, especially from the perspective of German companies. Figure 17 shows the results of the companies in the stage of system suppliers.

System suppliers	AM	06	07	08	Δ
Bosch	83	85	82	84	-1
Continental	65	61	82	51	-9
Mahle	69	70	67	70	0
Schaeffler	102	104	104	98	-6
ZF	57	59	57	55	-4
BorgWarner	45	49	44	43	-6
Denso	42	49	39	40	-9
Magna	26	22	30	27	5
Valeo	16	19	19	11	-8
CCC (stage)	56	58	58	53	-4

System suppliers	AM	06	07	08	Δ
Bosch	50	47	49	54	6
Continental	45	39	56	39	0
Mahle	48	41	48	55	14
Schaeffler	69	69	69	69	1
ZF	39	38	38	41	3
BorgWarner	32	32	32	32	1
Denso	30	32	28	30	-2
Magna	24	22	24	25	4
Valeo	23	24	24	23	-1
DIO (stage)	40	38	41	41	3

System suppliers	AM	06	07	08	Δ
Bosch	61	65	62	56	-8
Continental	65	57	87	50	-8
Mahle	55	62	56	47	-14
Schaeffler	51	55	54	43	-13
ZF	47	50	49	42	-8
BorgWarner	53	60	55	42	-17
Denso	56	67	59	43	-24
Magna	51	55	56	43	-11
Valeo	60	67	65	49	-18
DSO (stage)	55	60	60	46	-13

System suppliers	AM	06	07	08	Δ
Bosch	27	27	29	26	-1
Continental	45	36	61	37	1
Mahle	34	33	36	32	0
Schaeffler	18	20	19	14	-5
ZF	29	29	30	28	0
BorgWarner	39	43	43	32	-10
Denso	44	50	48	33	-17
Magna	49	54	49	42	-12
Valeo	68	72	70	61	-10
DPO (stage)	39	40	43	34	-6

Figure 17. Results of system suppliers.

Schaeffler Group had the longest average CCC in the stage of system suppliers, which was mainly affected by relatively long DIO (69 days) and very short DPO (18 days). On the other hand, it could be argued if the company should be included in the stage of system suppliers or in the stage of steel and metal components on the previous level of the chain. In this study, it was placed on the stage of system suppliers because of the products of its brand LuK, clutches, but group's other products could be seen more as steel and metal components. Furthermore, the findings indicate that there are more similarities in the results between Schaeffler Group and steel component suppliers. In the stage of steel and metal components, the DIO of almost all the companies is longer than the average DIO of system suppliers. The management of inventories and also the production logic of system suppliers differ from earlier levels, and it seems that in the figures of Schaeffler Group the effect of other products than clutches is emphasized. The company with the shortest average CCC in the stage of system suppliers was Valeo (16 days). Its average DIO was shortest in the stage - 23 days - while its DSO and DPO were both relatively long (60 and 68 days). Valeo, as well as other non-German companies in the stage of system suppliers are able to finance their inventories with accounts payable.

ExxonMobil, in the stage of oil, and Geely, in the stage of car manufacturers, are the companies that had the shortest average CCC in the entire value chain of the automotive industry. Geely's short CCC - 11 days - resulted from a long DPO, but ExxonMobil, in turn, had a very short DIO (10 days), but it also managed other components effectively and had an average CCC of 7 days. In the stage of car

manufacturers Geely was an exception, as the other companies on the stage had the longest cash conversion cycles in the chain. This was naturally because of the receivables from their financing business, which Geely, in turn, does not seem to offer to its customers. Also some companies in the level U3 and in the stage of steel and metal had over 100 days long CCC. The CCC of the companies in level U3, the suppliers of system suppliers, varies a lot at every stage. When searching for an effective value chain to be part of, system suppliers should carefully consider which companies to purchase from, since there really are differences in working capital management between the companies in level U3. Overall, the scale of average cash conversion cycles in the chain is very wide: from ExxonMobil's one week to Renault's six months.

When looking at the CCC of car manufacturers from their operative business and ignoring the receivables from their financing business, it can be seen that without financing receivables, also for example Nissan and Renault, would have quite low CCC, which is surprising as Renault's CCC with financing receivables was the longest in the chain. CCC of car manufacturers with and without financing receivables can be seen in Figure 18. The CCC of companies Geely and Hyundai is the same in both tables, because the receivables from financing and operative businesses were not divided in their balance sheets.

Financing business included

Car manufacturers	AM	06	07	08	Δ
BMW	141	133	133	157	24
Daimler	143	181	111	135	-46
Geely	11	31	5	-3	-34
Honda	85	83	77	95	11
Hyundai	56	39	59	70	31
Nissan	128	120	126	138	17
Renault	184	179	181	192	13
Toyota	89	86	83	97	11
VW	122	114	119	132	18
CCC (stage)	106	107	99	113	5

Only operative business

Car manufacturers *	AM	06	07	08	Δ	
BMW	43	40	42	48	9	
Daimler	55	47	51	68	21	
Geely	11	31	5	-3	-34	**
Honda	42	36	37	52	16	
Hyundai	56	39	59	70	31	**
Nissan	11	-4	17	20	24	
Renault	5	0	-2	15	15	
Toyota	25	25	23	28	3	
VW	38	32	36	45	13	
CCC (stage)	32	27	30	38	11	

*** CCC, when accounts receivable from financing business not included in DSO**
**** Accounts receivable from financing and operative businesses not divided in balance sheet**

Figure 18. The CCC of car manufacturers with and without receivables from financing business.

The best and worst practices in the value chain of automotive industry were analyzed by creating two different chains from the sample. From each stage of the value chain, a company with the shortest CCC was picked to the best chain and a company with the longest CCC to the worst chain. The chains with companies are shown in figure 19. The average CCC of the best chain was 37 days, which was 30 days shorter than the average of the stages. The average CCC of the worst chain was 101 days, 34 days longer than the average of the stages. In most stages, the difference between the best and worst company results from the inventories. For example, in the stage of steel and metal, the difference in DIO between the companies with best and worst CCC was 55 days. In comparison to best and worst chains in the study of pulp and paper industry, it was found that the average CCC of the best chain was the same in both studies, 37 days. The average CCC of the worst chain in the value chain of pulp and paper industry was 87 days.

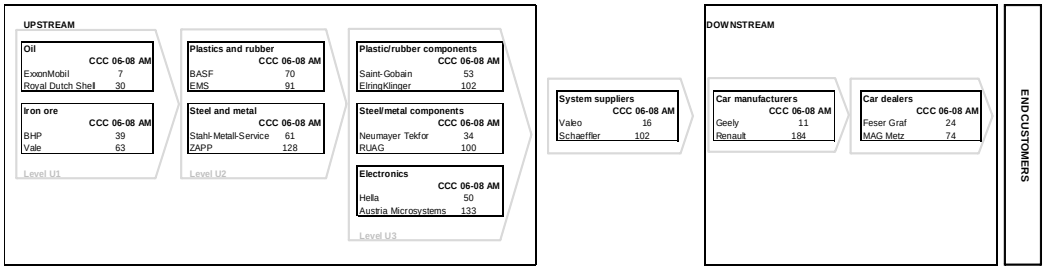


Figure 19. The chain of the best and the worst companies.

Since the data was collected in the fall of 2010, all companies in the chain had not published their annual reports for year 2009 yet. Therefore the year 2009 was not considered in the main analysis. However, the data of year 2009 was collected from 51 companies that already provided their financial figures of that year. The results of the year 2009 show that there were a lot of changes in the CCC of companies. The CCC of 31 companies lengthened, whereas 20 companies had a negative direction with their CCC. The change of most companies was more than 5 days, and even 23 of 51 companies showed that their CCC in year 2009 was more than 10 days shorter or longer than in year 2008. On the other hand, the CCC of 18 companies remained almost the same in year 2009 by changing only 1-5 days.

Anyhow, even if this kind of fluctuation may sound like a lot, it seems to be normal when compared to earlier years of the observation period. The range of change in CCC was widest in years 2006-2007, 0-77 days, while in years 2008-2009 it was 1-56 days (with a smaller sample). Among the system suppliers, the CCC of the companies did not change notably in year 2009. The changes were 2-12 days, which compared to the changes in earlier years, 0-21 days in 2007 and 1-31 days in 2008, can be considered relatively small. Within the stage, Valeo's short CCC was reduced even more, being 4 days in 2009. This resulted from the lengthened DPO. Valeo was also the only company in the stage of system suppliers, whose CCC reduced from year 2008.

5.6 The amount and interest costs of working capital

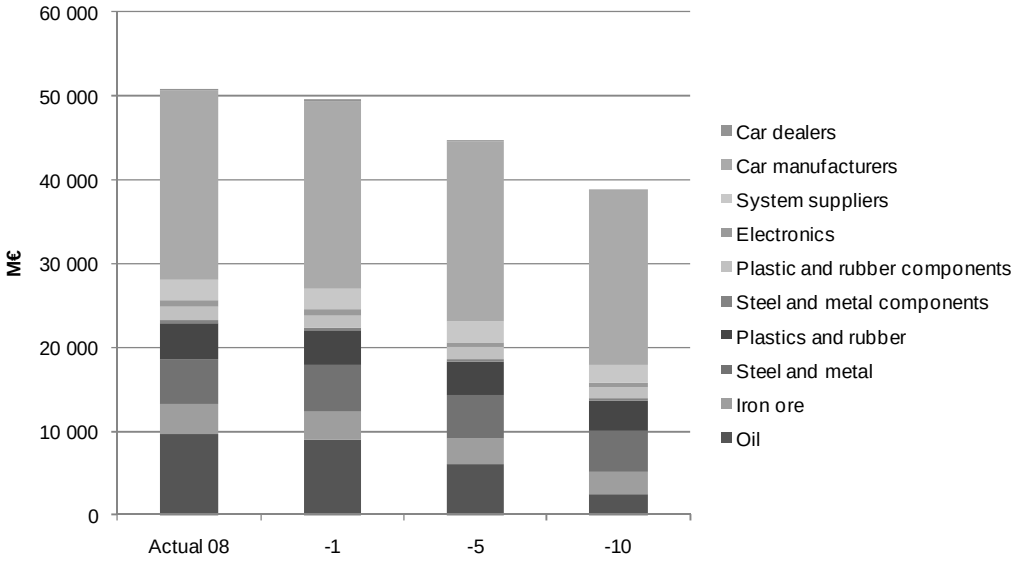
To find out the benefits resulting from the decrease of CCC, it was calculated how much working capital in money would be released if the CCC was reduced by one, five, and ten days. In this calculation, it was presumed that the sales will remain constant, and the point of comparison was the figures of year 2008. For each stage of the value chain, an average company was created by calculating the average amount of working capital of companies in each stage, and therefore it can be thought that every stage is represented by an average company operating in that particular area of automotive industry. The figures of each firm were converted to euros by the yearly average rate course released by the European Central Bank. The calculation was carried out as follows:

The average amount of working capital of stage when CCC decreased ceteris paribus

$$WC = \frac{(CCC_{2008} - d) \cdot Sales_{2008}}{365} \tag{6}$$

where d refers to the number of days (1, 5, 10) CCC decreases from the value of year 2008.

Results of this calculation are shown in Figure 20. Column “Actual 08” describes the amount of working capital in millions of euros tied up in average firms in the value chain of automotive industry. The following columns show the change in the amount of working capital, if the CCC was reduced by one, five and ten days.



The amounts in M€

Actual 08	-1 day	-5 days	-10 days	
74	73	66	58	**Car dealers**
22 505	22 321	21 582	20 659	**Car manufacturers**
2 566	2 522	2 346	2 126	**System suppliers**
674	664	624	573	**Electronics**
1 505	1 477	1 365	1 225	**Plastic and rubber components**
403	398	376	348	**Steel and metal components**
4 246	4 188	3 955	3 663	**Plastics and rubber**
5 505	5 431	5 133	4 761	**Steel and metal**
3 420	3 345	3 048	2 676	**Iron ore**
9 747	9 028	6 153	2 558	**Oil**

Figure 20. Working capital in Millions of Euros.

It can be seen that, for example, by decreasing CCC by five days, an average system supplier would release approximately 24 Million Euros of working capital. The released working capital would be naturally more notable in case of oil companies or car manufacturers, since also their business is much larger by volume. By reducing CCC while sales and EBIT remain constant, the profitability of the company would become better.

To analyze the impacts of reducing CCC, interest costs of working capital were calculated with different variables. As in earlier calculation of the amount of working capital, in these calculations each stage is represented by an average firm, which is created by calculating the average of the firms in the all stages of this value chain.

Figure 21 describes every stage's share of working capital tied up in the entire value chain of automotive industry in year 2008.

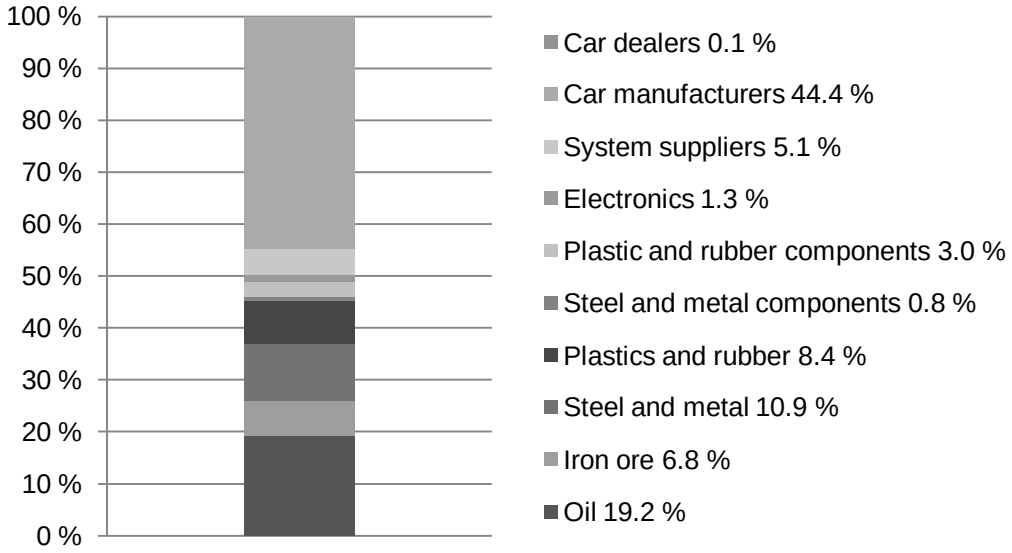


Figure 21. Shares of working capital tied up in all value chain in year 2008.

It can be seen in the figure 21, that the first level of the chain, stages of oil and iron ore, and the stage of car manufacturers tie up the major part of chain's working capital. The share of level U1 is 26 % and the share of car manufacturers 44 %, which leave only 30 % for the other 7 stages. This can be explained by the large size of oil, iron ore and car manufacturing companies.

Interest costs for the current need of working capital (based on the figures of year 2008) was calculated as follows:

The interest cost of working capital of stage

$$Interest\ cost = i \cdot WC \cdot \frac{CCC}{365} \tag{7}$$

where *i* is yearly interest cost,
WC is the firm's average amount of working capital of stage in euros, and
CCC is the cash conversion cycle of stage.

Figure 22 describes the interest costs of tied-up working capital in millions of euros for the average firm of each stage in year 2008. The interest costs have been calculated with different interest rates. The interest costs have been calculated from the working capital in money presented earlier in this chapter.

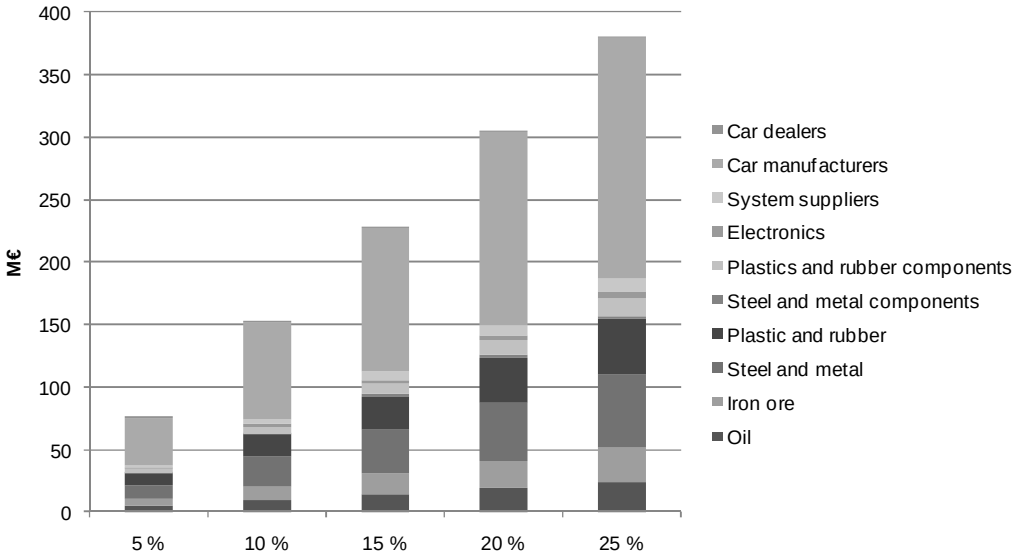


Figure 22. Interest costs of tied up working capital in each stage's average firms in year 2008.

Figure 23 shows how interest costs of tied up working capital are divided between the stages in the value chain of automotive industry. Relation between the stages remains constant even if the interest rates are different.

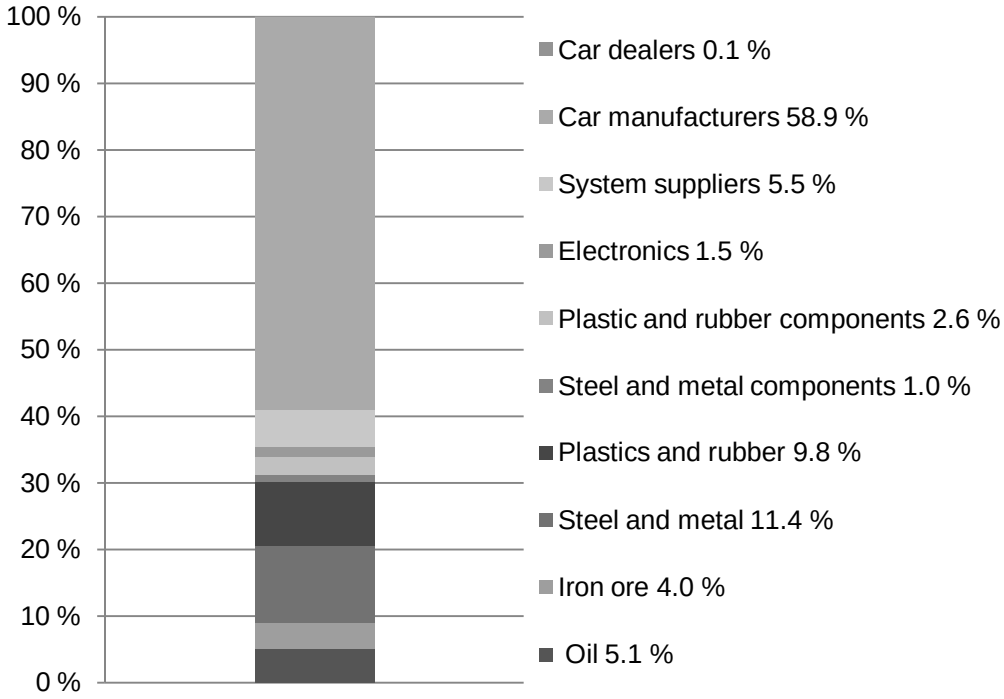


Figure 23. Shares of interest costs of working capital tied up in the value chain.

As described in Figure 23, an average car manufacturer clearly has the biggest interest costs in comparison to other average firms of the chain. It can also be seen that even if the volume of oil business is large and their working capital in euros is a lot, the interest costs of an average oil company are rather low because of the short cycle time of working capital. This indicates that the cash conversion cycle effects on the interest costs.

5.7 Future research

Even if the comparison of the results of this study to the REL/CFO study showed that the sample of the study represents the automotive industry relatively well, and the companies were picked carefully, some companies and stages were left out of the study. In future research, the chain could be complemented for example with the stages related to textiles and software in the upstream. In the downstream part of the chain, independent garages and spare part shops, as well as car rentals and car leasing companies for example, could be considered in the analysis.

In this study, the value chain had a strong European perspective. In further research, the point of view could be more global. It would be interesting to examine if there are differences in working capital management between Japan, Western Europe and USA, the three main automotive areas in the world, and if the working capital management of companies operating in growing areas of automotive industry, like in Eastern Europe, India and China, differ somehow from the practices of traditional automotive actors. In this study, Chinese car manufacturer Geely differed notably from the other manufacturers by having a very short and in years 2008 and 2009 even negative CCC. It would be interesting to find out, if this kind of performance is descriptive for the Chinese automotive industry, or if Geely is an outlier also in that context.

The observation period covers three years and ends 2008. It would be interesting to see the longer development of the cycle times. For example, it would be interesting to study how the past financial crisis has affected on working capital management. To see the consequences of the worldwide financial crisis in CCC and working capital management, a longer observation period should be analyzed in order to understand if the companies had a certain CCC level before the crisis and if there were remarkable changes in CCC after the year 2008, when analyzing the situation in the context of a longer period. In this shorter observation period, the years out of line can not be seen very clearly.

Similar research design is now used to study pulp and paper and automotive industries. Except for some specialities of the industry, results were surprisingly similar. It would be interesting to study some other industries still, for example the industry of information and communication technology (ICT), and learn if they would differ from the pulp and paper and automotive industries. Also the influence of business model on CCC could be studied by analyzing the business models of companies performing low CCC.

6 CONCLUSIONS

In this study, the cash conversion cycle was used to examine the working capital management in the value chain of automotive industry during the years 2006-2008. The companies operating in the value chain of automotive industry are dependent on their relations with other companies. A company that seeks to reduce its working capital at the expense of its value chain partners does not turn any more competitive since the competition is more like value chain against value chain rather than company against company. According to Porter (1985 p. 99), sustainable competitive advantage can be achieved either by reducing the costs of the value chain or by reconfiguring the value chain the company operates at. In order to reduce tied-up working capital, the management of working capital in the entire value chain is essential, not just the management of the working capital in separate companies. The other option, reconfiguring the value chain, can be realized by aspiring to the value chain that is more efficient than company's present value chain, or by being active in mergers and acquisitions.

The average cash conversion cycle (CCC) of automotive industry is 67 days for the period of 2006-2008. Difference between years 2006 and 2008 is minimal. This indicates that the relation between working capital and sales is nearly constant. Pirttilä et al. (2010) made same conclusion of constant CCC in their study of pulp and paper industry. On the other hand, even if the CCC remains constant in the value chain of automotive industry, its components accounts receivable and accounts payable have changed remarkable while the change in inventories has been low. Because the changes of accounts receivable and accounts payable offset each other, the CCC remains almost steady. Interesting finding is that in each stage of automotive industry the turnover time of accounts receivable has shortened. This indicates that companies have paid attention to management of accounts receivable and focused on collecting remittance from the customers.

The cycle time of inventories depends more on the policies of production and inventory management than on the terms of purchase and sales that define the

turnover time of accounts receivable and payable. Several evidences show the benefits of just-in-time (JIT) and similar models to manage physical supply chain are given, but the terms of purchase and sales still follow the traditions adopted after an era of cash payments. The terms of payments are bargaining issues that could be redefined without jeopardizing the production of the physical product. The decrease of the working capital invested would lead to improvement of the return on investment (ROI) through a value chain that implements this new method to payments. These types of value chains would be more interesting and attractive for capital investors.

By analyzing working capital management in an inter-organizational context, a company receives a holistic view of the value chain it operates at. On the other hand, the company can benchmark its position against competitors in its own stage and its position in the value chain, but the company can also see the most efficient partners and the chain, where it wants to belong to. To analyze and improve the situation of working capital management of a firm, following issues should be considered:

Benchmarking against the best practices. A firm should compare its own working capital performance to the results of competitors and other companies in the same stage in order to find the targets for development.

Cooperation in the management of working capital components. Working capital should be managed in cooperation within a firm. The components of working capital should be in reasonable balance with each other.

Responsibility of working capital management for one person. Working capital management should be coordinated by one responsible person within a firm. The position of the responsible person should be relatively high in the organization, in order to achieve the best results.

Setting goals for each component. The target for the CCC should be set via individual goals for each component. Improving the CCC at the expense of one of the components is not reasonable.

The optimal level for working capital in the value chain is difficult to adjust by the information received from the study, but with more efficient working capital management many companies could decrease their CCC and therefore release working capital for other objectives. According to the study, the cycle times of working capital can be shortened through the value chain basically in two ways: by more efficient cycle times of inventories, or by shortening the payment periods. The essential element of inventory optimization in the value chain is information sharing between supplier and customer. More accurate information about the inventory levels and order points of the customer may decrease the inventories of suppliers and release working capital. The partnership is about creating win-win situations. The supplier can mutually reward the customer with the longer credit terms of other compensation for example. On the other hand, companies should consider in which stages it is needed to keep inventories, because the cost of the inventory increases from stage to stage.

The managers from the entire value chain of automotive industry should try to negotiate together in order to find a reasonable way to reduce tied-up working capital. The meaning of relative long payment periods to working capital should be discussed. Long credit terms could be a part of sales promotion or required by customer, but have companies considered that the credit periods also tie up capital into the value chain? Should the payment terms be updated to be equivalent to the speed of supply chain? The amount of working capital tied into the value chain affects return on investment directly by increasing the invested capital and decreasing the ROI. The current technology with electronic invoicing and payment would enable faster cycle times of accounts receivable and payable and the increase of the competitiveness of the value chain. A value chain that has will to make redefinitions where each actor can be a winner will increase its competition power against other chains. In the value chain overall, more

information could be shared between the actors. By using open book accounting, companies have been able to make their businesses more effective. This has enabled, for example, companies finding processes in the chain, which do not add value but on contrary even reduce it. To be realistic, this kind of changes in the traditional thinking can not be considered as an easy job since the trust is the issue that should be occurring through the value chain.

From the system supplier point of view, these companies alone can not do very much to improve the competitive position of the entire value chain. However, some actors in the chain should take the initiative and call parties involved together to discuss what could be done to improve working capital management on the level of entire automotive value chain. System suppliers could take this responsibility as relatively neutral actors, since the improvements in a chain's working capital management have pretty low impact on the systems supplier's part of chain.

All in all, attention should be paid to working capital management in individual firms as well as in the value chains as a whole. In both cases, successful working capital management requires cooperation. In a firm, purchasing, production, sales and inventory management should be in balance in order to find the optimal level for working capital. In a value chain, accounts payable of one actor are accounts receivable of another and they are dependent on the terms negotiated between companies. In order to balance working capital in the value chain, ways for doing so need to be found in cooperation.

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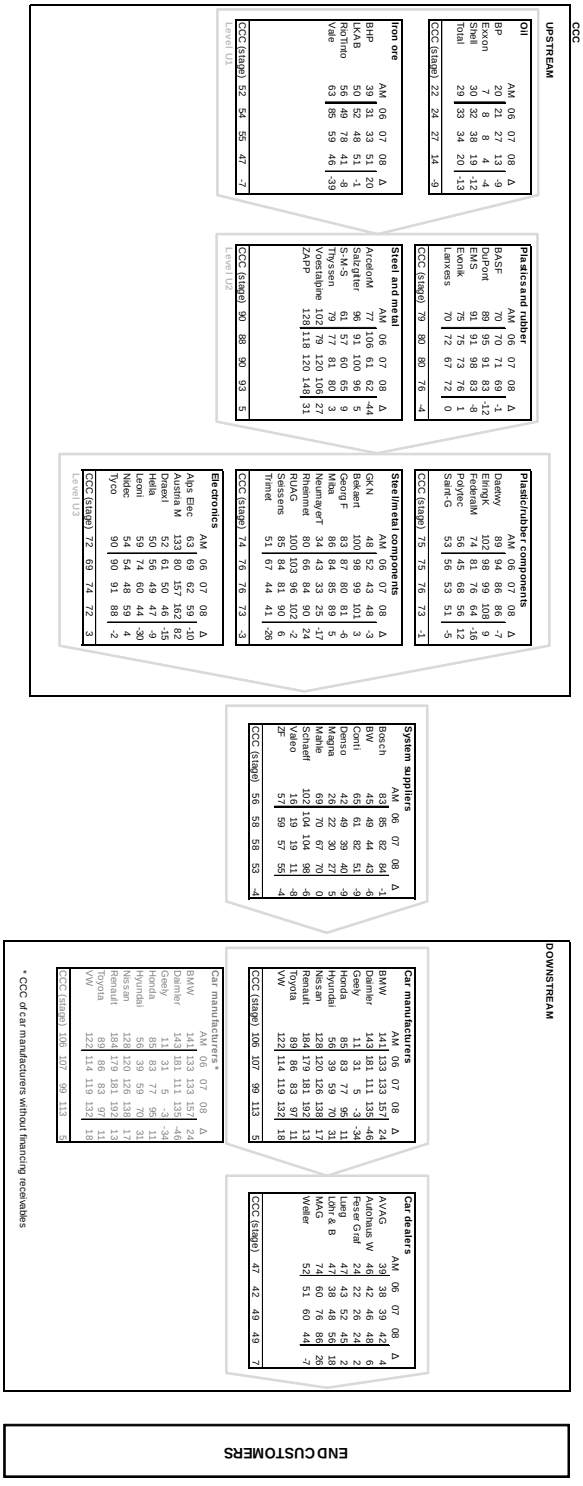
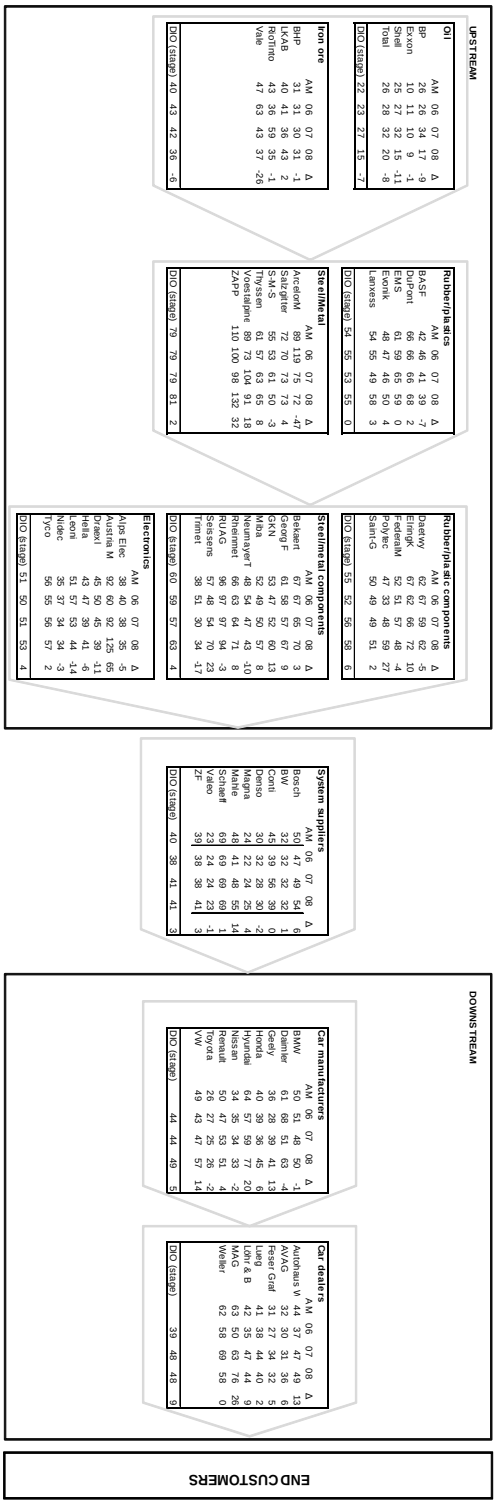
APPENDIX 1. CCC of companies.



APPENDIX 2. DIO of companies.



APPENDIX 3. DSO of companies.

DSO

UPSTREAM

Oil

	AM	06	07	08	Δ
BP	38	46	44	25	-21
Exxon	23	25	29	15	-10
Shell	34	35	43	25	-11
Total	39	41	44	31	-10
DSO (stage	34	37	40	24	-13

Iron ore

	AM	06	07	08	Δ
BHP	37	32	31	49	18
LKAB	39	42	43	31	-12
RioTinto	36	31	54	23	-7
Vale	46	65	44	30	-34
DSO (stage	39	42	43	33	-9

Rubber/plastics

	AM	06	07	08	Δ
BASF	52	57	54	45	-12
DuPont	54	58	58	46	-12
EMS	54	61	60	41	-20
Evonik	60	61	60	59	-2
Lanxess	44	49	45	40	-8
DSO (stage	53	57	55	46	-11

Steel/Metal

	AM	06	07	08	Δ
ArcelorM	37	57	35	21	-36
Salzgitter	50	48	54	48	0
S-M-S	23	25	22	22	-3
Thyssen	54	55	53	54	-1
Voestalpine	51	50	61	41	-9
ZAPP	34	36	32	34	-2
DSO (stage	42	45	43	37	-8

Rubber/plastic components

	AM	06	07	08	Δ
Daetwy	46	49	48	42	-7
ElringK	56	56	56	54	-2
FederalM	55	57	58	50	-7
Polytec	54	47	65	49	2
Saint-G	52	55	52	47	-8
DSO (stage	52	53	56	48	-5

Steel/metal components

	AM	06	07	08	Δ
GKN	47	46	48	46	-0
Bekaert	71	72	74	66	-6
Georg F	57	65	59	46	-20
Miba	61	66	64	54	-11
NeumayerT	38	36	42	37	0,5
Rheinmet	63	50	71	67	17
RUAG	75	68	74	84	17
Seissens	45	53	48	33	-20
Trimet	33	44	30	24	-21
DSO (stage	53	56	56	48	-7

Electronics

	AM	06	07	08	Δ
Alps Elec	57	67	58	46	-21
Austria M	92	98	105	73	-25
Draexl	35	42	30	32	-10
Hella	47	51	50	41	-10
Leoni	49	54	45	47	-7
Nidec	75	85	73	66	-19
Tyco	71	72	73	67	-5
DSO (stage	61	67	62	53	-14

System suppliers

	AM	06	07	08	Δ
Bosch	61	65	62	56	-8
BW	53	60	55	42	-17
Conti	65	57	87	50	-8
Denso	56	67	59	43	-24
Magna	51	55	56	43	-11
Mahle	55	62	56	47	-14
Schaeff	51	55	54	43	-13
Valeo	60	67	65	49	-18
ZF	47	50	49	42	-8
DSO (stage)	55	60	60	46	-13

DOWNSTREAM

Car manufacturers

	AM	06	07	08	Δ
BMW	114	110	109	125	15
Daimler	115	164	86	96	-67
Geely	55	59	49	56	-3
Honda	76	82	72	74	-8
Hyundai	31	29	33	31	2
Nissan	135	144	130	132	-13
Renault	198	197	202	194	-4
Toyota	91	92	88	94	2
VW	103	99	103	106	7
DSO (stage)		108	97	101	-8

Car dealers

	AM	06	07	08	Δ
AVAG	13	14	14	12	-2
Autohaus V	24	22	27	23	1
Feser Graf	26	21	31	26	4
Lueg	26	28	28	21	-6
Löhr & B	18	16	18	20	4
MAG	22	20	25	22	2
Weller	15	14	14	16	2
DSO (stage)		19	22	20	1

END CUSTOMERS

APPENDIX 4. DPO of companies.

DPO

UPSTREAM

Oil

	AM 06	07	08	Δ

Oil	AM	06	07	08	Δ
BP	44	51	51	29	-22
Exxon	26	28	31	20	-8
Shell	29	30	37	20	-10
Total	36	36	42	30	-6
DPO (stage	34	36	40	25	-11

Iron ore	AM	06	07	08	Δ
BHP	29	31	28	28	-3
LKAB	28	31	31	23	-8
RioTinto	24	19	34	18	-0
Vale	30	43	27	21	-21
DPO (stage	28	31	30	23	-8

Rubber/plastics	AM	06	07	08	Δ
BASF	24	33	24	16	-17
DuPont	31	29	32	31	2
EMS	25	29	27	17	-12
Evonik	33	33	33	34	1
Lanxess	28	32	27	27	-5
DPO (stage	28	31	29	25	-6

Steel/Metal	AM	06	07	08	Δ
ArcelorM	50	70	49	31	-40
Salzgitter	26	26	27	25	-1
S-M-S	17	22	23	7	-15
Thyssen	36	35	35	39	4
Voestalpine	39	45	45	26	-19
ZAPP	15	18	10	17	-1
DPO (stage	31	36	32	24	-12

Rubber/plastic components	AM	06	07	08	Δ
Daetwy	20	22	21	17	-5
ElringK	20	19	23	18	-1
FederalM	33	28	38	33	5
Polytec	44	36	45	53	17
Saint-G	48	48	48	47	-2
DPO (stage	33	31	35	34	3

Steel/metal components	AM	06	07	08	Δ
Bekaert	38	41	39	35	-7
Georg F	35	36	36	31	-5
GKN	52	41	57	57	16
Miba	28	31	29	23	-9
NeumayerT	52	47	56	54	7
Rheinmet	48	47	50	48	1
RUAG	71	61	74	76	15
Seissens	17	17	21	13	-3
Trimet	20	27	16	16	-11
DPO (stage	36	39	35	34	-5

Electronics	AM	06	07	08	Δ
Alps Elec	31	38	34	22	-16
Austria M	51	78	40	36	-43
Draexl	27	31	25	25	-6
Hella	40	43	40	36	-7
Leoni	41	37	39	47	9
Nidec	57	68	60	42	-26
Tyco	37	37	37	36	-1
DPO (stage	41	47	39	35	-13

System suppliers	AM	06	07	08	Δ
Bosch	27	27	29	26	-1
BW	39	43	43	32	-10
Conti	45	36	61	37	1
Denso	44	50	48	33	-17
Magna	49	54	49	42	-12
Mahle	34	33	36	32	0
Schaeff	18	20	19	14	-5
Valeo	68	72	70	61	-10
ZF	29	29	30	28	0
DPO (stage)	39	40	43	34	-6

DOWNSTREAM

Car manufacturers	AM	06	07	08	Δ
BMW	23	28	23	18	-10
Daimler	34	50	25	25	-26
Geely	79	56	83	100	44
Honda	31	37	31	25	-13
Hyundai	39	47	33	38	-9
Nissan	41	59	38	27	-32
Renault	64	65	74	52	-13
Toyota	29	34	31	23	-11
VW	30	29	30	31	3
DPO (stage)	41	45	41	38	-7

Car dealers	AM	06	07	08	Δ
Autohaus V	23	17	28	24	8
AVAG	6	6	6	7	1
Feser Graf	33	26	40	33	7
Lueg	19	22	20	16	-6
Löhr & B	13	13	17	9	-5
MAG	12	10	13	12	2
Weller	25	21	23	30	8
DPO (stage	19	17	21	19	2

END CUSTOMERS