

Anna-Maria Talonpoika

FINANCIAL WORKING CAPITAL – MANAGEMENT AND MEASUREMENT

Thesis for the degree of Doctor of Science (Technology) to be presented with due permission for public examination and criticism in the Auditorium of the Student Union House at Lappeenranta University of Technology, Lappeenranta, Finland on the 6th of May, 2016, at noon.

Acta Universitatis
Lappeenrantaensis 695

Supervisor Professor Timo Kärrä
LUT School of Business and Management
Lappeenranta University of Technology
Finland

Reviewers Professor Mervi Niskanen
Faculty of Social Sciences and Business Studies
University of Eastern Finland
Finland

Associate Professor Grzegorz Michalski
Faculty of Engineering and Economics
Wroclaw University of Economics
Poland

Opponent Assistant Professor Teemu Laine
Faculty of Business and Built Environment
Tampere University of Technology
Finland

ISBN 978-952-265-946-0
ISBN 978-952-265-947-7 (PDF)
ISSN-L 1456-4491
ISSN 1456-4491

Lappeenranta University of Technology
Yliopistopaino 2016

Abstract

Anna-Maria Talonpoika

Financial working capital - management and measurement

Lappeenranta 2016

76 pages

Acta Universitatis Lappeenrantaensis 695

Diss. Lappeenranta University of Technology

ISBN 978-952-265-946-0, ISBN 978-952-265-947-7 (PDF), ISSN-L 1456-4491,

ISSN 1456-4491

Unexpected changes in cash flow have started to occur more frequently after the financial crisis. The capital structures of companies have also changed, and financial flexibility as well as flexible asset management have therefore become more important. This thesis aims at presenting financial working capital management, a part of flexible asset management, as a possibility to gain financial flexibility and survive the changes. This thesis operates in the interface of corporate finance, strategic management and management accounting, and it has two main objectives: to examine financial working capital management and to develop measures of financial working capital.

The research in this thesis has been conducted using archival research and design science. Qualitative comparative analysis and model building are used to formulate tools and strategies for financial working capital management. The tools are tested with simulations, case studies and statistical analysis. The empirical data is collected from companies listed in the Helsinki Stock Exchange.

The results of this thesis indicate that there are several possible financial working capital management strategies. FOCAL matrix is created in the thesis to assist in the selection of a strategy. The results also imply that profitability can be improved by reducing financial working capital, which creates a need to change the financial working capital management strategy. Financial flow cycle, and its modification, is developed in this thesis to measure financial working capital.

Financial working capital as a concept is presented in this thesis with an orientation towards the management view. New dimensions have also been produced to financial management and working capital management, while providing a holistic approach to financial flexibility. Financial working capital management strategies are presented to managers and practical tools are provided for decision-making.

Keywords: financial working capital management, financial flexibility, asset management, profitability, liquidity, measurement

Acknowledgements

My journey through the doctoral studies has been rather short but it has included several ups and downs. I would have not managed to go through this without all the people around me. Thank you. It is now time to end this journey and head for a new one.

I want to express my sincere gratitude to Professor Timo Kärri, whose guidance and supervision has made this doctoral thesis possible. We have had several fruitful discussions related to my doctoral studies as well as research in general. I am grateful to my reviewers Professor Mervi Niskanen and Associate Professor Grzegorz Michalski, who have given their time to provide constructive comments which have improved this thesis. I also want to thank my opponent Assistant Professor Teemu Laine, who has given his time and consideration for this thesis.

I want to thank all members of the C³M research team: Miia, Sari, Salla, Leena, Tiina, Antti, Maaren, Sini-Kaisu, Lasse and Antero. We have had several wonderful discussions during the last couple of years and your comments and ideas has been really valuable to me. Special thanks to my co-authors Miia and Sari. I would not have been able to write the papers without you. You have been kind to answer all my questions which have risen during this process, no matter how small or large.

I am grateful for the financial support received from the Finnish Foundation for Technology Promotion (Tekniikan edistämissäätiö). The annual working grant provided me the opportunity to focus to this thesis. I also want to thank Research Foundation of Lappeenranta University of Technology for their financial support.

Finally, I would like to express my deepest thanks to my family. I want to thank my parents, Tiina and Erkki, for the discussions and encouragement during the doctoral studies. You have provided a practical view to my theoretical research. My little brother, Mikko, thank you for reminding to find the fun parts of life. I am indebted to my live-in partner Erno, who has supported my doctoral studies in all possible ways. It will be my turn to support your studies in the future.

Pirkkala, April 2016



Anna-Maria Talonpoika

Contents

Abstract

Acknowledgements

Contents

List of publications	9
Nomenclature	11
1 Introduction	13
1.1 Background and motivation	13
1.2 Objectives and scope	14
1.3 Outline of the thesis.....	16
2 Theoretical foundations	19
2.1 Financial flexibility	19
2.2 Flexible asset management.....	20
2.3 Working capital management.....	22
2.4 Working capital measures	26
3 Research design	31
3.1 Epistemology.....	31
3.2 Theoretical perspective.....	33
3.3 Methodology	34
3.4 Methods	36
3.5 Data collection.....	39
4 Research contribution	43
4.1 Financial working capital management.....	43
4.2 Financial working capital measures	48
4.3 Summary of individual publications	54
5 Conclusions	57
5.1 Theoretical contribution	57
5.2 Managerial implications.....	58
5.3 Evaluation of the research	59
5.4 Recommendations for further research	61
References	63
Publications	

List of publications

This thesis is based on the following publications. The rights have been granted by publishers to include the publications in the dissertation.

Publication I

Talonpoika, A.-M., Kärri, T., Pirttilä, M. and Monto, S. (n.d.). Defined strategies for financial working capital management. *International Journal of Managerial Finance*. Accepted for publication.

The author planned the study with co-authors. The author was responsible for conducting the analyses and writing and revising the publication.

Publication II

Talonpoika, A.-M., Kärri, T. and Pirttilä, M. (n.d.). The dynamics of financial working capital management strategies. *International Journal of Business Innovation and Research*. Accepted for publication.

The author planned the study and developed the model with co-authors. The author was responsible for conducting case analyses and writing and revising the publication.

Publication III

Talonpoika, A.-M., Kärri, T. and Pirttilä, M. (2016). Circulate your idling assets. *Proceedings of the 10th World Congress on Engineering Asset Management (WCEAM 2015)*, pp. 573-580.

The author planned the study with co-authors. The author was responsible for conducting the simulations and writing the publication.

Publication IV

Talonpoika, A.-M., Monto, S., Pirttilä, M. and Kärri, T. (2014). Modifying the cash conversion cycle: revealing concealed advance payments. *International Journal of Productivity and Performance Management*, 63(3), pp. 341-353.

The author planned the study, designed the measure and analysed the empirical data with co-authors. The author wrote most of the publication.

Publication V

Talonpoika, A.-M., Pirttilä, M. and Kärri, T. (n.d.). Improving working capital measures for today's needs. *Revised and further submitted version*.

The author planned the study and analysed the empirical data with co-authors. The author was responsible for designing the measures and writing and revising the publication.

Nomenclature

Variables

B	average depreciation time of fixed assets	(years)
CCC	cash conversion cycle	(days)
DAO	days of advance payments outstanding	(days)
DFA	days of financial assets outstanding	(days)
DFL	days of financial liabilities outstanding	(days)
DIO	days of inventory outstanding	(days)
DOA	days of operating assets outstanding	(days)
DOL	days of operating liabilities outstanding	(days)
DPO	days of accounts payables outstanding	(days)
DSO	days of accounts receivables outstanding	(days)
EBITDA%	earnings before interests, taxes, depreciations and amortizations	(%)
FA%	fixed assets percentage	(%)
FFC	financial flow cycle	(days)
mCCC	modified cash conversion cycle	(days)
MCCC	modified cash conversion cycle	(days)
MFFC	modified financial flow cycle	(days)
OCA	other current assets	(days)
OCL	other current liabilities	(days)
ROI	return on investment	(%)

Abbreviations

ACCC	adjusted cash conversion cycle
FAM	flexible asset management model
FOCAL	strategy matrix for financial working capital management
HSE	Helsinki Stock Exchange
ICT	information and communications technology
IFRS	international financial reporting standards
NTC	net trade cycle
PAS	publicly available specifications
QCA	qualitative comparative analysis
RQ	research question
SME	small and medium sized enterprise
U.S.	United States
WCCC	weighted cash conversion cycle

1 Introduction

The first chapter introduces the concept of financial working capital. Background and motivation for the research are presented to start the discussion on working capital management. Objectives and scope, as well as the outline of this thesis, are also presented in the first chapter.

1.1 Background and motivation

Companies have faced many unexpected changes during and after the financial crisis which began from the United States (U.S.) in 2007. The financial structure of companies has changed because of the crisis, and companies have been forced to prepare for costly external financing. Financial institutions have strained their conditions, and inflexible companies are struggling to survive (Koskinen, 2015). Financial flexibility has become crucial for all companies regardless of their size and company structure. Denis (2011) defines financial flexibility as an ability to react to unexpected changes in cash flow or investment opportunities with a value-maximizing approach.

However, financial flexibility is just one aspect of a company's flexibility. Gibson (2000) also highlights functional and physical flexibility. These are all important to a company adjusting to the new business environment caused by the economic downturn. Komonen et al. (2012) present flexible asset management as a solution for companies building their flexibility. Companies aspiring towards flexibility have been noticed, and Marttonen et al. (2013a) have introduced a flexible asset management (FAM) model which aims at optimizing profitability by adjusting fixed assets and working capital. The FAM model includes a term called residual, which reflects the financial flexibility of the company. The residual term is the starting point of this thesis and it will be subsequently called financial working capital.

Current assets and current liabilities are often referred to as working capital. Working capital can be defined in numerous ways. Current assets less current liabilities are called net working capital, whereas inventories and accounts receivables less accounts payables are called operational working capital. Fleuriet et al. (1978) define financial working capital as financial assets less financial liabilities. Net working capital presents the capital employed by a company, whereas operational and financial working capital imply whether it is employed by operations or financials. Companies and academia have had an increasing interest towards operational working capital management after the financial crisis, and therefore research on operational working capital covers several aspects, including profitability effects and financial supply chain management (e.g. Knauer and Wöhrmann, 2013; Pirttilä, 2014).

Literature on financial working capital, on the other hand, is scarce. Financial working capital management was introduced in 1978 by Fleuriet et al. as a part of a dynamic working capital model. The model has been studied widely in Brazil but the research on

financial working capital management has been limited to a single publication (Souza, 2003). This thesis pursues to present financial working capital management and measurement, which may be seen as one possibility to gain financial flexibility.

1.2 Objectives and scope

Financial working capital management is studied in this thesis. The thesis has two main objectives: (1) to examine financial working capital management and (2) to develop measures of financial working capital. These objectives provide a broad view to financial working capital from two supportive perspectives. Financial working capital and its management have not been widely studied and therefore a holistic view is needed to understand the phenomena. Figure 1.1 presents the linkage between objectives, research questions and individual publications of this thesis.

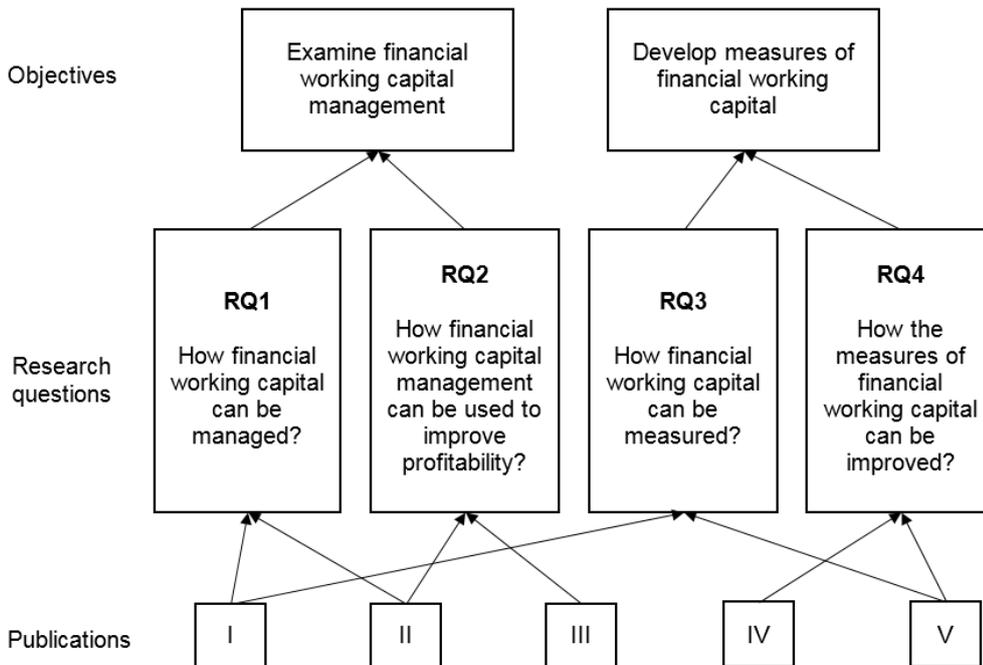


Figure 1.1: Objectives, research questions and publications.

The objectives are divided into four research questions. There are two research questions which are linked to the first objective, which examines the financial working capital management. Research question 1 focuses on how financial working capital can be managed. Management strategies and tools are studied in publications I and II to find a solution for this question. Research question 2 seeks ways to improve profitability

through financial working capital management. Publication II provides a financial working capital management tool which considers profitability, and simulations are done in publication III to study the effects of financial working capital management on profitability.

The second objective, which aims at developing measures of financial working capital, is also divided into two research questions. Research question 3 studies how financial working capital can be measured. Publications I and V present measures which can be used to calculate financial working capital. Research question 4 focuses on how financial working capital measures can be improved. Publications IV and V provide improvements to financial and operational working capital measures.

This thesis focuses on financial working capital management. Figure 1.2 presents the scope of this thesis. Financial working capital management is in the intersection of three large research areas: management accounting, corporate finance and strategic management. These research areas present a different view of financial working capital, and this thesis aims at combining these three research traditions. Financial working capital management combines asset management and financial management, whereas financial working capital measurement can be seen as a part of performance measurement. This thesis has a management accounting viewpoint because the tools and measures presented in this thesis are designed for managerial use.

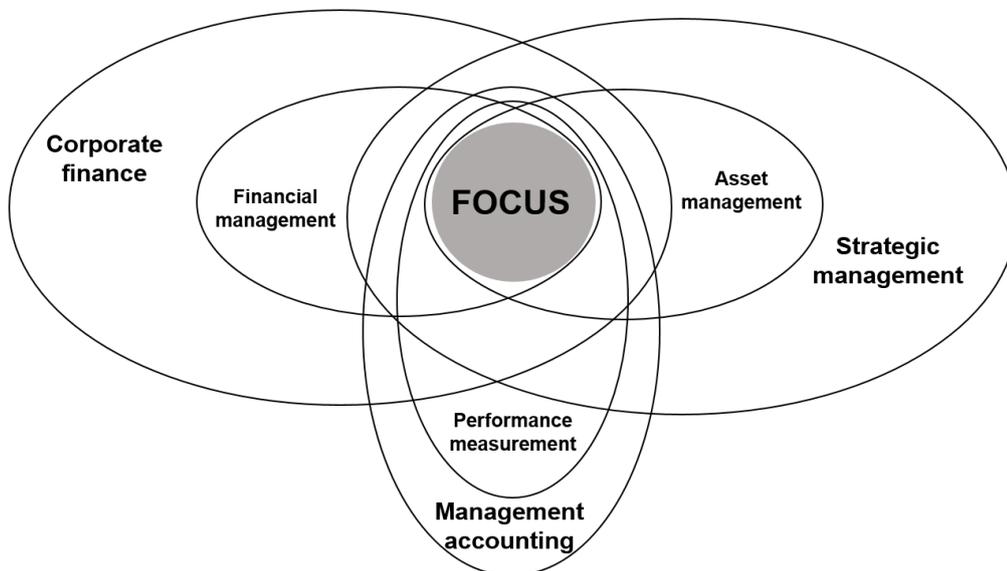


Figure 1.2: Scope of the thesis.

Management accounting and financial accounting have converged during the last couple of decades (Taipaleenmäki and Ikäheimo, 2013). The convergence has been caused by changes in technology and in accounting research and practices (Hemmer and Labro, 2008; Weissenberger and Angelkort, 2011). This has also required changes in accounting measures, which are one section of performance measures (Christoffersen, 2013). Performance measurement is used to help managers define and evaluate strategic goals (e.g. Gomes et al., 2011). It has been studied widely in different contexts (e.g. Deville et al., 2014; Larimo et al., 2016), but in this thesis only accounting measures are considered and therefore it is seen as part of management accounting.

Financial management as a part of corporate finance focuses mainly on cash flows and debt management (e.g. Fee et al., 2014; Isshaq and Bobkin, 2009). It could be said that it concerns the financial health of companies (e.g. Horngren et al., 2006). The dynamic working capital model aims at studying financial health and therefore it has been studied from several perspectives (e.g. Nascimento et al., 2012). Financial working capital has also been studied as a part of the model in financial management literature (e.g. Souza, 2003) but not on its own.

Asset management is a part of strategic management and it studies both fixed and current assets (Frolov et al., 2010). Fixed assets have been studied widely, but the research on current assets has mainly focused on operational working capital management (e.g. Ojanen et al., 2012). Single financial working capital components have been connected to operational working capital in previous literature (e.g. Ivashina and Scharfstein, 2010). There are also a few studies which include financial working capital but the emphasis has been on operational working capital management (e.g. Marttonen et al., 2013a).

Financial management and asset management are linked together through financial flexibility because flexibility requires capital structure decisions, which affect both areas (e.g. Denis and McKeon, 2012). Financial working capital management decisions could be seen as one type of capital structure decisions. Financial working capital management decisions as well as financial flexibility decisions are also heavily strategic decisions (e.g. Bancel and Mittoo, 2011). These management decisions require accurate measures and information from the performance of the company (e.g. Franco-Santos et al., 2012), which connects performance measurement to financial working capital management. Financial working capital management and measurement is therefore studied from performance measurement, financial management and asset management perspectives to provide the best holistic view possible.

1.3 Outline of the thesis

This thesis consists of an introductory part and individual publications. The introductory part provides an overview of the research presented in this thesis, whereas a more detailed view of the research is presented in the publications. The introductory part is divided into five chapters which can be seen in Figure 1.3. The first chapter discusses the background, objectives and scope of the thesis, which presents the motivation for the research. The

research questions are also formulated in the first chapter. The second chapter presents current academic knowledge on financial working capital management by reviewing previous literature on financial flexibility, flexible asset management and working capital management. The third chapter provides methodological justification of the thesis by introducing the theoretical perspective, methodologies and data used in the research. The fourth chapter summarizes the main findings of individual publications to present the results of this thesis and answer the research questions set in the first chapter. The fifth chapter concludes the thesis by providing theoretical contributions, managerial implications and future research prospects. The reliability and validity of the research are also evaluated in the fifth chapter.



Figure 1.3: Outline of the thesis.

2 Theoretical foundations

The theoretical foundation of this thesis is presented in this chapter. Prior literature is reviewed to gain current academic knowledge on financial working capital management. The starting point of this thesis is in financial flexibility, and financial flexibility literature is first reviewed in short. The focus of financial flexibility lies in flexible asset management which is briefly presented. Flexible asset management can be divided into two sides: fixed assets and working capital of which the latter presents the scope of this thesis. Previous literature on working capital management and measures is reviewed for a holistic view of financial working capital management.

2.1 Financial flexibility

Denis (2011) defines financial flexibility as an ability to react to unexpected changes, and he considers financial flexibility as a key element in the financial policy of a company. It secures the business in case of costly external finance, unsecure cash flows and unpredictable growth. Gryglewicz (2011) suggests financial flexibility to be maintained with optimal planning of cash holdings, capital structure and dividend policy. The maintenance is especially important when there is uncertainty in short- and long-term cash flows. His research indicates that cash flows can be smoothed with flexible dividend policies, and high levels of cash holdings can increase cash flows. Balasubrahmanyam et al. (2012) as well as Bancel and Mittoo (2011) consider financial flexibility as a strategic decision and suggest it as a starting point for strategy formulation.

Gamba and Triantis (2008) define cost of debt, corporate tax rate and liquidation value of capital as the determinants of financial flexibility. Bancel and Mittoo (2004) add legal environment as one the determinants. Singh and Hodder (2000) agree that legal environment as well as macroeconomic conditions are crucial, but Chang and Noorbakhsh (2009) find cultural aspects to be considerable in determining financial flexibility. Brounen et al. (2004), on the other hand, do not consider country determinants important; instead, they emphasize the size of the company when making decisions on financial flexibility. Gamba and Triantis (2008) also consider the age of the company remarkable, and they conclude that young companies with less capital should pay extra attention to financial flexibility.

Marchica and Mura (2010) state that financial flexibility can enhance investment ability. This can be made with a conservative leverage policy which indicates low level of debt. Financially flexible companies are able to make more investments which are also better when the value of investments is considered. O'Connor Keefe and Tate (2013) add that financially constrained and inflexible companies have to decrease their investments especially if they do not have enough cash holdings and their cash flow is volatile. de Jong et al. (2012), on the other hand, see low leverage as the key to future investments. However, Gamba and Triantis (2008) consider financial flexibility and investment flexibility to be substitutes and therefore recommend fixed asset intensive companies to

reconsider their financial flexibility. Gupta et al. (2011) even recommend disinvestments to increase financial flexibility.

Ang and Smedema (2011) find financial flexibility crucial in preparing for financial crises. Financially constrained companies with low level of cash holdings are unable to prepare for financial crises, but unconstrained companies with high level of cash holdings are able to do that. Arslan-Ayadin et al. (2014) also see the important role of financial flexibility during a financial crisis. Financially flexible companies are able to exploit investment opportunities during a financial crisis and they also perform better. Bancel and Mittoo (2011) add that the impact of a financial crisis is lower for financially flexible companies. The business operations of financially flexible companies do not suffer as much during a financial crisis as the business operations in financially inflexible companies. They consider flexible companies to have low leverage and high level of cash holdings. Gorbenko and Strebulaev (2010) even argue that financial crises and other temporary shocks in the cash flow may improve the financial flexibility of a company.

2.2 Flexible asset management

Asset management aims at perceiving the best value of assets according to Herder and Wijnia (2012). They define assets on a broad scale which means that assets can be tangible or intangible, financial or non-financial. They also argue that the best value depends on the viewpoint. The best value can be short-term profit or long-term ecological sustainability depending on whichever is studied. El-Akruti and Dwight (2013) have a more practical approach to asset management as they see asset management as planning and controlling asset-related activities. Asset management is conducted on three levels: operational, aggregate and strategic. Flexible asset management needs all of these levels. Aoudia et al. (2008) as well as Lin et al. (2007) consider good control of assets essential in asset management and their results show that profitability can be increased with proper asset management. Schneider et al. (2006) point out that asset management has to take the entire lifecycle of assets into consideration since capital depreciation costs as well as maintenance costs are the largest costs of fixed assets.

El-Akruti et al. (2013) consider asset management as a competitive strategy which enhances the success of a company. Frolov et al. (2010) also considers effective asset management to be an important but complex part of strategic management. It requires synergies from accounting, engineering, finance, humanities, logistics and information systems. They note that asset management, as well as other business processes, consist of functions that need to be identified so that they can be managed. Komonen et al. (2012) emphasize asset management decisions to be made on a company level instead of a single asset level, because asset management is not just maintenance management but it is also investment planning, lifecycle management as well as strategic planning to provide competitive advantage to the company. Company asset management should follow the development of markets because a dynamic business environment requires rapid changes in assets, which can be achieved with flexible asset management.

Publicly Available Specification (PAS) 55-1 (2008) and 55-2 (2008) have been created to unify the terminology and practices of asset management. The specifications describe the optimized management of physical assets and its application. The specifications focus on physical assets and therefore ISO 55000 standard series have been published to broaden the scope of asset management. The series consist of three parts: ISO 55000 (2014), ISO 55001 (2014) and ISO 55002 (2014). ISO 55000 describes the principles and terminology of asset management, whereas ISO 55001 and ISO 55002 focus on the asset management system and its application. The ISO 55000 series defines asset management on a very broad scale and therefore it is applicable in all companies.

Flexible asset management requires flexible investment management. Ojanen et al. (2012) claim that capital intensive industries often face problems with overcapacity, low profitability of investments and variable demand, and therefore flexible investment and capacity planning as well as dynamic lifecycle management are needed. Flexible investment management enables asset adjustments according to demand, whereas dynamic lifecycle management prolongs the lifecycle of assets when decreases in capital investments occur. Hatinen et al. (2012) see flexible investment management as an important part of flexible asset management. Large companies usually have long-term investment strategies which aim at gaining more market share. SMEs, on the other hand, have more flexible investment strategies which enable them to adjust investments based on demand. They conclude that the sizing and timing of the investments have to be correct so that no costly overinvestment or underinvestment is executed.

Flexible asset management interests not only academia but also managers. Kärri (2007) has presented a flexible asset structure model which is a concrete tool for flexible asset management. The model can estimate the need for fixed assets and working capital when goals have been defined for return on investments and operating income ratios. Marttonen et al. (2013a) have introduced the flexible asset management (FAM) model which is derived from Kärri's model. The FAM model has been created as a decision-making tool for managers and it also emphasizes the management of both working capital and fixed assets. The model is based on five parameters which affect return on investment. The parameters are the cycle time of operational working capital, operating margin ratio, fixed assets ratio, average depreciation period and a residual term consisting of other current assets and liabilities. Equation 2.1 presents the calculation of the FAM model. Marttonen et al. (2013b) have also extended the model to include an owners' perspective which is observed through return on equity.

$$ROI = \frac{EBITDA\% - \left(FA\% \times \frac{1}{B-1}\right)}{\frac{CCC}{365} + \frac{r}{365} + FA\%} \quad (2.1)$$

2.3 Working capital management

Working capital can be defined in several different ways. Working capital usually refers to current assets and liabilities in the balance sheet. Guthmann and Dougall (1948) define working capital as current assets less current liabilities which is the widest and most used definition of working capital. This definition is called net working capital. Working capital can also be defined as current assets and current liabilities employed by the operations of a company. These operations are mainly considered to be inventory, accounts receivables and accounts payables. This view is called operational working capital, which can be calculated as inventories plus accounts receivables less accounts payables. The third view of working capital is financial working capital, which includes the parts of net working capital which are not employed by operational working capital. Figure 2.1 presents the different views of working capital in the balance sheet. The management of net working capital, operational working capital and financial working capital are explained in more detail later in this chapter.

ASSETS	LIABILITIES AND SHAREHOLDERS' EQUITY
Fixed assets	Shareholders' equity
Current assets	Long-term liabilities
<i>Inventories</i>	Short-term liabilities
<i>Paid advances</i>	<i>Reserves</i>
Receivables	Loan amortizations
<i>Trade receivables</i>	<i>Received advances</i>
Loan receivables	Payables
Tax receivables	<i>Trade payables</i>
Other receivables	Tax payables
<i>Accrued income</i>	Other payables
Securities	<i>Deferred income</i>
Cash and equivalents	
<i>Operational working capital</i>	Financial working capital

Figure 2.1: Working capital in the balance sheet.

Working capital management has been known to managers for decades but academic interest towards working capital management policies started when Gentry et al. (1979) presented their study on working capital management. The literature review of Viskari et al. (2011a) indicated that working capital management research has been increasing since the financial crisis which started from the U.S. in 2007. Pirttilä (2014) showed in her dissertation that working capital management research has been booming the last couple of years. The crisis can also be seen in management literature. Payne (2002) as well as Steyn et al. (2002) suggested effective working capital management as an opportunity to

finance growth in the beginning of 2000. Mullins (2009) as well as Kaiser and Young (2009), on the other hand, offer working capital management as a possibility to free cash for daily operations. Hofler (2009) also notes the importance of trade credit when bank debts are difficult and expensive to acquire.

Net working capital management

Net working capital is almost equivalent to liquidity and the terms are occasionally used to reference each other. Emery (1984) considers net working capital as a measure of liquidity which implies whether a company can survive its short-term liabilities. Dash and Ravipati (2009) have tried to find a solution to the managers' dilemma which comes from balancing between liquidity and profitability, because Eljelly (2004), among others, has showed that liquidity and profitability have a negative correlation. Liquidity is still needed to ensure business operations, and profitability is needed to ensure growth and shareholder value, and therefore a balance should be found between liquidity and profitability.

Michalski (2008) emphasizes that net working capital management should aim at maximizing company value. Zwissler et al. (2013) even suggest a lean approach to net working capital management which would ensure value creation. Nevertheless, de Almeida and Eid Jr. (2014) have discovered that a large amount of net working capital reduces the company value. They have also found that an investment in net working capital is worth less than a similar investment in cash, which is also shown by Autukaite and Molay (2011). Flor and Hirth (2013) find that companies with large amounts of net working capital are more prone to make investments, although Myers and Rajan (1998) see that these companies make poor investments which do not increase their company value.

Operational working capital management

Sometimes operational working capital has been called process-related working capital since it presents the capital employed by operational processes. Operational working capital consists of three components: inventory, accounts receivables and accounts payables, which Mullins and Komisar (2009) call the noncash components of working capital. Accounts receivables and accounts payables are often studied together since they represent the different sides of trade credit. All three components have been studied jointly but also separately since inventory management is traditionally considered as part of operations and trade credit is a part of finance. The literature includes several theories about inventory management as well as trade credit management. Operational working capital management has also been studied as an entity from several perspectives. Viskari et al. (2011a) present three major research streams for operational working capital management: working capital management practices, determinants of working capital and the relation between working capital management and profitability. These days financial supply chain management can also be counted as a major research stream in working capital management.

In the past, inventory management has focused on planning purchases and controlling the inventory. Therefore there is a vast number of mathematical inventory optimization models like the Economic Order Quantity model by Harris (1990). The recent development in inventory models is the connection to trade credit terms. Chung et al. (2013) as well as Huang and Chung (2003) have created a mathematical inventory model which proposes the optimal cycle time of inventory but also presents an optimal trade credit policy. Bougheas et al. (2009) have presented an inventory model which calculates trade credit costs into the inventory model. Teng et al. (2013) have even created an inventory model which aims at minimizing the employed operational working capital. Luciano and Peccati (1999) note that capital structure has an effect on which inventory management model the company chooses.

Companies extend and receive trade credit at the same time. Long et al. (1993) note that trade credit is an important source of financing for companies but they still do not understand the meaning of it. Niskanen and Niskanen (2006) as well as Petersen and Rajan (1997) argue that smaller and younger companies use trade credit more often than larger and older companies. Ferrando and Mullier (2013) support this view by stating that trade credit is used to enhance growth. Coulibaly et al. (2013), Fisman and Love (2003) as well as Ge and Qiu (2007) highlight this especially in emerging and developing countries. García-Teruel and Martínez-Solano (2010a; 2010b) have found that companies have target levels for accounts receivables and payables and that they follow these target levels in trade credit decisions. Molina and Preve (2009) consider that companies extend trade credit when they have profitability problems but restrict it when cash flow problems occur. The findings of Bastos and Pindado (2013) follow these conclusions because companies which extend large quantities of trade credit are more likely to postpone their own trade credit payments.

Working capital management practices have been studied in different countries and in different sized companies. Belt and Smith (1991) found differences and similarities in the working capital management practices of U.S. and Australian companies. Khoury et al. (1999) even discovered that only a small portion of Canadian companies have formal working capital practices compared to U.S. and Australian companies. Howorth and Westhead (2003) consider limited working capital management resources to be the reason why SMEs have focused their working capital management on areas which are expected to improve performance. On the other hand, Ricci and Morrison (1996) claim that working capital management practices are aimed at increasing sales despite the size of the company. Noreen et al. (2009) consider that working capital management decisions are made on a corporate level instead of local or regional levels. Salawu (2006), on the other hand, states that working capital management practices depend on the industry instead of single companies.

Working capital determinants have been studied from the viewpoint of internal and external determinants. Chiou et al. (2006) argue that debt ratio and operating cash flow influence working capital. Moss and Stine (1993) discovered that larger companies have shorter cycle times of operational working capital, and high cash flows also decrease the

cycle time of operational working capital. Baños-Caballero et al. (2010), on the other hand, claim that older companies with high cash flows would have longer cycle times of operational working capital. A short cycle time of operational working capital is linked to growth opportunities, large amounts of debt and fixed assets. This view is supported by Palombini and Nakamura (2012), who connect short cycle times of operational working capital to large size, high cash flow, large amounts of debt, high growth rate and diversified ownership. Akinlo (2012) and Hill et al. (2010) also find growing sales as a determinant for a short cycle time of operational working capital.

Profitability has been studied a lot in management literature. There are also several studies on profitability and its connection to operational working capital. Jose et al. (1996) were the first to study the effect of operational working capital on profitability. They found that profitability can be enhanced with aggressive working capital management. They measured profitability with return on assets and return on equity and operating working capital with cash conversion cycle. Shin and Soenen (1998) supported the findings in their study which was based on return on sales as a profitability measure and net trade cycle as an operational working capital measure. These results have also been verified by Wang (2002), Deloof (2003), Lazaridis and Tryfonidis (2006) and García-Teruel and Martínez-Solano (2007a) among others. These studies can be considered as the base research for the connection between profitability and operational working capital management. The result is that a short cycle time of operational working capital improves profitability. The result has also been confirmed by several studies executed in numerous countries.

Financial supply chain management is the newest research stream of operational working capital and it connects the traditional supply chain management to working capital management. Rafuse (1996) already requested lean and supply chain oriented working capital management. Protopappa-Sieke and Seifert (2010) agree because operational and financial flows and costs are inseparable. Blackman and Holland (2006) add that financial supply chain management can bring cost savings to companies. Hutchison et al. (2009) proposes financial supply chain management to reduce the cycle time of operational working capital in the supply chain but notes that the cycle time of operational working capital may increase temporarily for individual companies. Viskari et al. (2012a) suggest different working capital management policies for individual companies depending on their position in the supply chain. Hofmann and Kotzab (2010) even warn that aggressive working capital management in individual companies may reduce the value of other companies in the supply chain. Grosse-Ruyken et al. (2011) therefore argue that the optimal cycle time of operational working capital should be set to the entire supply chain instead of single companies. Randall and Farris (2009) as well as Viskari et al. (2011b) claim that efficient financial supply chain management can improve the profitability of the supply chain. Pirttilä (2014) and Wuttke et al. (2013) have produced analysing methods and decision models to help managers in the financial supply chain management.

Financial working capital management

Fleuriet et al. (1978) have presented a dynamic working capital model (also known as Fleuriet's model) which introduces financial working capital. The model divides current assets and liabilities into financial (erratic) and operational (cyclical) assets and liabilities. The financial items mainly include cash and debts, whereas operating items consist of trade credit and inventories. The model also includes a term called non-cyclical (permanent) working capital which includes e.g. fixed assets and long-term debts. Financial working capital has also been included in the FAM model which defines it as net working capital less operational working capital (Marttonen et al., 2013). The view of Marttonen et al. (2013) is adopted in this thesis. Financial working capital management has been studied mainly as part of the dynamic working capital model, although the study of Souza (2003) focuses on financial working capital management. His results imply that financial working capital affects the financial state of companies, and management strategies and policies for financial working capital are needed to improve profitability. His study does not include any specific strategies, but Guimarães and Nossa (2010) have presented some managerial implications for financial working capital management.

Financial working capital management has not been presented previously in literature as a single subject. The management has been part of larger frameworks, which are related to general working capital management (Guimarães and Nossa, 2010) and flexible asset management (Marttonen, 2013). This thesis focuses on financial working capital and aims at providing an overview of financial working capital management and present models and tools, which can be incorporated in the management of financial working capital. Souza (2003) discovered that financial working capital affects profitability, and the FAM model (Marttonen, 2013) also connects profitability with financial working capital. This thesis thus reaches to explain how financial working capital management could be used to improve profitability.

2.4 Working capital measures

There are numerous working capital measures which have different perspectives on working capital. The measures are used e.g. in financial statements analysis or management decision-making and therefore variety is needed. Smith and Begemann (1997) divide working capital measures into three categories: position measures, leverage measures and activity measures. In this thesis, the measures are classified based on the working capital they measure: net working capital measures, operational working capital measures and financial working capital measures. Position measures are often used to measure net working capital, whereas leverage measures can be used to measure financial working capital, and activity measures are basically used for operational working capital. The variety of measures has grown during the last thirty years, and Emery (1984) and Gentry (1988) explain that earlier ratios were the main measures for working capital because working capital was considered to be a part of liquidity management.

Net working capital measures

Net working capital measures are often ratios such as current and quick ratio. Ratios are static measures and they provide a quick general view on net working capital. Bernstein et al. (1981) claim that ratios are used to measure working capital because they are easy to use, but Emery (1984) argues that the use of ratios is based on historical events. Ratios as net working capital measures have even received some criticism. Guthmann (1954) and Wright (1956) have stated that ratios are not useful in estimating net working capital. Net working capital measures are mainly used in financial statement analysis and not in managerial decision-making. Current and quick ratio as well as working capital ratio are presented below.

Current and quick ratio are probably the most used measures in financial statement analysis. They present the liquidity situation of a company, and therefore they provide a view on net working capital. Petersen and Plenborg (2012) state that current ratio describes whether current assets are able to cover short-term liabilities. Current ratio can be defined as current assets divided by current liabilities. Equation 2.2 presents the current ratio. Quick ratio can be calculated in situations where it is uncertain whether current assets can be liquidated in their book value. Quick ratio can be defined as cash, securities and receivables divided by current liabilities less received advance payments, which can be seen in Equation 2.3. There are reference values for both of these ratios (see Table 2.1) which can be used when the liquidity risk is evaluated. Nevertheless, Petersen and Plenborg (2012) note that asset structures vary across industries and the ratios should be benchmarked against other companies in the same industry.

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}} \quad (2.2)$$

$$\text{Quick ratio} = \frac{\text{Cash} + \text{securities} + \text{receivables}}{\text{Current liabilities} - \text{received advances}} \quad (2.3)$$

Table 2.1: Reference values for current and quick ratio (Yritystutkimusneuvottelukunta, 2005).

Current ratio		Quick ratio
2.0 -	Good	1.0 -
1.0 - 2.0	Satisfactory	0.5 - 1.0
- 1.0	Weak	- 0.5

Working capital ratio can be defined in several ways. The best known working capital ratio is the working capital turnover rate. Keythman (2013) states that the working capital

turnover rate describes the efficiency with which a company uses net working capital to produce sales. The turnover rate can be defined as sales divided by net working capital, which is calculated as current assets less current liabilities. Equation 2.4 shows the calculation of working capital turnover rate. There are no set reference values for the working capital turnover rate, but Keythman (2013) suggests to benchmark the turnover rate against other companies in the same industry to find the industry averages. Working capital percentage is the inverse ratio to working capital turnover rate. Lohrey (2013) explains that the working capital percentage presents the share of sales used to finance net working capital. The working capital percentage is calculated as net working capital divided by sales, which can be seen in Equation 2.5. There are no reference values for the working capital percentage.

$$\text{Working capital turnover rate} = \frac{\text{Sales}}{\text{Current assets} - \text{Current liabilities}} \quad (2.4)$$

$$\text{Working capital percentage} = \frac{\text{Current assets} - \text{Current liabilities}}{\text{Sales}} \quad (2.5)$$

Operational working capital measures

Operational working capital is mainly measured with activity measures which are often cycle times or turnover times according to Filbeck and Krueger (2005). Farris and Hutchison (2002) conclude that operational working capital measures measure the efficiency of working capital management. Operational working capital measures are designed for managerial decision-making and they include information about inventories, accounts receivables and accounts payables. Grosse-Ruyken et al. (2011) as well as Hofmann and Kotzab (2010) show that operational working capital measures can also be used to measure the efficiency of financial supply chain management. Cash conversion cycle (CCC), which was developed by Richards and Laughlin (1980), can be considered as the basic measure of operational working capital. CCC and its modifications are explained next in more detail.

The cash conversion cycle was developed by Richards and Laughlin (1980) to criticize the use of ratios in the measurement of operational working capital. Knauer and Wöhrmann (2013) consider that it has now become the most used measure of operational working capital. Farris and Hutchison (2002) use the term cash-to-cash cycle (C2C) which is only an alternative term for CCC. There are several variations of CCC in the academic literature. Richards and Laughlin (1980) calculate CCC as presented in Equation 2.6, whereas Farris and Hutchison (2003) as well as Ding et al. (2013) use a simpler equation (see Equation 2.7). It can be seen that the numerator is pretty much the same but the equations have different denominators. The simplest variation from CCC is net trade cycle (NTC) which was developed by Shin and Soenen (1998). NTC (see

Equation 2.8) uses sales as the denominator for all components. NTC is also often called CCC and it is used in the latter parts of this thesis when operational working capital is measured.

$$CCC = \frac{\text{Inventories}}{\text{COGS}} \times 360 + \frac{\text{Notes and accounts receivables}}{\text{Net sales}} \times 360 - \frac{\text{Accounts payables} - \text{Salaries, benefits and payroll tax}}{\text{COGS} + \text{Selling, general and administrative expense}} \times 360 \quad (2.6)$$

$$CCC = \frac{\text{Inventories}}{\text{COGS}} \times 365 + \frac{\text{Accounts receivables}}{\text{Net sales}} \times 365 - \frac{\text{Accounts payables}}{\text{COGS}} \times 365 \quad (2.7)$$

$$NTC = \frac{\text{Inventories} + \text{Accounts receivables} + \text{Accounts payables}}{\text{Net sales}} \times 365 \quad (2.8)$$

CCC studies three components, inventories as well as accounts receivables and accounts payables, of operational working capital on a company level. There are some modifications of CCC which are designed for different circumstances. Gentry et al. (1990) have designed the weighted cash conversion cycle (WCCC) which provides more detailed information than the original CCC. WCCC connects the monetary values of operational working capital components to their cycle times. WCCC can be concluded as weighted operating cycle less weighted days in accounts payables. Viskari et al. (2012b) have elaborated WCCC into adjusted cash conversion cycle (ACCC). The calculation logic of ACCC is based on WCCC but it can be used on customer or product levels. These modifications present the efficiency of working capital management in days which is similar to the original CCC.

Financial working capital measures

Financial working capital measures are often considered to be the same as net working capital measures because, as Gentry (1988) states, financial working capital considers the cash portion of net working capital compared to the noncash portion, which is called operational working capital. Fleuriet et al. (1978) have presented a dynamic working capital model which is the only direct working capital measure. It measures financial working capital as cash balance which can be defined as financial current assets less financial current liabilities. The cash balance presents financial working capital in currency instead of cycle time, which is more typical of operational working capital measures. Marttonen (2013), on the other hand, measures financial working capital with a cycle time. Marques and Braga (1995) have developed a framework which presents the financial position of a company based on financial, operational and net working capital, where the dynamic working capital model of Fleuriet et al. (1978) has been used to study

working capital. The framework is needed to make conclusions about financial conditions, since positive or negative values of financial working capital are not informative enough. This thesis aims at offering a definition which could be widely exploited in the future and simultaneously providing standards for measuring financial working capital. A generally accepted definition and measure would ensure the comparability of different studies and also the reporting of companies.

3 Research design

Research design is a process which describes the selection of specific research methods most suitable for the research problem. The selection of method is also influenced by the researcher's own perspectives. Crotty (1998) divides research design into four steps. Figure 3.1 presents these steps. First, epistemological questions are considered. The second phase applies the chosen epistemological view to the theoretical perspective of the research. Thirdly, methodology is chosen based on the theoretical perspective. Fourthly and finally, research methods are selected according to the chosen methodology. The research design process of this thesis is presented in the following sub-sections.

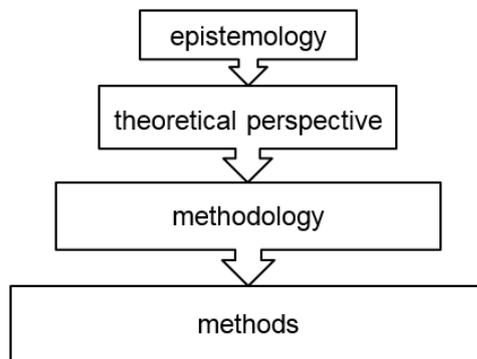


Figure 3.1: Research design (Crotty, 1998).

3.1 Epistemology

Epistemology is theory of knowledge. The epistemological debate is one of the basic debates in science. Researchers argue against different views of knowledge and how knowledge can be defined. The debates mainly concern epistemology itself but ontology and methodology are also needed to understand epistemological views. Ontology is theory of reality, and the definition of reality widely influences epistemology. Methodology has a crucial effect on epistemology as well, because different research methods shape epistemological views. This thesis follows Burrell and Morgan's (1979) view of epistemology with some modifications. Burrell and Morgan have originally presented their epistemological framework in the context of social sciences. Working capital management belongs to management sciences which is partially included in social sciences, and therefore this framework is selected. However, views of human nature are not included in this brief section of epistemology because working capital management does not concern interaction between humans. The modified framework of Burrell and Morgan (1979) is presented in Figure 3.2. The choicen views are in bold in the figure.

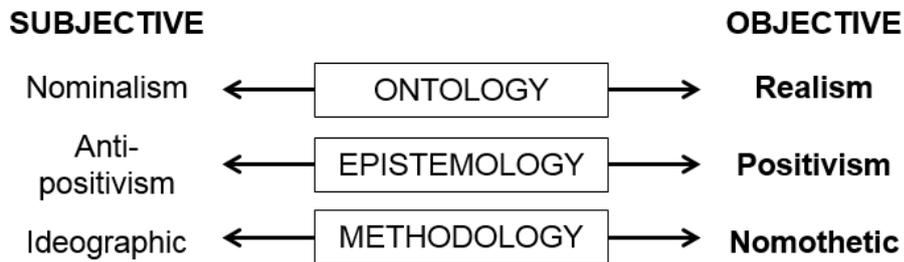


Figure 3.2: The assumptions of social science. Modified from Burrell and Morgan (1979).

Ontology describes the reality around us. Nominalism sees reality as a concept where labels are simply structuring reality. Reality is founded on individual experiences concerning the surrounding world. Realism considers reality tangible. The structures of reality are immutable and reality is always seen similarly. (Burrell and Morgan, 1979) This thesis is based on the realism view of reality. Research on working capital management concerns tangible, e.g. inventories, and intangible, e.g. trade receivables, objects. Therefore the research field determines the ontological choice. The author as a researcher is also inclined toward realism. The author sees reality as a tangible and structured organism.

Epistemology concerns knowledge. Anti-positivism only recognizes knowledge developed from personal observations and experience. Knowledge is relativistic and depends on the researcher. Positivism considers that everything can be described by regularities and causal relations. Knowledge can be created by developing and testing hypotheses, and therefore it explains and predicts the surrounding reality. (Burrell and Morgan, 1979) Positivism is the viewpoint of this thesis. Working capital management is a concept that cannot be observed because it is just numbers and figures. Previous research on the topic has proved that there are regularities in working capital management. The author finds that especially subjects of managerial science are intangible but they are nevertheless studied. This shows, at least for the author, that knowledge does not require personal experience in the studied subject. Nevertheless, the author also sees knowledge as a collective product produced by the scientific community, which is close to Longino's (1990) philosophical view of science as social knowledge.

Methodological debate focuses on appropriate data collection and research methods. The ideographic view accentuates the researcher's personal experience. Data collection should be made in person in the studied situations. The nomothetic view emphasizes systematic protocols and documented techniques. The testing of statistical hypotheses is the commonly accepted research method in the nomothetic view. (Burrell and Morgan, 1979) This thesis is based on the nomothetic view. Archival research and design science are the main research methodologies applied in this thesis. The nomothetic view of methodology supports the positivism view of knowledge as well as the realism view of ontology.

3.2 Theoretical perspective

Theoretical perspective is often called research paradigm. Hirscheim and Klein (1989) define paradigm as a professional community which shares same kind of beliefs about knowledge and the reality formulating it. The chosen paradigm therefore tells others how to interpret research results. Research paradigms have been studied mainly in the field of social sciences but also in natural sciences. Several researchers have created different classifications for research paradigms (e.g. Burrell and Morgan, 1979; Habermas, 1973; Orlikowski and Baroudi, 1991). The paradigms are always classified according to the views of reality and knowledge (the epistemological views presented above) but there might also be other classification criteria. The classification of Orlikowski and Baroudi (1991) is used in this thesis.

Orlikowski and Baroudi (1991) define three classification criteria for scientific paradigms. First is the structure of physical and social reality, second is the nature of knowledge, and third is the relationship between theory and practice. These criteria are used to evaluate different paradigms. This thesis is based on the positivist paradigm, whereas the others are interpretivist and critical. A summary of the paradigm classification can be seen in Table 3.1.

Table 3.1: Paradigm classification (Orlikowski and Baroudi, 1991).

	Positivist	Interpretivist	Critical
<i>Physical and social reality</i>	Objective Stable	Subjective Stable	Subjective Dynamic
<i>Knowledge</i>	Evaluating	Evaluating	Constructing
<i>Relationship between theory and practice</i>	Technical	Phenomena related Value-laden	Theory criticizes status quo

The positivist paradigm considers reality to be objective. Reality exists independent of humans, e.g. organizations have a structure and reality despite the members of the organization. Reality is also considered to be stable. Human actions do not affect the surrounding reality. Knowledge is empirically testable according to the positivist paradigm. Knowledge is mainly based on universal laws and it can only be obtained using appropriate methodologies. The positivist paradigm emphasizes hypotheses testing with statistical methods, and validity and reliability are considered extremely important. New knowledge is created by analysing reality with more accurate measures. The positivist paradigm sees the relationship between theory and practice as technical. Empirically tested universal laws can be directly adopted into practice. There are no values involved which could complicate the adoption. (Orlikowski and Baroudi, 1991)

Interpretivist and critical paradigms consider reality to be subjective, which means that reality depends on the observer. Interpretivist paradigm sees reality as stable, just like

positivist paradigm, but critical paradigm sees reality as dynamic, which indicates that reality changes constantly according to human actions. The interpretivist paradigm creates knowledge by subjectively understanding the processes in the surrounding reality. The adoption of theory into practice is always affected by the values and interests of the researcher as well as the phenomena itself. The critical paradigm creates knowledge by changing the processes and structures in reality and documenting the results of these actions. The purpose of the adopted theory is to cause changes in the practice. (Orlikowski and Baroudi, 1991)

3.3 Methodology

Methodology provides a framework for research methods and it is the next step of research design. Research methodologies can be classified in different ways, just like research paradigms. The most often used is the classification into quantitative and qualitative methods (e.g. Ahrens and Chapman, 2007; Anderson and Widener, 2007). Hesford et al. (2007) define nine different research methodologies for management accounting research, although it can be questioned whether they are methodologies or methods. Some of them are clearly methodologies and others just methods. The methodologies are: analytical, archival, case, experiment, field, framework, review, survey and other (simulation). van Aken (2004) separates methodology into three approaches: formal, explanatory and design. The methodologies used in this thesis are archival research and design science, and they incorporate different kind of quantitative research methods. Table 3.2 presents the methodologies, methods and empirical data of the individual publications.

Table 3.2: Research designs of individual publications.

Publication	Methodology	Research methods	Empirical data
Publication I	Archival research	Qualitative comparative analysis	Financial statements of 98 HSE-listed companies, observation period 2008-2012
Publication II	Design science	Model building Case study	Financial statements and press releases of three HSE-listed companies, observation period 1999-2013
Publication III	Archival research	Simulation	Financial statements of 98 HSE-listed companies, observation period 2008-2012
Publication IV	Design science	Model building Statistical analysis	Financial statements of 108 HSE-listed companies, observation period 2010
Publication V	Design science	Model building Case study	Financial statements of three HSE listed companies, observation period 2010-2012

Archival research

Moers (2007, 399) defines archival research as “an empirical study that uses archival data as the primary source of data applying quantitative methods to analyse these data”. Archival research is therefore defined only by the type of data used in the research. Archival, or secondary, data is data that has been originally collected for purposes other than academic research. The data has to be quantitative in order to use quantitative methods. Archival data can be public or confidential. Compensation data, bonus plan data and financial statement data are examples of public data. Confidential data can be third-party surveys or internal data of a company. Financial statement data is the form of secondary data used in this thesis. Press releases are also used as secondary data in publication II.

Archival data has its advantages as well as disadvantages. Five clear advantages can be distinguished. Firstly, the required data is already available, which eliminates the need for data gathering and fastens up the research process. Secondly, the existing third-party surveys are more extensive, which allows more research problems to be solved. Thirdly, larger samples and better response rates can be achieved. Fourthly, the data is considered clear without the fear of false observation. Fifthly, time-series and panel data is easily available which enables deeper analysis. (Moers, 2007; Zikmund et al., 2010)

There are also five disadvantages, although they are not as clear as the advantages. Firstly, management accounting practices are not publicly disclosed, which complicates the research. Secondly, because there are only few companies which disclose their management accounting practices, the company selection is not random. Thirdly, the disclosed data is mainly from a corporate level, which prevents some type of management accounting research. Fourthly, the confidential data can be hard to access, which may hinder the research process. Fifthly, easy-access databases cause uncritical use of data which skew the research results. (Moers, 2007)

Design science

Design science aims at building and evaluating solutions for practical problems. March and Smith (1995) consider the solutions as constructions, models or methods. Design science is often used in engineering and medical science, because these sciences are based on designing compared to natural sciences which are explanatory. Hevner et al. (2004) separate the design science approach from design science research because the aims of these practices differ. Design science research aims at adapting knowledge to solve previously studied problems, whereas the design science approach aims at providing solutions for unsolved problems using novel techniques. The design science approach is used in this thesis. There are also other terms for design science in the management literature. Kasanen et al. (1993) describes the phenomena as constructive research whereas Jönsson and Lukka (2007) see the phenomena as interventionist research. (van Aken, 2004)

The design science process can be divided into six phases (Figure 3.3). First, the problem is identified and motivation for the research is presented. The research proposal can be defined in this phase. Secondly, the objectives of the design are defined which indicates the requirements of problem-solving. Previous solutions are also scanned to see their opportunities. Thirdly, a solution is developed for the problem. Fourthly, the solution is applied to the problem and the problem is tried to be solved. Fifthly, the performance of the solution is evaluated and the solution is validated through theory. Finally, conclusions are drawn and the solution can be published. (Peffers et al., 2008)

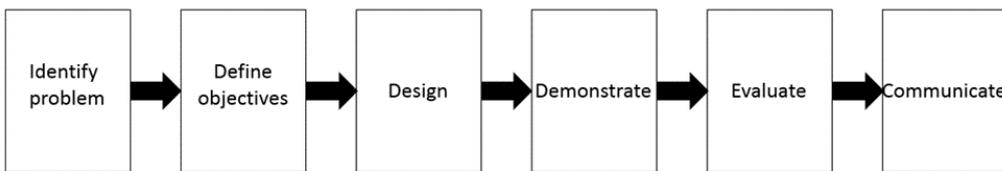


Figure 3.3: Design science process (Peffers et al., 2008).

3.4 Methods

The research of working capital management, as well as management accounting, uses a great variety of research methods (Hesford et al., 2007). The available methods are limited by the chosen methodology. Archival research limits research methods which use secondary data. Design science requires model building and evaluation of the solution. Five different research methods are used in this thesis: qualitative comparative analysis, model building, case study, simulation, and statistical analysis. The research methods used in the individual publications can be seen in Table 3.2. Different methods are used to achieve better insights into the studied phenomena.

Qualitative comparative analysis

Qualitative comparative analysis (QCA) is a mixed qualitative and quantitative research method developed by Charles Ragin (1987) for the research of political science, although nowadays it is used in all fields of science. QCA systematically compares cases with similar outcomes to identify similarities and differences in explaining variables. Cases are considered to be complex configurations of explaining variables. The systematic comparison is made using Boolean algebra which is the opposite of linear algebra, which is used in traditional statistical analysis. QCA is a nonparametric method which does not assume any particular probability distribution for the data. (Fizz, 2011; Greckhamer et al., 2008)

QCA is performed in four steps: 1) development of set-memberships, 2) formulation of the data matrix, 3) evaluation of consistency, and 4) logical reduction. The first step is the development of set-memberships. The studied variables are divided into explaining

variables and outcome variables. The variables are then calibrated into crisp-sets or fuzzy-sets. Crisp-sets are membership-sets with binary values of 0 or 1. Fuzzy-sets, on the other hand, can have continuous values between 0 and 1. A median value of the variable equals a membership score of 0.5 in the fuzzy-set, and it is also the limit when binary values are determined. The second step is to form a data matrix from the explaining variables. All possible combinations of the explaining variables are listed in the matrix according to their fuzzy or crisp values. The consistency, coverage and number of cases are also reported in the data matrix. (Fizz, 2011; 2007)

The third step is the evaluation of consistency. Consistency is calculated with a cross-case analysis of configurations and the outcome variable. The configurations, including the outcome variable, are divided by the total amount of configurations. The minimum level of consistency is defined, and configurations that do not fulfil the level are deleted. Ragin (2008) recommends 0.75 as the minimum level of consistency. The minimum number of cases is also defined and configurations with fewer cases are deleted. The fourth step is logical reduction, which is based on Boolean algebra. The result of the logical reduction is sufficient configurations which are empirically important (Ordanini et al., 2014). (Fizz, 2011; 2007; Ragin, 2006)

QCA has been used as the main research method in publication I. The entire QCA was performed using fs/QCA software (Ragin and Davey, 2014). The data was first calibrated into fuzzy-sets and after that the data matrix was formulated. The minimum level of consistency was set to 0.9 which is a bit higher than the recommended minimum, although Fizz (2011) uses higher limits as well (Ragin, 2008). The minimum number of cases was selected to be three, which is consistent with previous literature (Ordanini et al., 2014). In the fourth step, a total of 128 configurations was reduced to 21 sufficient configurations.

Statistical analysis

Mean value analysis has been used to evaluate the solution built using design science in publication IV. Mean value is the arithmetic average value of the data points. Comparison between the means of two populations is one of the most used statistical analyses. The analysis is performed in order to discover whether the populations are identical or not. Mean value analysis is often considered to be sufficient for this sort of testing, although comparison of variances is sometimes needed. (Hayter, 2013) The Mann-Whitney U test was also used in publication IV. The Mann-Whitney U test is a nonparametric statistical test used to test whether observations in separate groups are independent of each other. The U test compares the medians of the separate groups. Null hypothesis assumes the medians to be equal and alternative hypothesis assumes the medians unequal. (Black, 2013; Mann and Whitney, 1947)

Descriptive statistics are presented in publications I and IV which use statistical methods. The purpose of descriptive statistics is to describe raw data in an easily understandable and interpretable form. Black (2013) includes 16 statistical measures in descriptive

statistics. He defines three groups for different kinds of descriptive statistics: central tendency, variability and shape. Hayter (2013) considers that descriptive statistics are measured using seven measures: mean, median, trimmed mean, mode, variance, quantiles and coefficient of variance. The descriptive statistics selected for the publications in this thesis are mean, median, standard deviation and percentiles. Mean is the arithmetic average value of observations, median is the middle value of observations, standard deviation describes the amount of variation in observations and percentiles depict the highest value under certain percentile. (Hayter, 2013)

Model building

Model building is used in the design science approach to construct a solution for a problem. Model building differs from pure analytical modelling which focuses on portraying processes using deductive logic (Demski, 2007). Model building in design science is based on a problem noticed in the real world (van Aken and Romme, 2009). Model building follows the first four steps of design science which were presented in Figure 3.3. Model building begins by defining the problem, which is different in publications II, IV and V. The problem is defined in the publications using the gap visible in previous literature. The built model is constructed to answer the defined problem. Publication II presents the model in the form of a strategy matrix, whereas models in publications IV and V are measures. All models developed and presented in this thesis are aimed at supporting managerial decision-making. (Peffer et al., 2008; van Aken, 2004)

Simulation

Simulation is a method to imitate the behaviour of processes, and it is a combination of induction and deduction (Axelrod, 1997; Banks et al., 2001). Simulation can be used to gain information about real life processes which cannot be experimented directly (Banks, 2009). Simulation is based on a simple model built on observations and existing literature. Simulation models the behaviour of the built model (Gilbert and Troitzsch, 2005). Even the most complex behaviour can be divided into simple variables (Simon, 1996), and there is not only one way to perform simulation as there are several types of simulation methods (Dooley, 2002).

Simulation in publication III was conducted using the FAM model. Variables of the FAM model were identified and mean values for the variables were calculated using an empirical dataset. Four simulations were made, and each time one of the variables in the FAM model was altered. The alterations were 80 percent and 120 percent of the average value. The alterations present optimistic and pessimistic scenarios of varying values.

Case study

Yin (2009) defines case study as an analysis of a person, group or event. Case study is often used to examine complex decision-making situations because it provides a deep

context-specific understanding (Järvensivu and Törnroos, 2010). Case studies can be categorized into three different types: explanatory, exploratory and descriptive. They can also be divided into single case studies and multiple-case studies. The case study method used in publications II and V is exploratory multiple-case study. Multiple-case study allows the phenomena to be studied within each case and across cases. Exploratory case study evaluates a situation where several potential outcomes exist. Exploratory case study can be done on a single case level but similarities and differences can also be identified between the cases. (Yin, 2009) The case studies in publications II and V were performed to evaluate the solutions built using design science approach.

3.5 Data collection

The empirical data used in this thesis consists of the financial statements of Finnish companies listed in the OMX Nordic Helsinki (Helsinki Stock Exchange (HSE)). Publication II also exploits the press releases of selected companies. HSE was chosen due to the heterogeneity of the listed companies and the public accessibility of the data. HSE currently consists of 124 companies in 10 branches. Table 3.3 presents the division of the branches. The sizes of the companies vary dramatically from small companies to large multinational companies. Financial companies, which present 13% of the companies, are excluded from the data sample. The capital structure of financial companies differs from other companies, and therefore working capital cannot be calculated similarly to those companies.

Table 3.3: Division of branches in HSE.

Branch	Count	Portion
Basic materials	12	10%
Consumer goods	14	11%
Consumer services	11	9%
Financials	16	13%
Health care	5	4%
Industrials	44	35%
Oil & gas	1	1%
Technology	18	15%
Telecommunications	2	2%
Utilities	1	1%
	124	100%

The financial statement data is collected directly from the financial statements of the companies. The collection has been performed manually by the author herself. Cole et al. (2009) have questioned the comparability of financial statements. They claim that the International Financial Reporting Standards (IFRS) ease the comparison but there are still differences in the financial statements which may hinder comparison. All of the companies in the data are obligated to produce their financial statements according to the

IFRS, and the companies also follow the Finnish regulations for financial statements. The author sees that these two procedures assure the comparability of the data.

Publications I and III

Publications I and III use the same data set. The data consists of 98 companies listed in HSE. The observation period covers years 2008-2012 which implies a total amount of observations of 490. The selected companies have been listed in HSE for the entire observation period and they have not been merged into other companies. Neither have the companies made any major acquisitions which might distort the observations and their comparability. The data was collected during summer 2013 which indicates that all the exploited financial statements have been adjusted. Table 3.4 provides descriptive statistics of the data set.

Table 3.4: Descriptive statistics of publications I and III.

N=490	Mean	Std. Deviation	Perc. 10	Median	Perc. 90
DIO	43	42	0	38	94
DSO	54	28	23	50	87
DPO	27	21	9	23	43
CCC	70	46	20	63	131
OCA	62	63	15	44	127
OCL	90	55	35	82	154
FFC	-28	70	-101	-33	39
ROI	5.3 %	23.7 %	-13.7 %	7.6 %	23.6 %
EBITDA%	8.8 %	10.5 %	-10.0 %	8.2 %	20.5 %
FA%	57.8 %	57.7 %	15.2 %	42.0 %	105.2 %
B	14	12	6	11	23

Publication II and V

The data in publications II and V consists of the financial statements and press releases of three companies listed in HSE. The observation period in publication II extends from 1999 to 2013 and in publication V from 2010 to 2012. The studied companies are Nokia, Stora Enso and Stockmann. Basic facts about the companies can be seen in Table 3.5. The selection of the companies was based on four criteria. The first criteria was the membership of HSE. The dataset needed to be based on companies listed in HSE since, at that point, the results of publication I were validated only with companies in HSE. The second criteria was that the selected companies had to be from different branches of HSE. The third criteria was internationalization. The selected companies should be multinational to better reflect the economic conditions. The fourth criteria was profitability. The selected companies were required to have similar profitability conditions which in this case was a declining trend.

Table 3.5: Case companies of publication II and V.

Case company	Nokia	Stora Enso	Stockmann
Branch	Technology	Basic materials	Consumer services
Sales (1,000 €)	> 50,000	> 15,000	> 2,000
Employees	> 50,000	> 25,000	> 15,000

Nokia is the largest of the case companies and it operates in the technology branch. Nokia is a multinational technology company and it had four major business lines during the studied period: network and infrastructures, maps and location services, technology development and licensing, and mobile devices. Stora Enso is the leading paper and pulp manufacturer in Europe and it operates in the basic materials branch. Stora Enso also has multinational operations in several countries and the business is focused on wooden constructions and packaging materials beside pulp and paper. Stockmann is a multinational retail company and it operates in the consumer services branch. Stockmann has focused on department stores and fashion chain stores.

Publication IV

The data in publication IV consists of the financial statements of 108 companies listed in HSE in 2010. The selected companies include companies from all other branches except the financial branch. The observation period has been limited to one year because the aim of empirical testing in the publication is only to validate the modified measure. Table 3.6 provides descriptive statistics of the data in publication IV.

Table 3.6: Descriptive statistics of publication IV.

N=108	Mean	Std. Deviation	Perc. 10	Median	Perc. 90
ROI	9 %	18 %	-8 %	10 %	26 %
DIO	47	56	0	40	100
DSO	58	33	23	52	99
DPO	32	31	10	25	54
DAO	13	27	0	1	37
CCC	73	63	20	66	135
mCCC	60	61	-1	57	122

4 Research contribution

The results of this thesis are presented in this chapter. First, the results are reviewed through the objectives of this thesis. The objectives are to examine the management of financial working capital and to develop the measures of financial working capital. Secondly, the individual publications included in the thesis are summarized.

4.1 Financial working capital management

The first objective of this thesis is to examine financial working capital management. The objective is divided into two research questions: 1) How can financial working capital be managed?, and 2) How can financial working capital management be used to improve profitability? The objective is approached from three different perspectives in this thesis. Publication I responds to the first question while it defines financial working capital and provides strategies for financial working capital management. Publication II contributes to both research questions since it offers a strategy matrix which presents the evolution of the strategies presented in publication I and observes profitability related to the strategies. Finally, publication III answers the second research question and studies the effects of financial working capital management on profitability.

Publication I

The aim of publication I is to define financial working capital and present the logic behind it. The definition also includes the calculation and definition of measures which will be presented in chapter 4.2. The main aim of the publication is to study financial working capital management strategies. The definition is based on the FAM model (Marttonen et al., 2013a) and the strategies are studied with QCA. Publication I contributes to research question 1 as it presents financial working capital management strategies.

Financial working capital can be defined as current assets less current liabilities which are not tied into operational processes. Therefore financial working capital mainly includes cash and short-term bank debts. Financial working capital is affected by several variables because it includes items from the balance sheet. The FAM model, which includes financial working capital as a component (called residual in the model), gives a foundation for the variables which affect financial working capital. Figure 4.1 presents the variables which affect financial working capital directly. Operational working capital, fixed assets and relative profitability have an impact on financial working capital. Figure 4.1 also shows the underlying variables which affect financial working capital through the three main variables.

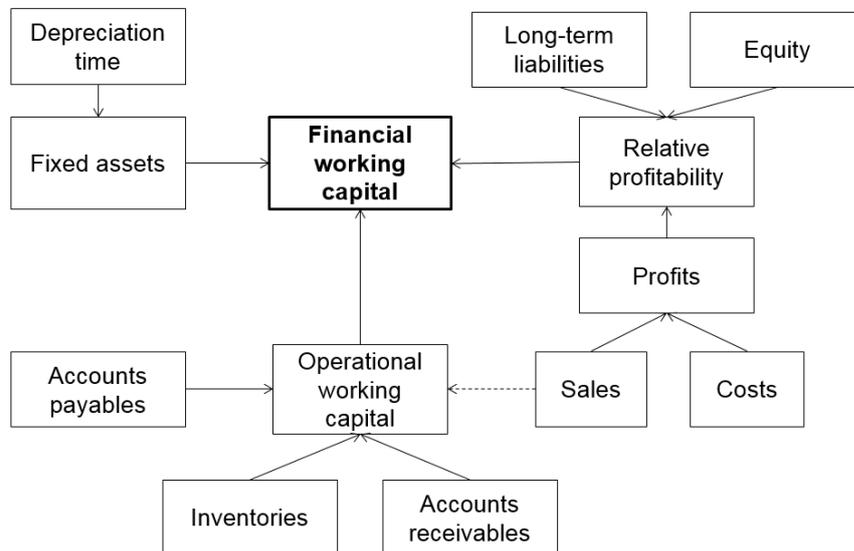


Figure 4.1: Variables affecting financial working capital.

Financial working capital management primarily aims at maximizing liquidity as financial working capital presents the liquidity situation of a company. Table 4.1 presents financial working capital management strategies formulated using QCA. These strategies reach for the highest possible financial working capital, which will provide the highest liquidity. The results indicate that there are eleven strategies that can be used to manage financial working capital. The strategies are based on the variables presented in Figure 4.1. The strategies can be divided into three groups based on the profitability requirements. The first group consists of five strategies which do not require good profitability, the second group also includes five strategies but in these strategies good profitability is a necessity, and the third group has only one strategy which is suitable for companies with good return on investment (ROI) but weak earnings before interests, taxes, depreciations and amortizations (EBITDA%). The table should be read so that the upward arrows present values that are above median and downward arrows present values below median. The median values used in the publication can be found in Table 3.4, and they should always be included when the table is used.

Financial working capital management strategies can be used in managerial decision-making. The strategies in Table 4.1 are easy to adopt when a few principles are kept in mind. A suitable strategy for the company has to take the profitability conditions of the company into consideration. A limit to good profitability in the publication has been set to 7.6% when ROI is calculated and 8.2% when EBITDA% is used. The companies also need to realize the level of fixed assets when the strategy is defined. Companies operating in capital intensive industries have limited opportunities to reduce their fixed assets, and therefore these companies should choose a strategy that works best with a high level of

fixed assets. The level of operational working capital, on the other hand, is the most volatile factor in the strategies. Companies may even have to adjust their operational working capital to meet the requirements of the chosen strategy.

Table 4.1: Financial working capital management strategies.

	<i>Strategies</i>										
	1a	1b	1c	1d	1e	2a	2b	2c	2d	2e	3
<i>Operational working capital</i>											
DIO	▼	▼	▲	▼		▼	▲	▼		▼	▲
DSO	▼		▼		▼	▲	▼	▼		▼	▼
DPO	▼	▲	▼	▼	▲			▼	▼	▼	▼
<i>Fixed assets</i>											
FA% B		▼	▲	▼	▼	▼	▼	▼	▼	▼	▼
	▼	▼	▼	▲	▲	▼	▼		▼	▲	
<i>Profitability</i>											
ROI	▼	▼	▼			▲	▲	▲	▲	▲	▲
EBITDA%	▼	▼		▼	▼	▲	▲	▲	▲		▼

Publication II

The aim of publication II is to create a tool for financial working capital management. The created tool is a strategy matrix. The matrix is developed using design science and it is tested with three case companies. Publication II primarily contributes to research question 1 as it presents a tool for financial working capital management. Research question 2 is reviewed as the analysis in the publication also considers profitability conditions and their relation to financial working capital in the case companies.

FOCAL matrix is a strategy matrix for financial working capital management. The matrix has two dimensions: financial working capital management strategies and time. The management strategies are presented on the y-axis and time in years is presented on the x-axis. The objective of the matrix is to present the evolution of financial working capital management strategies by time. The matrix has been developed as a tool for managers to examine the changes in financial working capital management strategies. The tool can also be used for benchmarking in which case the matrix can include information on several companies.

FOCAL matrix is designed to be quick and easy to use. First, the strategies are defined using Table 4.1 and Table 3.4 as a guideline for strategy selection. Companies may first select a suitable strategy and then find the correct position in the matrix. All companies do not follow the financial working capital management strategies presented in Table 4.1, in which case they cannot find a position in the matrix. The matrix will enable the

companies to improve their financial working capital management strategies to the direction which will best support their liquidity and profitability. An example of the FOCAL matrix is presented in Figure 4.2.

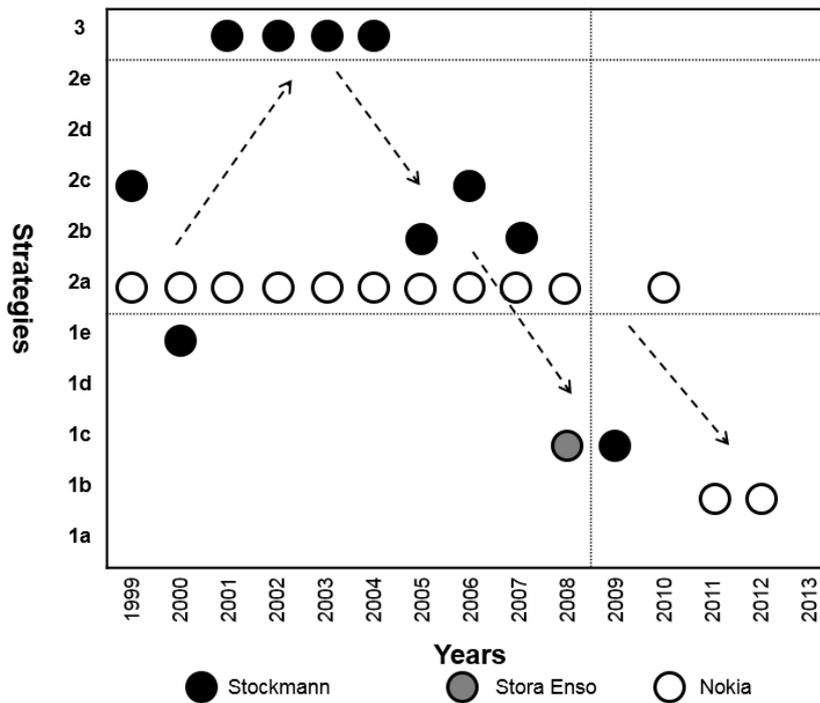


Figure 4.2: FOCAL matrix.

The FOCAL matrix in Figure 4.2 presents the financial working capital management strategies of the case companies used in the testing. The matrix has been divided into six sections with dotted lines. The horizontal lines divide the three strategy groups which were formulated by profitability requirements. The vertical line marks the financial crisis which occurred in Finland during the years 2008-2009. The vertical line should be defined by the companies and it should represent major changes in the industry or in the economy. The evolution of the strategies has been drawn with dashed arrows.

The results indicate that companies change their financial working capital management strategies according to their financial situation. The case companies had a declining trend in profitability during the observation period, and the matrix shows that the companies changed their financial working capital management strategies towards strategies that do not require high profitability. The results also imply that companies (e.g. Stora Enso in the matrix) do not always follow the predetermined financial working capital

management strategies even though their financial working capital management is efficient.

Publication III

The aim of publication III is to study the effects of financial working capital management on profitability. The effects are studied using the simulation method. Publication III contributes to research question 2 as it simulates how changes in financial working capital affect relative profitability.

The simulations made in the publication are based on the FAM model (see Equation 2.1). Financial working capital is placed in the denominator in the model and therefore the equation implies that relative profitability will increase when financial working capital is reduced. The simulations confirm this mathematical finding and add more viewpoints to the results. Relative profitability will improve when financial working capital is reduced but the effect can be enhanced with other variables. Reduction of fixed assets and increase of earnings will amplify the reduction effect of financial working capital on profitability. Increase in the average depreciation time and decrease in the cycle time of operational working capital will also enhance the effect but not to the same extent. The best results would be achieved with adjustments to all variables.

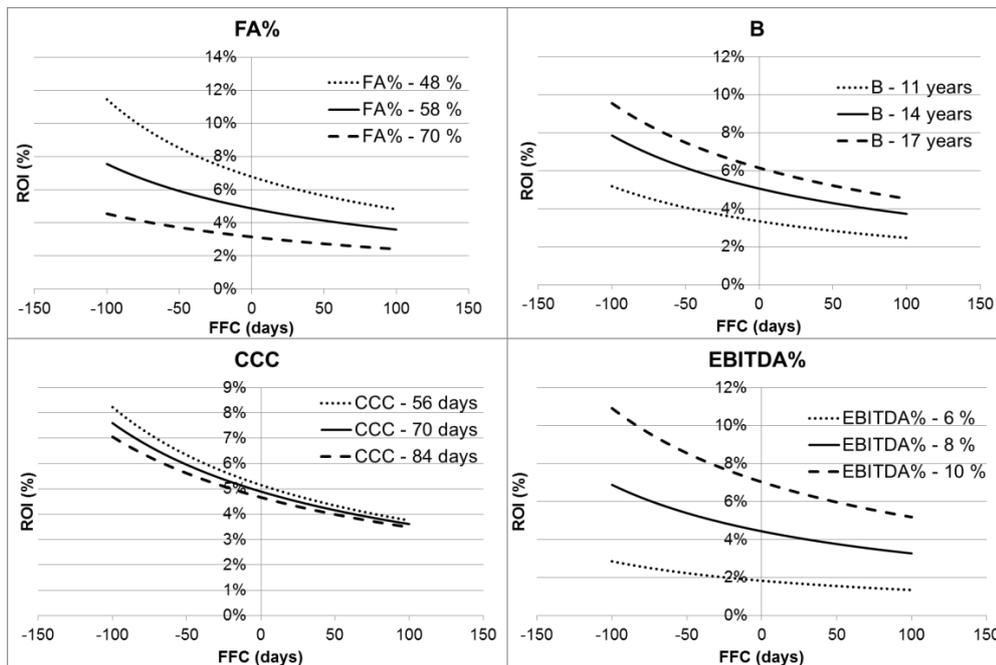


Figure 4.3: Simulation results.

Financial working capital should be minimized for the best possible relative profitability. However, this affects the liquidity of the company negatively since a good amount of financial working capital represents a solid liquidity position. Reductions only in financial working capital are often not enough if companies seek good relative profitability, and the relative amount of fixed assets should also be reduced. Investments in fixed assets should be limited and alternative solutions should be sought (e.g. leasing) to improve profitability. Increase in the average depreciation period requires changes in fixed assets as well. Increased earnings will increase profitability, and therefore reducing costs and developing cost structures are good starting points for better profitability. These actions cannot be done in all industries, and therefore adjustments in financial and operational working capital are important when striving for good profitability.

Summary

The examination of financial working capital was the first objective of this thesis. The objective was divided into two research questions, and the first question concerned the management of financial working capital. The results of this thesis show that there are several strategies that can be used in financial working capital management. The strategies are based on three different factors related to financial working capital. The factors are operational working capital, fixed assets and earnings. Successful management of financial working capital requires actions concerning all of the factors. The results also indicate that companies may change their chosen financial working capital management strategies according to their financial situation. Companies can use FOCAL matrix as a tool in financial working capital management.

The second research question focused on the effects of financial working capital management on profitability. The results indicate that financial working capital management is related to profitability. Profitability can be improved by minimizing financial working capital. The improvements can be amplified with reductions of fixed assets. These results imply that financial working capital management strategies should be chosen properly to take profitability into consideration, and all factors affecting the strategy have to be considered. The results also reveal that companies are able to change their financial working capital management strategies when their profitability changes.

4.2 Financial working capital measures

The second objective of this thesis is to develop measures of financial working capital. The objective is divided into two research questions (RQ 3 and 4): 3) How can financial working capital be measured?, and 4) How can financial working capital measures be improved?. Publication I mainly contributes to the third research question by defining financial working capital and its measure. Publication IV is more focused on the fourth research question as it improves the measurement of working capital. Publication V answers both research questions 3 and 4 by defining the limit between financial and operational working capital more precisely and improving both measures.

Publication I

The aim of publication I is to define financial working capital and provide a measure for financial working capital. The measure is derived from the FAM model (see Equation 2.1) which considers both financial and operational working capital and fixed assets when relative profitability is modelled. Financial working capital is presented in the FAM model as residual and it is not specifically considered as financial working capital.

Financial flow cycle (FFC) is the measure derived from the FAM model. FFC presents financial working capital as a cycle time. The cycle time approach is novel in the field of financial working capital and liquidity, whereas it is normal in the field of operational working capital as presented in chapter 2.4. The liquidity measures are traditionally ratios (e.g. current and quick ratio), and Fleuriet et al. (1978) have defined financial working capital in absolute monetary value. The cycle time approach is beneficial especially for managers, because it provides an easy look into the liquidity situation of the company. FFC provides information on how many days current assets will stretch after current liabilities are covered. This information is crucial in situations where there are problems with sales.

$$FFC = OCA - OCL \quad (4.1)$$

$$OCA = \frac{(\text{Current assets} - \text{Inventories} - \text{Accounts receivables}) \times 365}{\text{Net Sales}} \quad (4.2)$$

$$OCL = \frac{(\text{Current liabilities} - \text{Accounts payables}) \times 365}{\text{Net Sales}} \quad (4.3)$$

Equation 4.1 shows the calculation of FFC. FFC consists of two components: other current assets (OCA) and other current liabilities (OCL). OCA is presented in Equation 4.2 and OCL is presented in Equation 4.3. OCA includes current assets less inventories less accounts receivables, whereas OCL includes current liabilities less accounts payables. The components include all other items of current assets and current liabilities except the items related to operational working capital. The items considered as operational working capital are defined using the cash conversion cycle presented by Shin and Soenen (1998) in Equation 2.8.

Publication IV

The aim of publication IV is to extend CCC to include received advance payments. The publication aims at testing whether the previously defined limit between operational and financial working capital could be shifted. The design science approach will be used to modify CCC. Publication IV contributes to research question 4 as it modifies CCC, which will affect financial working capital measures.

CCC measures the time operational working capital is tied up in days as can be seen in Figure 4.4. Operational working capital (and CCC) includes three components: inventories, accounts receivables and accounts payables. Nevertheless, there are e.g. received advance payments which are cash movements based on operations, and therefore they should be included in operational working capital. Figure 4.5 presents how received advance payments can reduce the cycle time of operational working capital. Companies do not have to wait as long to receive their cash as they would if prepayments would not be used. Advance payments are one term of payment and they should be treated as all other trade credit terms. Accounts payables can be seen as an item to finance inventories, whereas advance payments are an alternative for accounts receivables.

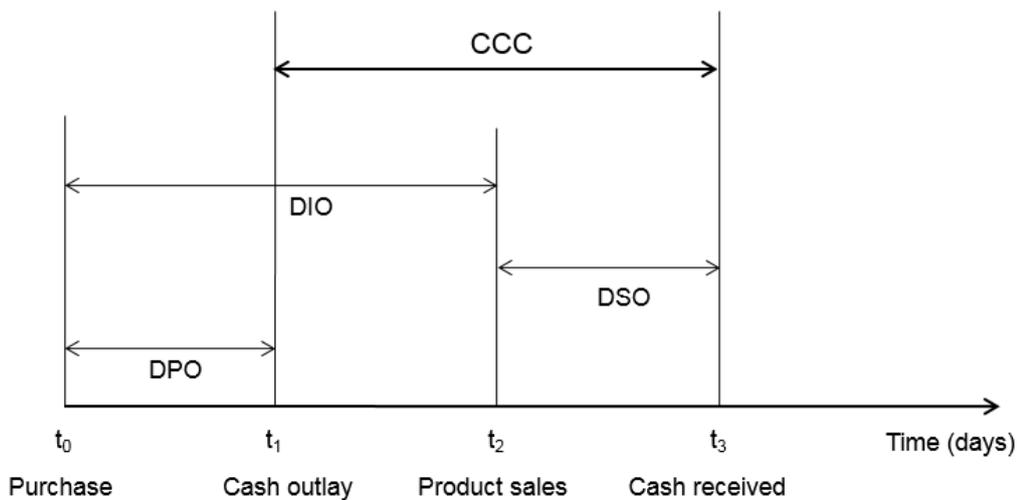


Figure 4.4: Cash conversion cycle (Richards and Laughlin, 1980).

The modified cash conversion cycle (mCCC) is based on CCC presented by Shin and Soenen (1998) in Equation 2.8. Received advance payments form a new component which will be reduced from CCC because it will free the tied up capital. The component is called days of advance payments outstanding (DAO) and it is calculated analogously to other components of CCC. DAO is presented in Equation 4.4 and mCCC can be seen in Equation 4.5.

$$DAO = \frac{\text{Advance Payments} \times 365}{\text{Net Sales}} \tag{4.4}$$

$$mCCC = CCC - DAO \tag{4.5}$$

The results indicate that received advance payments reduce the cycle time of operational working capital and therefore increase the efficiency of operational working capital management. The cycle time of operational working capital was reduced by 13 days on average when mCCC was used instead of CCC (see Table 3.6). However, there was great variance between industries because prepayments are not used in all industries. Extensive use of advance payments can be found in three industries: project, ICT and publishing. Advance payments reduce the cycle time of operational working capital in project industry from 111 days to 74 days, which indicates that the cycle time of advance payments is 37 days. The cycle time of advance payments in the ICT industry is 55 days and 26 days in the publishing industry. These results show that operational working capital management efficiency can be notably improved when received advance payments are considered as part of operational working capital instead of financial working capital.

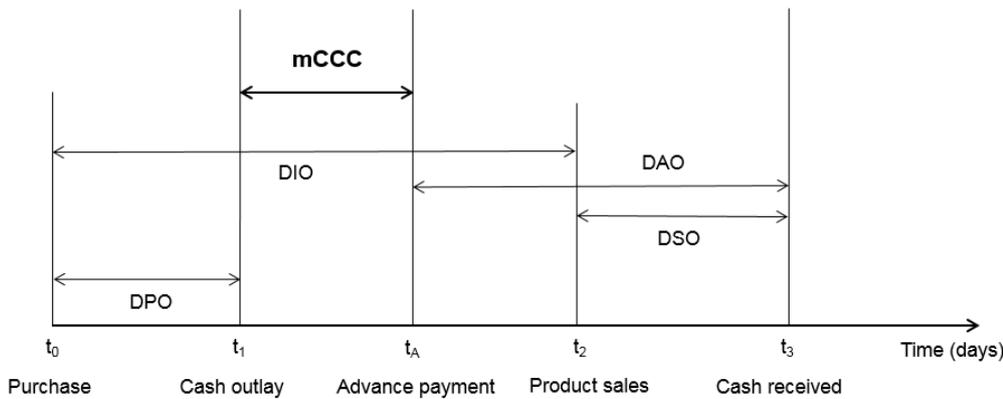


Figure 4.5: Modified cash conversion cycle.

Publication V

The aim of publication V is to modify measures of financial and operational working capital to clearly separate the financial and operational components. The research design approach will be adopted in the modifications. The publication contributes to research

questions 3 and 4 as it improves measures of financial and operational working capital and therefore presents a measure for financial working capital.

Net working capital can be divided into operational and financial working capital. Operational working capital is tied up in operational activities, whereas financial working capital includes items needed to finance operational working capital and other daily business activities. The definitions presented earlier in this thesis consider that operational working capital includes inventories, accounts receivables and accounts payables, whereas all other items of current assets and current liabilities are financial working capital. However, publication IV introduces the idea that operational working capital could also include items that are traditionally considered financial because they are related to operational processes. Figure 4.6 presents a detailed division of current assets and current liabilities to operational and financial working capital. Paid and received advance payments, accrued and deferred income as well as reserves should be considered as operational working capital instead of financial working capital.

Cash Conversion Cycle		Modified Cash Conversion Cycle	
+	-	+	-
Inventories Accounts receivables	Accounts Payables	Inventories Accounts receivables Paid advances Accrued income	Accounts payables Received advances Deferred income Reserves
Financial Flow Cycle		Modified Financial Flow Cycle	
+	-	+	-
Other Current Assets	Other Current Liabilities	Cash Securities/Investments Loan receivables Tax receivables Other receivables	Loan amortizations Tax payables Other payables

Figure 4.6: Original and modified working capital measures.

The modified cash conversion cycle (MCCC) consists of two components: days of operating assets outstanding (DOA) and days of operating liabilities outstanding (DOL). The components include several items which can be seen in Figure 4.6. The calculation of MCCC is presented in Equation 4.6, the calculation of DOA can be seen in Equation 4.7 and DOL is calculated in Equation 4.8.

$$MCCC = DOA - DOL \quad (4.6)$$

$$DOA = \frac{(Inventories + Accounts Receivables + Paid advances + Accrued Income) \times 365}{Net Sales} \quad (4.7)$$

$$DOL = \frac{(Accounts Payables + Received Advances + Deferred Income + Reserves) \times 365}{Net Sales} \quad (4.8)$$

The modified financial flow cycle (MFFC) also includes two components: days of financial assets outstanding (DFA) and days of financial liabilities outstanding (DFL). The items included in the components can be seen in Figure 4.6. There is an item called other receivables in DFA which consists of minor receivables which companies report but do not specify. The same policy also applies to other payables. MFFC is presented in Equation 4.9, DFA is calculated in Equation 4.10 and Equation 4.11 shows DFL.

$$MFFC = DFA - DFL \quad (4.9)$$

$$DFA = \frac{[Cash + Investments + (Loan + Tax + Other)Receivables] \times 365}{Net Sales} \quad (4.10)$$

$$DFL = \frac{[Loan amortizations + (Tax + Other)Payables] \times 365}{Net Sales} \quad (4.11)$$

The results of the empirical testing indicated that the original and modified measures present a different image. The difference between the measures varied between 5 and 62 days depending on the company. The results show that there is no clear direction for the change. The cycle time of financial working capital may increase or decrease depending on the company as well as the capital structure of the industry. Advance payments and reserves are not used in all industries, and therefore the difference between the measures can be minor. Companies employing the specified items can see the actual cycle time of operational and financial working capital and manage them properly. The modified measures also show the interest groups a more detailed view of the efficiency of working capital management.

Summary

The second objective of this thesis was to develop measures of financial working capital. The objective was divided into two research questions, and the first (RQ 3) question considered the measurement of financial working capital. Financial working capital can be measured with financial flow cycle (FFC), which is a measure derived from the residual in the FAM model. FFC presents financial working capital as a cycle time which makes it easy to interpret. The cycle time indicates how many days the company can operate with current assets after it has covered current liabilities. FFC includes all other current assets except inventories and accounts receivables and all other current liabilities except accounts payables which are included in operational working capital. The cycle time of financial working capital can also be measured with the modified financial flow cycle (MFFC) which only includes specified financial items.

The fourth (RQ 4) research question considered the improvements of financial working capital measures. FFC can be improved to only consist of financial items, and operational items can be shifted to operational working capital measures. The improved measure MFFC provides a more detailed look into financial working capital compared to FFC, and therefore managers should use it in their decision-making. The improvements in financial working capital measures also affect operational working capital measures. MFFC should therefore be used together with MCCC instead of CCC for accurate results.

4.3 Summary of individual publications

Five complementary publications have been included in this thesis to present the research concerning financial working capital management. The thesis had two objectives: to examine financial working capital management and to develop measures for financial working capital. The first objective was divided into two research questions: 1) How can financial working capital be managed? and 2) How can financial working capital management be used to improve profitability?. Research question 1 was answered in publications I and II as they presented strategies and tools for financial working capital management. Publications II and III addressed research question 2 when they presented that financial working capital can be reduced to improve profitability and that the financial working capital management strategy can be changed.

The second objective of this thesis, which was to develop measures for financial working capital management, was also divided into two research questions: 3) How can financial working capital be measured? and 4) How can financial working capital measures be improved?. Publications I and V contribute to research question 3 as they present measures for financial working capital. Research question 4 is addressed in publications IV and V which provide modifications for financial and operational working capital measures. Table 4.2 presents a summary of the results of the individual publications.

Table 4.2: Summary of the publications in the thesis.

	Publication I	Publication II	Publication III	Publication IV	Publication V
Title	<i>Defined strategies for financial working capital management</i>	<i>The dynamics of financial working capital management strategies</i>	<i>Circulate your idling assets</i>	<i>Modifying the cash conversion cycle: revealing concealed advance payments</i>	<i>Improving working capital measures for today's needs</i>
Objective	To define financial working capital and present management strategies.	To create a management tool and evaluate the evolution of financial working capital management strategies.	To study the effects of financial working capital on profitability.	To extend cash conversion cycle to include received advance payments.	To modify working capital measures to separate financial and operational accounting items.
Methodology	Archival	Design science	Archival	Design science	Design science
Data	Financial statements of 98 HSE-listed companies	Financial statements and press releases of 3 HSE-listed companies	Financial statements of 98 HSE-listed companies	Financial statements of 108 HSE-listed companies	Financial statements of 3 HSE listed companies
Research question	RQ1 RQ3	RQ1 RQ2	RQ2	RQ4	RQ3 RQ4
Main results	Financial working capital can be managed with different strategies.	Management strategies evolve according to the financial situation and FOCAL matrix can be used to study the strategies.	Profitability can be improved by decreasing the cycle time of financial working capital.	Advance payments should be included in operational working capital instead of financial working capital.	Modified measures provide a more manageable look on working capital management.

5 Conclusions

This chapter illustrates the theoretical and practical contribution of this thesis. Five distinctive theoretical contributions can be found in the findings of this thesis. The contributions extend and advance the current academic knowledge on financial working capital management. Three managerial implications can be defined through the results of this thesis. The managerial implications enable managers to exploit financial working capital management in strategic decision-making. The research conducted in this thesis is also evaluated in this chapter. The evaluation is made with guidelines presented for positivistic research. Finally, recommendations for further research are presented to inspire future research on financial working capital management.

5.1 Theoretical contribution

Firstly, this thesis provides an introduction to financial working capital management. Fleuriet et al. (1978) have originally presented a dynamic working capital model, which separated financial and operational working capital. The definition of financial working capital in this thesis is based on the ideas of Fleuriet et al. (1978) and Marttonen et al. (2013a). The research on financial working capital management is scarce and focused solely on the management of the dynamic working capital model (e.g. De Medeiros, 2005; Guimarães and Nossa, 2010). This thesis offers a detailed look into the phenomena of financial working capital management. The result of research question one offered financial working capital management strategies and support tools, which can be also used in cooperation with the management tools created for the dynamic working capital model (e.g. Marques and Braga, 1995). This thesis also approaches financial working capital management from a managerial point of view instead of a theoretical point of view adopted in previous studies (e.g. Nascimento et al., 2012).

Secondly, this thesis provides a new viewpoint to corporate finance and financial management. Cash and debt management are often studied independently in literature on financial management (e.g. Fee et al., 2014; Song and Lee, 2012). This thesis provides a joint view of a company's current assets and liabilities because financial working capital considers both current assets and liabilities not tied up in operational working capital. Financial working capital also presents the liquidity situation of the company, which is also a concern in financial management (e.g. Isshaq and Bopkin, 2009). The result of research question three introduced cycle time measures for financial working capital, which provide supportive information about a company's liquidity situation in addition to traditional ratios (e.g. Petersen and Plenborg, 2012). The result of research question two, which implies that profitability can be improved by reducing the cycle time of financial working capital, supports the view that aggressive liquidity management will improve profitability (e.g. Wang, 2002), even though there has been a debate about the non-linear nature of the relationship between liquidity and profitability (e.g. Dash and Ravipati, 2009; Myers and Rajan, 1998).

Thirdly, this thesis advances knowledge on financial flexibility. Financial management literature has been focusing on financial flexibility after the financial crisis (e.g. Denis, 2011). Financial flexibility can be maintained with optimal cash holdings, capital structure and dividend policy (e.g. Bancel and Mittoo, 2011; Gryglewicz, 2011). The results of research questions one and three introduce measures and management strategies for financial working capital, which can be used to provide a holistic view of the liquidity situation of the company, and financial working capital could therefore be called as an indicator of financial flexibility. However, there are several corporate policies related to financial flexibility decisions (e.g. Bonaimé et al., 2014; Lie, 2005), which cannot be indicated with financial working capital.

Fourthly, this thesis adds a new dimension to working capital management literature. Working capital management research has mainly focused on operational working capital management, which consists of several different research streams (Viskari et al., 2011a). Financial working capital management has been previously studied mainly from the financial management view, which is related to the dynamic working capital model (e.g. Marques and Braga, 1995; Souza, 2003). Financial working capital management has previously been related to asset management only in few studies (e.g. Marttonen et al., 2013a; 2013b), which have concerned the FAM model. Asset management literature is quite often focused only on fixed assets (e.g. El-Akruti and Dwight, 2013; Ojanen et al., 2012), and therefore this thesis aims at providing a new aspect to asset management literature and especially to working capital management literature. Prior literature on working capital management has been clearly divided into net working capital management and operational working capital management (e.g. de Almeida and Eid Jr., 2014; Deloof, 2003). The results of research questions one and two indicate how financial working capital and operational working capital have a clear connection and why they should both be separately noted in management decisions.

Fifthly, this thesis verifies the FAM model. Marttonen (2013) describes the FAM model in her doctoral thesis and suggests testing the model with different data because her data was limited to maintenance companies. The FAM model has also been used in other publications but the focus has mainly been on maintenance (e.g. Marttonen et al., 2013a). The FAM model has been used as the foundation of this thesis and it has been tested with empirical data consisting of companies listed in the Helsinki Stock Exchange. The results of research question two indicate that the FAM model provides reliable results when simulations are made with broader data in publication III. The evidence gathered in this thesis therefore shows that the FAM model can be used also for other companies and not just industrial maintenance companies.

5.2 Managerial implications

Firstly, this thesis introduces the phenomena of financial working capital management. Companies have started to reduce the cycle time of operational working capital after the financial crisis. Several companies are aiming for a negative cycle time, but it should be

kept in mind that optimizing operational working capital may lead to problems in financial working capital. Financial working capital should be managed jointly with operational working capital to gain financial flexibility and improve profitability. Financial working capital observes both current assets and liabilities, and therefore companies are able to make strategic decisions based on the complete picture instead of deciding separately on cash holdings or bank debts.

Secondly, this thesis presents possible management strategies for financial working capital. Financial working capital management is affected by several variables. This thesis connects seven variables to financial working capital, but there are many more which also have an effect. These variables should be noticed when decisions on financial working capital are made, because the best strategy for financial working capital management depends on those variables. Financial working capital can be maximized for best liquidity, or the level of financial working capital and the affecting variables can be adjusted to improve profitability. The managers' dilemma, which results from balancing between liquidity and profitability, cannot be solved with financial working capital but a good management strategy can help maintain the chosen position.

Thirdly, this thesis provides tools for financial working capital management. Measures for financial working capital management are presented in this thesis to enable the definition of financial working capital and reveal the liquidity situation of a company. The financial working capital measures are cycle times, which present how many days a company can operate after current liabilities are covered. This provides companies with more practical information on their liquidity situation than traditional ratios which should be benchmarked to similar companies to determine the appropriate level. This thesis also offers a FOCAL matrix which can be used to study the evolution of a company's financial working capital management strategies. The matrix shows the current and past strategies but companies can also define goals for the future. The goals can be set by analysing their own business and by benchmarking similar companies.

5.3 Evaluation of the research

Research can be evaluated with several different frameworks. The evaluation framework is grounded to the chosen theoretical perspective which guides the selection of methodology and methods. The theoretical perspective of this thesis is positivistic and it is described more closely in chapter 3.2. The evaluation of positivistic research can be divided into four categories: internal and external validity, reliability and objectivity. All these should be evaluated when the suitability of methodology and methods is determined. The four categories are discussed next in more detail.

Internal validity studies the extent to which independent variables explain the dependent variable (Zikmund et al., 2010). The variables in publications I-III of this thesis have been selected on the basis of previous literature. It can therefore be assumed that these variables are unbiased and they reflect the dependent variable correctly. The variables in publication IV are mainly selected from prior literature, except for the variable DAO

which was developed in the publication. The variable was constructed using analogy to the corresponding variables in the equation which increases validity. Variables in publication V were developed in the publication. The variables were constructed using the same analogy used when DAO was formulated. The variables were divided into financial and operational through careful inspection of all accounting items. The selection method of these variables may cause bias, but it should be kept in mind that design science research cannot always be evaluated with positivistic measures (van Aken, 2005).

External validity observes the generalizability of the results (Zikmund et al., 2010). The empirical data of the thesis consists only of companies listed in HSE, which is the largest limitation of this study. The results of this thesis have been tested only with companies with headquarters in Finland, which hinders the generalizability of the results. The sample size is decent in publications I, III and IV but publications II and V have three case companies. The case companies do not represent a major portion of companies but the case companies have been selected through four predetermined criteria presented in chapter 3.5. The selected research methods also reduce external validity. QCA, simulations and model building are based on real life data but the results describe potential situations which cannot necessarily be executed in actual management decisions. Also, management decisions in companies are not based only on financial working capital variables, and therefore there are several variables which affect the decision making but are not noted in this thesis, e.g. the dividend policy. The external validity of the results can also be questioned because the models constructed with design science have only passed the α -test, and a β -test has not been executed (van Aken, 2004).

Reliability studies the quality of data. The quantitative data used in this thesis consists of the financial statements of companies listed in HSE. The author has collected the financial information manually from financial statements. The manual collection may have caused some clerical errors, but an inspection of the data did not reveal any outliers which may have been caused by collection errors. The financial statements have been formulated using IFRS and national guidelines and they have been audited. This increases the reliability of the data and enables the comparison of companies. The financial statement information only represents the situation on the last day of an accounting period which may affect the results. Internal data of the companies was not available and therefore this data can be considered most suitable. The qualitative data used in publication II consists of press releases. The information on press releases has not been verified but the author believes that any false information would have been noticed by the media and therefore this information can be considered reliable.

Objectivity assesses the reproducibility of the results. Objectivity studies methods whereas reliability is focused on data. QCA, which was used in publication I, is a relatively new method but Ragin (2006) has developed detailed instructions for exploiting the method. The research followed the guidelines found in previous literature (e.g. Fizz, 2011; Ragin, 2008). Simulation in publication III was conducted using basic principles. The baseline figures were formulated from the average figures of the data and all figures were adjusted with a similar percentage. The exact procedure has been described in

publication III. Model building has been used in publications II, IV and V. The process of model building cannot be specifically described, and therefore the objectivity of this method can be questioned. Artefact transferability is one possibility for examining objectivity (van Aken, 2005), but the models have not been tested outside their original context. Case studies in publications II and IV were conducted to test the constructed models. The method can be considered objective because the data was inserted into the existing models. Statistical analysis was used in publication IV to test the constructed model. The analyses were conducted using the general guidelines of statistical research, and it can therefore be considered objective.

5.4 Recommendations for further research

Firstly, financial working capital management strategies could be defined using modified working capital measures. The management strategies presented in this thesis were formulated using the original working capital measures because the development of improved measures was started later in the research. The strategies could be redefined so that modified measures would be used as the basis of the strategies. This would provide more detailed information for managers and researchers.

Secondly, qualitative research methods could be adopted into financial working capital management research. The research in this thesis was conducted using quantitative research methods, and quantitative data was mainly used in the research. Financial working capital management could be studied further with interviews with financial managers. The interviews might provide a deeper view of financial working capital management in companies, and the actual state of financial working capital management in companies could be recognized.

Thirdly, financial working capital management strategies could be redefined with other research methods. QCA was used in this thesis to formulate management strategies. Future research could use other quantitative and qualitative research methods to study the strategies. Statistical research could be used as a foundation for strategy formulation and the strategies could be improved with qualitative research to correspond to the actual strategies used in companies.

Fourthly, more tools for financial working capital management could be developed. The FOCAL matrix was presented in this thesis as a tool for financial working capital management. The matrix can be easily used to select and benchmark strategies. Managers still need tools to help them in decision-making. A new tool could integrate financial working capital management into everyday business so that operative decisions would also include the viewpoint of financial working capital management.

Fifthly, financial working capital management could be studied in different settings. The research in this thesis focused on companies listed in HSE. HSE is a relatively small stock exchange, and therefore there is not much heterogeneity between the companies. In addition, the financial environment in Finland is bank dominated which is not the case

everywhere. In the future, financial working capital management could be studied in other stock exchanges and the studies could also include SMEs and not just large multinational corporations.

Finally, the effects of the financial crisis and interest rates on financial working capital management could be studied. The majority of the data used in this thesis was collected from a period of financial crisis. The interest rates were relatively high for companies, even though they were low for consumers, and debts were difficult to acquire. The author considers that the financial crisis and the level of interest rates have affected financial working capital management. Time-series analysis in publication II did not reveal any notable effects, but the dataset included just three companies and therefore the effects should be studied with a larger sample size.

References

- Ahrens, T. and Chapman, C.S. (2007). Doing qualitative research in management accounting: positioning data to contribute to theory. In: Chapman C.S., Hopwood, A.G. and Shields, M.D, eds., *Handbook of Management Accounting Research. Vol. 1*, pp. 299-318. Amsterdam: Elsevier.
- Akinlo, O.O. (2012). Determinants of working capital requirements in selected quoted companies in Nigeria. *Journal of African Business*, 13(1), pp. 40-50.
- Anderson, S.W. and Widener, S.K. (2007). Doing quantitative field research in management accounting. In: Chapman, C.S., Hopwood, A.G. and Shields, M.D., eds., *Handbook of Management Accounting Research. Vol. 1*, pp. 319-342. Amsterdam: Elsevier.
- Ang, J. and Smedema, A. (2011). Financial flexibility: Do firms prepare for recession?. *Journal of Corporate Finance*, 17(3), pp. 774-787.
- Arslan-Ayadin, Ö., Florackis, C. and Ozkan, A. (2014). Financial flexibility, corporate investment and performance: evidence from financial crises. *Review of Quantitative Finance and Accounting*, 42(2), pp. 211-250.
- Aoudia, M., Belmokhtar, O. and Zwingelstein, G. (2008). Economic impact of maintenance management ineffectiveness of an oil and gas company. *Journal of Quality in Maintenance Engineering*, 14(3), pp. 237-261.
- Autukaite, R. and Molay, E. (2011). Cash holdings, working capital and firm value: evidence from France. *SSRN Working Paper Series*. [Retrieved May 4, 2015], url: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1836900.
- Axelrod, R. (1997). Advancing the art of simulation in the social sciences. In: Conte, R., Hegselmann, R. and Terna, P., eds., *Simulating Social Phenomena*, pp. 21-40. Berlin: Springer.
- Balasubrahmanyam, S., Kaipa, P. and Akhilesh, K.B. (2012). The impact of a firm's financial flexibility on its strategic renewal: key concepts with evidential support from businesses across industries. *Global Journal of Flexible Systems Management*, 13(3), pp. 165-175.
- Bancel, F. and Mittoo, U.R. (2004). Cross-country determinants of capital structure choice: a survey of European firms. *Financial Management*, 33(4), pp. 103-132.
- Bancel, F. and Mittoo, U.R. (2011). Financial flexibility and the impact of the global financial crisis. *International Journal of Managerial Finance*, 7(2), pp. 179-216.

- Banks, J., Carson, J., Nelson, B. and Nicol, D. (2001). *Discrete-event system simulation*. Upper Saddle River: Prentice Hall.
- Banks, C.M. (2009). What is modeling and simulation?. In: Sokolowski, J.A. and Banks, C.M., eds., *Principles of modeling and simulation: A multidisciplinary approach*, pp. 3-24. New Jersey: John Wiley & Sons.
- Baños-Caballero, S., García-Teruel, P.J. and Martínez-Solano, P. (2010). Working capital management in SMEs. *Accounting and Finance*, 50(3), pp. 511-527.
- Bastos, R. and Pindado, J. (2013). Trade credit during a financial crisis: a panel data analysis. *Journal of Business Research*, 66(5), pp. 614-620.
- Belt, B. and Smith, K.V. (1991). Comparison of working capital management practices in Australia and the United States. *Global Finance Journal*, 2(1-2), pp. 27-54.
- Bernstein, L.A., Most, K.S. and Block, M. (1981). Working capital as a tool. *Journal of Accountancy*, 152(6), pp. 82-94.
- Black, K. (2013). *Applied business statistics: Making better business decisions*. 7th edn. Hoboken: Wiley.
- Blackman, I.D. and Holland, C. (2006). The management of financial supply chains: from adversarial to co-operative strategies. In: Suomi, R., Cabral, R., Hampe, J., Heikkila, A., Järveläinen, J. and Koskivaara, E., eds., *IFIP International Federation for Information Projects, Volume 226, Project E-society: Building Bricks*, pp. 82-95. Boston: Springer.
- Bonaimé, A.A., Hankins, K.W. and Harford, J. (2014). Financial flexibility, risk management and payout choice. *Review of Financial Studies*, 27(4), pp. 1074-1101.
- Bougheas, S., Mateut, S. and Mizen, P. (2009). Corporate trade credit and inventories: new evidence of a trade-off from accounts payable and receivable. *Journal of Banking and Finance*, 33(2), pp. 300-307.
- Brounen, D., de Jong, A. and Koedijk, K. (2004). Corporate finance in Europe: confronting theory with practice. *Financial Management*, 33(4), pp. 71-101.
- Burrell, G. and Morgan, G. (1979). *Sociological paradigms and organizational analysis: Elements of the sociology of corporate life*. London: Heinemann.
- Chang, K. and Noorbakhsh, A. (2009). Does national culture affect international corporate cash holdings?. *Journal of Multinational Financial Management*, 19(5), pp. 323-342.
- Chiou, J., Cheng, L. and Whu, H. (2006). The determinants of working capital. *The Journal of American Academy of Business*, 1(10), pp. 149-155.

- Christoffersen, J. (2013). A review of antecedents of international strategic alliance performance: synthesized evidence and new directions for core constructs. *International Journal of Management Reviews*, 15(1), pp. 66-85.
- Chung, K-J., Lin, S-D. and Srivastava, H.M. (2013). The inventory models under conditional trade credit in supply chain system. *Applied Mathematical Modelling*, 37(24), pp. 10036-10052.
- Cole, V., Branson, J. and Breesch, D. (2009). How to measure the comparability of financial statements?. *International Journal of Managerial and Financial Accounting*, 1(4), pp. 379-397.
- Coulibaly, B., Sapriza, H. and Zlate, A. (2013). Financial frictions, trade credit, and the 2008-09 global financial crisis. *International Review of Economics and Finance*, 26, pp. 25-38.
- Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks: SAGE Publications.
- Dash, M. and Ravipati, R. (2009). A liquidity-profitability trade-off model for working capital management. *SSRN Working paper Series*. [Retrieved March 31, 2015], url: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1408722.
- de Almeida, J.R. and Eid Jr., W. (2014). Access to finance, working capital management and company value: evidences from Brazilian companies listed on BM&FBOVESPA. *Journal of Business Research*, 67(5), pp. 924-934.
- de Jong, A., Verbeek, M. and Verwijmeren, P. (2012). Does financial flexibility reduce investment distortions?. *The Journal of Financial Research*, 35(2), pp. 243-259.
- Demski, J.S. (2007). Analytic modeling in management accounting research. In: Chapman, C.S., Hopwood, A.G. and Shields, M.G., eds., *Handbook of Management Accounting Research*. Vol. 1. Amsterdam: Elsevier.
- Deloof, M. (2003). Does working capital management affect profitability of Belgium firms?. *Journal of Business Finance & Accounting*, 30(3-4), pp. 573-587.
- Denis, D.J. (2011). Financial flexibility and corporate liquidity. *Journal of Corporate Finance*, 17(3), pp. 667-674.
- Denis, D.J. and McKeon, S.B. (2012). Debt financing and financial flexibility evidence from proactive leverage increases. *Review of Financial Studies*, 25(6), pp. 1897-1929.
- Deville, A., Ferrier, G.D. and Leleu, H. (2014). Measuring the performance of hierarchical organizations: an application to bank efficiency at the regional and branch levels. *Management Accounting Research*, 25(1), pp. 30-44.

- Ding, S., Guariglia, A. and Knight, J. (2013). Investment and financing constraints in China: Does working capital management make a difference?. *Journal of Banking & Finance*, 37(5), pp. 1490-1507.
- Dooley, K. (2002). Simulation research methods. In: Joel, B., ed., *Companion to organizations*, pp. 829-848. London: Blackwell.
- El-Akruti, K. and Dwight, R. (2013). A framework for the engineering asset management system. *Journal of Quality in Maintenance Engineering*, 19(4), pp. 398-412.
- El-Akruti, K., Dwight, R. and Zhang, T. (2013). The strategic role of engineering asset management. *International Journal of Production Economics*, 146(1), pp. 227-239.
- Eljelly, A.M.A. (2004). Liquidity-profitability tradeoff: an empirical investigation in an emerging market. *International Journal of Commerce and Management*, 14(2), pp. 48-61.
- Emery, G. W. (1984). Measuring short-term liquidity. *Journal of Cash Management*, 4(4), pp. 25-32.
- Farris, M.T. and Hutchison, P.D. (2002). Cash-to-cash: the new supply chain management metric. *International Journal of Physical Distribution & Logistics Management*, 32(4), pp. 288-298.
- Farris, M.T. and Hutchison, P.D. (2003). Measuring cash-to-cash performance. *The International Journal of Logistics Management*, 14(2), pp. 83-91.
- Fee, C.E., Pierce, J.R., Seo, H. and Yan, S. (2014). Bank debt, flexibility, and the use of proceeds from asset sales. *Journal of Financial Services Research*, 46(1), pp. 77-97.
- Ferrando, A. and Mulier, K. (2013). Do firms use the trade credit channel to manage growth?. *Journal of Banking & Finance*, 37(8), pp. 3035-3046.
- Filbeck, G. and Krueger, T.M. (2005). An analysis of working capital management results across industries. *Mid-American Journal of Business*, 20(2), pp. 11-18.
- Fisman, R. and Love, I. (2003). Trade credit, financial intermediary development, and industry growth. *The Journal of Finance*, 58(1), pp. 353-374.
- Fizz, P.C. (2007). A set-theoretic approach to organizational configurations. *Academy of Management Review*, 32(4), pp. 1180-1198.
- Fizz, P.C. (2011). Building better causal theories: a fuzzy-set approach to typologies in organization research. *Academy of Management Journal*, 54(2), pp. 393-420.

- Fleuriet, M.J., Kehdy, R. and Blanc, G.A. (1978). *A Dinâmica financeira das empresas brasileiras*. Belo Horizonte: Fundação Dom Cabral. In Portuguese.
- Flor, C.R. and Hirth, S. (2013). Asset liquidity, corporate investment, and endogenous financing costs. *Journal of Banking and Finance*, 37(2), pp. 474-489.
- Franco-Santos, M., Lucianetti, L. and Bourne, M. (2012). Contemporary performance measurement systems: a review of their consequences and a framework for research. *Management Accounting Research*, 23(2), pp. 79-119.
- Frolov, V., Ma, L., Sun, Y. and Bandara, W. (2010). Identifying core functions of asset management. In: Amadi-Echendu, J.E., Brown, K., Willett, R. and Mathew, J., eds., *Definitions, Concepts and Scope of Engineering Asset Management*, pp. 19-29. London: Springer-Verlag.
- Gamba, A. and Triantis, A. (2008). The value of financial flexibility. *Journal of Finance*, 63(5), pp. 2263-2296.
- García-Teruel, P.J. and Martínez-Solano, P. (2007a). Effects of working capital management on SME profitability. *International Journal of Managerial Finance*, 3(2), pp. 164-177.
- García-Teruel, P.J. and Martínez-Solano, P. (2007b). Short-term debt in Spanish SMEs. *International Small Business Journal*, 25(6), pp. 579-602.
- García-Teruel, P.J. and Martínez-Solano, P. (2010a). A dynamic approach to accounts receivable: a study of Spanish SMEs. *European Financial Management*, 16(3), pp. 400-421.
- García-Teruel, P.J. and Martínez-Solano, P. (2010b). A dynamic perspective on the determinants of accounts payable. *Review of Quantitative Finance and Accounting*, 34(4), pp. 439-457.
- Ge, Y. and Qiu, J. (2007). Financial development, bank discrimination and trade credit. *Journal of Banking and Finance*, 31(2), pp. 513-530.
- Gentry, J. (1988). State of the art of short-run financial management. *Financial Management*, 17(2), pp. 41-57.
- Gentry, J.A., Mehta, D.R., Bhattacharya, S.K., Cobbaut, R. and Scaringella, J.-L. (1979). An international study of management perceptions of the working capital process. *Journal of International Business Studies*, 10(1), pp. 28-38.
- Gentry, J.A., Vaidyanathan, R. and Lee, H.W. (1990). A weighted cash conversion cycle. *Financial Management*, 19(1), pp. 90-99.

- Gibson, V. (2000). Property portfolio dynamics: the flexible management of inflexible assets. *Facilities*, 18(3), pp. 150-154.
- Gilbert, N.G. and Troitzsch, G.K. (2005). *Simulation for the social scientist*. Berkshire: McGraw-Hill Education.
- Gomes, C., Yasin, M. and Lisboa, J. (2011). Performance measurement practices in manufacturing firms revisited. *International Journal of Operations & Productions Management*, 31(1), pp. 5-30.
- Gorbenko, A.S. and Strebulaev, I.A. (2010). Temporary versus permanent shocks: explaining corporate financial policies. *Review of Financial Studies*, 23(7), pp. 2591-2647.
- Greckhamer, T., Misangyi, V.F., Elms, H. and Lacey, R. (2008). Using qualitative comparative analysis in strategic management research. *Organizational Research Methods*, 11(4), pp. 695-726.
- Grosse-Ruyken, P.T., Wagner, S.M. and Jönke, R. (2011). What is the right cash conversion cycle for your supply chain?. *International Journal of Services and Operations Management*, 10(1), pp. 13-29.
- Gryglewicz, S. (2011). A theory of corporate financial decisions with liquidity and solvency concerns. *Journal of Financial Economics*, 99(2), pp. 365-384.
- Guimarães, A.L.d.S. and Nossa, V. (2010). Working capital, profitability, liquidity and solvency of healthcare insurance companies. *Brazilian Business Review*, 7(2), pp. 37-59.
- Gupta, S., Jain, P.K. and Yadav, S.S. (2011). Generating financial flexibility and financial performance through disinvestment: a comparative study of disinvested and non-disinvested public sector enterprises in India. *Global Journal of Flexible Systems Management*, 12(1-2), pp. 27-46.
- Guthmann, H.G. (1954). *Analysis of Financial Statements*, 4th edition. New York: Prentice Hall.
- Guthmann, H.G. and Dougall, H.E. (1948). *Corporate Financial Policy*, 2nd edition. New York: Prentice Hall Inc.
- Habermas, J. (1973). *Knowledge and human interests*. Boston: Beacon Press.
- Harris, F.W. (1990). How many parts to make at once. *Operations Research*, 38(6), pp. 947-950.

- Hatinen, L., Pirttilä, M., Viskari, S. and Kärri, T. (2012). The investment logics of Finnish industrial maintenance service providers. *International Journal of Strategic Engineering Asset Management*, 1(1), pp. 33-48.
- Hayter, A. (2013). *Probability and statistics for engineers and scientists*, 4th edition. Boston: Brooks.
- Hemmer, T. and Labro, E. (2008). On the optimal relation between the properties of managerial and financial reporting systems. *Journal of Accounting Research*, 46(5), pp. 1209-1240.
- Herder, P.M. and Wijnia, Y. (2012). A systems view on infrastructure asset management. In: van der Lei, T., Herder, P. and Wijnia, Y., eds., *Asset Management – The State of the Art in Europe from a Life Cycle Perspective*, pp. 31-45. Dordrecht: Springer.
- Hesford, J.W., Lee, S.-H., Van der Stede, W.A. and Young, S.M. (2007). Management accounting: a bibliographic study. In Chapman C.S., Hopwood, A.G. and Shields, M.D., eds., *Handbook of Management Accounting Research. Vol. 1*, pp. 3-26. Amsterdam: Elsevier.
- Hevner, A.R., March, S.T. and Park, J. (2004). Design science in information systems research. *MIS Quarterly*, 28(1), pp. 75-105.
- Hill, M.D., Kelly, G.W. and Highfield, M.J. (2010). Net operating working capital behavior: a first look. *Financial Management*, 39(2), pp. 783-805.
- Hirscheim, R. and Klein, H.K. (1989). Four paradigms of information systems development. *Communications of the ACM*, 32(10), pp. 1199-1215.
- Hofler, D. (2009). Strategies for high-yield working capital in today's economic environment. *Outsourced Logistics*, 2(1), pp. 26-29.
- Hofmann, E. and Kotzab, H. (2010). A supply chain-oriented approach of working capital management. *Journal of Business Logistics*, 31(2), pp. 305-330.
- Horngren, C.T., Datar, S.M. and Foster, G. (2006). *Cost accounting: a managerial emphasis*, 12th edn. Upper Saddle River: Pearson Prentice Hall.
- Howorth, C. and Westhead, P. (2003). The focus of working capital management in UK small firms. *Management Accounting Research*, 14(2), pp. 94-111.
- Huang, Y-F. and Chung, K-J. (2003). Optimal replenishment and payment policies in the EOQ model under cash discount and trade credit. *Asia-Pacific Journal of Operational Research*, 20, pp. 177-190.

Hutchison, P.D., Farris, M.T. and Fleischman, G.M. (2009). Supply chain cash-to-cash: a strategy for the 21st century. *Strategic Finance*, 91(1), pp. 41-48.

ISO 55000 (2014). *Asset management – Overview, principles and terminology*. Geneva: International Organization for Standardization.

ISO 55001 (2014). *Asset management – Management systems – Requirements*. Geneva: International Organization for Standardization.

ISO 55002 (2014). *Asset management – Management systems – Guidelines for the application of ISO 55001*. Geneva: International Organization for Standardization.

Isshaq, Z. & Bopkin, G.A. (2009). Corporate liquidity management of listed firms in Ghana. *Asia-Pacific Journal of Business Administration*, 1(2), pp. 189-198.

Ivashina, V. and Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial Economics*, 97(3), pp. 319-338.

Jose, M.L., Lancaster, C. and Stevens, J.L. (1996). Corporate returns and cash conversion cycles. *Journal of Economics and Finance*, 20(1), pp. 33-46.

Järvensivu, T. and Törnroos, J.Å. (2010). Case study research with moderate constructionism: conceptualization and practical illustration. *Industrial Marketing Management*, 39(1), pp. 100-108.

Jönsson, S. and Lukka, K. (2007). There and back again: doing interventionist research in management accounting. In: Chapman, S., Hopwood, A.G. and Shields, M.D., eds., *Handbook of Management Accounting Research. Vol. 1*, pp. 373-397. Amsterdam: Elsevier.

Kaiser, K. and Young, S.D. (2009). Need cash? Look inside your company. *Harvard Business Review*, 87(5), pp. 64-71.

Kasanen, E., Lukka, K. and Siitonen, A. (1993). The constructive approach in management accounting research. *Journal of Management Accounting Research*, 5(Fall), pp. 241-264.

Keythman, B. (2013). A high working capital turnover rate indicates what?. *Houston Chronicle*. [Retrieved May 8, 2015], url: <http://smallbusiness.chron.com/high-working-capital-turnover-ratio-indicates-what-61036.html>.

Khoury, N.T., Smith, K.V. and MacKay, P.I. (1999). Comparing working capital practices in Canada, the United States, and Australia: a note. *Canadian Journal of Administrative Sciences*, 16(1), pp. 53-57.

- Kim, C.-S., Mauer, D.C. and Sherman, A.E. (1998). The determinants of corporate liquidity: theory and evidence. *Journal of Financial and Quantitative Analysis*, 33(3), pp. 335-359.
- Knauer, T. and Wöhrmann, A. (2013). Working capital management and firm profitability. *Journal of Management Control*, 24(1), pp. 77-87.
- Komonen, K., Kortelainen, H. and Rääkkönen, M. (2012). Corporate asset management for industrial companies: an integrated business-driven approach. In: van der Lei, T., Herder, P. and Wijnia, Y., eds., *Asset Management – The State of the Art in Europe from a Life Cycle Perspective*, pp. 47-63. Dordrecht: Springer.
- Koskinen, P. (2015). Pankkien ehdot jarruttavat investointeja. *Kauppalehti*, March 27. In Finnish.
- Kärri, T. (2007). *Timing of capacity change: models for capital intensive industry*. Ph.D. thesis. Lappeenranta University of Technology.
- Larimo, J., Nguyen, H.L. and Ali, T. (2016). Performance measurement choices in international joint ventures: What factors drive them? *Journal of Business Research*, 69(2), pp. 877-887.
- Lazaridis, I. and Tryfonidis, D. (2006). Relationship between working capital management and profitability of listed companies in the Athens stock exchange. *Journal of Financial Management and Analysis*, 19(1), pp. 26-35.
- Lie, E. (2005). Financial flexibility, performance, and the corporate payout choice. *Journal of Business*, 78(6), pp. 2179-2203.
- Lin, S., Gao, J., Koronios, A. and Chanana, V. (2007). Developing a data quality framework for asset management in engineering organisations. *International Journal of Information Quality*, 1(1), pp. 100-126.
- Lohrey, J. (2013). What does working capital as a percentage of sales tell you?. *Houston Chronicle*. [Retrieved May 8, 2015], url: <http://smallbusiness.chron.com/working-capital-percent-sales-tell-you-71681.html>.
- Long, M., Malitz, I.B. and Ravid, S.A. (1993). Trade credit, quality guarantees, and product marketability. *The Journal of Financial Management Association*, 22(4), pp. 117-127.
- Longino, H.E. (1990). *Science as social knowledge: Values and objectivity in scientific inquiry*. Princeton: Princeton University Press.

- Luciano, E. and Peccati, L. (1999). Capital structure and inventory management: the temporary sale price problem. *International Journal of Production Economics*, 59(1-3), pp. 169-178.
- Mann, H.B. and Whitney, D.R. (1947). On a test of whether one of two random variables is stochastically larger than the other. *Annals of Mathematical Statistics*, 18(1), pp. 50-60.
- March, S. and Smith, G.F. (1995). Design and natural science research on information technology. *Decision Support Systems*, 15(4), pp. 251-266.
- Marchica, M. and Mura, R. (2010). Financial flexibility, investment ability, and firm value: evidence from firms with spare debt capacity. *Financial Management*, 39(4), pp. 1339-1365.
- Marttonen, S. (2013). *Modelling flexible asset management in industrial maintenance companies and networks*. Ph.D. thesis. Lappeenranta University of Technology.
- Marttonen, S., Monto, S. and Kärri, T. (2013a). Profitable working capital management in industrial maintenance companies. *Journal of Quality in Maintenance Engineering*, 19(3), pp. 429-446.
- Marttonen, S., Viskari, S. and Kärri, T. (2013b). Appeasing company owners through effective working capital management. *International Journal of Managerial and Financial Accounting*, 5(1), pp. 64-78.
- Marques, J.A.V.D.C. and Braga, R. (1995). Análise dinâmica do capital de giro: o modelo Fleuriet. *RAE Revista de Administração de Empresas*, 35(3), pp. 49-63. In Portuguese.
- Michalski, G. (2008). Liquidity or profitability: financial effectiveness of investments in working capital. In: Cervinek, P., ed., *Proceedings of International Financial Systems Conference 2008*, pp. 129-138. Brno, Czech Republic, June 25-26, 2008.
- Moers, F. (2007). Doing archival research in management accounting. In: Chapman C.S., Hopwood, A.G. and Shields, M.D., eds., *Handbook of Management Accounting Research. Vol. 1*, pp. 399-414. Amsterdam: Elsevier.
- Molina, C.A. and Preve, L.A. (2009). Trade receivables policy of distressed firms and its effects on the cost of financial distress. *Financial Management*, 38(3), pp. 663-686.
- Moss, J.D. and Stine, B. (1993). Cash conversion cycle and firm size: a study of retail firms. *Managerial Finance*, 19(8), pp. 25-34.
- Mullins, J.W. (2009). Capital is king!. *Business Strategy Review*, 20(4), pp. 4-8.

Mullins, J.W. and Komisar, R. (2009). *Getting to plan B: Breaking through a better business model*. Boston: Harvard Business Press.

Myers, S.C. and Rajan, R.G. (1998). The paradox of liquidity. *The Quarterly Journal of Economics*, 113(3), pp. 733-771.

Nascimento, C.d., Espejo, M.M.d.S.B., Voese, S.B. and Pfitscher, E.D. (2012). Tipologia de Fleuriet e a crise financeira de 2008. *Revista Universo Contábil*, 8(4), pp. 40-59.

Niskanen, J. and Niskanen, M. (2006). The determinants of corporate trade credit policies in a bank-dominated financial environment: the case of Finnish small firms. *European Financial Management*, 12(1), pp. 81-102.

Noreen, U., Khan, S.K. and Abbas, Q. (2009). International working capital practices in Pakistan. *International Research Journal of Finance and Economic*, (32), pp. 160-170.

O'Connor Keefe, M. and Tate, J. (2013). Is the relationship between investment and conditional cash flow volatility ambiguous, asymmetric or both?. *Accounting and Finance*, 53(4), pp. 913-947.

Ojanen, V., Hatinen, L., Kärri, T. and Kässi, T. (2012). Flexible investment planning and collaborative maintenance management. In: van der Lei, T., Herder, P. and Wijnia, A., eds., *Asset Management - The State of the Art in Europe from a Life Cycle Perspective*, pp. 65-77. Dordrecht: Springer.

Ordanini, A., Parasuraman, A. and Rubera, G. (2014). When the recipe is more important than the ingredients: a qualitative comparative analysis (QCA) of service innovation configurations. *Journal of Service Research*, 17(2), pp. 134-149.

Orlikowski, W.J. and Baroudi, J.J. (1991). Studying information technology in organizations: research approaches and assumptions. *Information Systems Research*, 2(1), pp. 1-28.

Palombini, N.V.N. and Nakamura, W.T. (2012). Key factors in working capital management in the Brazilian market. *RAE Revista de Administração de Empresas*, 52(1), pp. 55-69.

Payne, S. (2002). Working capital optimization can yield real gains. *Financial Executive*, 18(6), pp. 40-42.

Peppers, K., Tuunanen, T., Rothenberg, M.A. and Chatterjee, S. (2008). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3), pp. 45-77.

Petersen, M.A. and Rajan, R.G. (1997). Trade credit: theories and evidence. *The Review of Financial Studies*, 10(3), pp. 661-691.

- Petersen, C.V. and Plenborg, T. (2012). *Financial Statement Analysis: Valuation, Credit Analysis and Executive compensation*. Harlow: Pearson Education.
- Pirttilä, M. (2014). *The cycle times of working capital: Financial value chain analysis method*. Ph.D. thesis. Lappeenranta University of Technology.
- Protopappa-Sieke, M. and Seifert, R.W. (2010). Interrelating operational and financial performance measurements in inventory control. *European Journal of Operational Research*, 204(3), pp. 439-448.
- Publicly Available Specification (PAS) 55-1 (2008). *Specification for the optimized management of physical assets*. British Standards Institution.
- Publicly Available Specification (PAS) 55-2 (2008). *Guidelines for the application of PAS 55-1*. British Standards Institution.
- Rafuse, M.E. (1996). Working capital management: an urgent need to refocus. *Management Decision*, 34(2), pp. 59-63.
- Ragin, C.C. (1987). *The comparative method: Moving beyond qualitative and quantitative strategies*. Berkeley: University of California Press.
- Ragin, C.C. (2006). Set relations in social research: evaluating their consistency and coverage. *Political Analysis*, 14(3), pp. 291-310.
- Ragin, C.C. (2008). *Redesigning social inquiry: Fuzzy sets and beyond*. Chicago: University of Chicago Press.
- Ragin, C.C. and Davey, S. (2014). *Fuzzy-set/Qualitative comparative analysis 2.5*. Irvine: University of California.
- Randall, W.S. and Farris, M.T. (2009). Supply chain financing: using cash-to-cash variables to strengthen the supply chain. *International Journal of Physical Distribution & Logistics Management*, 39(8), pp. 669-689.
- Ricci, C. and Morrison, G. (1996). International working capital practices of the Fortune 200. *Financial Practice & Education*, 6(2), pp. 7-20.
- Richards, V.D. and Laughlin, E.J. (1980). A cash conversion cycle approach to liquidity analysis. *Financial Management*, 9(1), pp. 32-38.
- Salawu, R.O. (2006). Industry practice and aggressive conservative working capital policies in Nigeria. *European Journal of Scientific Research*, 13(3), pp. 294-304.

Schneider, J., Gaul, A.J., Neumann, C., Hogräfer, J., Wellssow, W., Schwan, M. and Schnettler, A. (2006). Asset management techniques. *Electrical Power and Energy Systems*, 28(9), pp. 643-654.

Shin, H. and Soenen, L. (1998). Efficiency of working capital management and corporate profitability. *Financial Practice and Education*, 8(2), pp. 37-45.

Simon, H.A. (1996). *The sciences of the artificial*, 3rd edition. Cambridge: Massachusetts Institute of Technology.

Singh, K. and Hodder, J.E. (2000). Multinational capital structure and financial flexibility. *Journal of International Money and Finance*, 19(6), pp. 853-884.

Smith, M.B. and Begemann, E. (1997). Measuring associations between working capital and return on investment. *South African Journal of Business Management*, 28(1), pp. 73-84.

Song, K. and Lee, Y. (2012). Long-term effects of a financial crisis: evidence from cash holdings of East Asian firms. *Journal of Financial and Quantitative Analysis*, 47(3), pp. 617-641.

Souza, M.S. (2003). Gestão da tesouraria das empresas. *Contabilidade Vista & Revista*, 14(3), pp. 99-111. In Portuguese.

Steyn, W., Hamman, W.D. and Smit, E.v.d.M. (2002). The danger of high growth combined with a large non-cash working capital base – a descriptive analysis. *South African Journal of Business Management*, 33(1), pp. 41-47.

Taipaleenmäki, J. and Ikäheimo, S. (2013). On the convergence of management accounting and financial accounting – the role of information technology in accounting change. *International Journal of Accounting Information Systems*, 14(4), pp. 321-348.

Teng, J-T., Yang, H-L. and Chern, M-S. (2013). An inventory model for increasing demand under two levels of trade credit linked to order quantity. *Applied Mathematical Modelling*, 37(14-15), pp. 7624-7632.

van Aken, J.E. (2004). Management research based on the paradigm of the design sciences: the quest for field-tested and grounded technological rules. *Journal of Management Studies*, 41(2), pp. 219-246.

van Aken, J.E. (2005). Management research as a design science: articulating the research products of mode 2 knowledge production in management. *British Journal of Management*, 16(1), pp. 19-36.

- van Aken, J.E. and Romme, G. (2009). Reinventing the future: adding design science to the repertoire of organization and management studies. *Organization Management Journal*, 6(1), pp. 5-12.
- Viskari, S., Lind, L., Kärri, T. and Schupp, F. (2012a). Using working capital management to improve profitability in the value chain of automotive industry. *International Journal of Services and Operations Management*, 13(1), pp. 42-64.
- Viskari, S., Lukkari, E. and Kärri, T. (2011a). State of working capital management research: bibliometric study. *Middle Eastern Finance and Economics*, 14, pp. 99-108.
- Viskari, S., Pirttilä, M. and Kärri, T. (2011b). Improving profitability by managing working capital in the value chain of pulp and paper industry. *International Journal of Managerial and Financial Accounting*, 3(4), pp. 348-366.
- Viskari, S., Ruokola, A., Pirttilä, M. and Kärri, T. (2012b). Advanced model for working capital management: bridging theory and practice. *International Journal of Applied Management Science*, 4(1), pp. 1-17.
- Wang, Y-J. (2002). Liquidity management, operating performance, and corporate value: evidence from Japan and Taiwan. *Journal of Multinational Financial Management*, 12(2), pp. 159-169.
- Weissenberger, B.E. and Angelkort, H. (2011). Integration of financial and management accounting systems: the mediating influence of a consistent financial language on controllership effectiveness. *Management Accounting Research*, 22(3), pp. 160-180.
- Wright, F.K. (1956). An examination of the working capital ratio. *The Australian Accountant*, 26(3), pp. 101-107.
- Wuttke, D.A., Blome, C. and Henke, M. (2013). Focusing the financial flow of supply chains: an empirical investigation of financial supply chain management. *International Journal of Production Economics*, 145(2), pp. 773-789.
- Yin, R.K. (2009). *Case study research: Design and methods*, 4th edition. Beverly Hills: SAGE Publications.
- Yritystutkimusneuvottelukunta. (2005). *Yritystutkimuksen tilinpäätösanalyysi*, 8th edition. Helsinki: Gaudeamus Kirja. In Finnish.
- Zikmund, W.G., Babin, B.J., Carr, J.C. and Griffin, M. (2010). *Business research methods*, 8th edition. Mason: South-Western.
- Zwissler, F., Okhan, E. and Westkämper, E. (2013). Lean and proactive liquidity management for SMEs. *Proceedings of 46th CIRP Conference on Manufacturing Systems*, pp. 604-609. Setubal, Portugal, May 29-30, 2013.

ACTA UNIVERSITATIS LAPPEENRANTAENSIS

657. AURINKO, HANNU. Risk assessment of modern landfill structures in Finland. 2015. Diss.
658. KAIJANEN, LAURA. Capillary electrophoresis: Applicability and method validation for biorefinery analytics. 2015. Diss.
659. KOLHINEN, JOHANNA. Yliopiston yrittäjämäisyyden sosiaalinen rakentuminen. Case: Aalto-yliopisto. 2015. Diss.
660. ANNALA, SALLA. Households' willingness to engage in demand response in the Finnish retail electricity market: an empirical study. 2015. Diss.
661. RIABCHENKO, EKATERINA. Generative part-based Gabor object detector. 2015. Diss.
662. ALKKIOMÄKI, VILLE. Role of service and data reuse in enterprises. 2015. Diss.
663. VÄNTSI, OLLI. Utilization of recycled mineral wool as filler in wood plastic composites. 2015. Diss.
664. KLEMOLA, KATJA. Tuottavuuden, vaikuttavuuden ja kustannusvaikuttavuuden arviointi alueellisesti integroiduissa sosiaali- ja terveystalouksissa – palvelujen käyttöön perustuva malli ja esimerkkejä. 2015. Diss.
665. HEROLD, KRISTIINA. Impact of Word-of-Mouth on consumer decision-making: An information processing perspective in the context of a high-involvement service. 2015. Diss.
666. OLABODE, MUYIWA. Weldability of high strength aluminium alloys. 2015. Diss.
667. VANHALA, ERNO. The role of business model in computer game development organizations. 2015. Diss.
668. SALAMPASIS, DIMITRIOS. Trust-embedded open innovation: Towards a human-centric approach in the financial industry. 2015. Diss.
669. DE SMET, DIETER. Innovation ecosystem perspectives on financial services innovation. 2015. Diss.
670. PORRAS, PÄIVI. Utilising student profiles in mathematics course arrangements. 2015. Diss.
671. SALMINEN, JUHO. The role of collective intelligence in crowdsourcing innovations. 2015. Diss.
672. ROSAS, SAILA. Co-operative acquisitions – the contextual factors and challenges for co-operatives when acquiring an investor-owned firm. 2015. Diss.
673. SINKKONEN, TIINA. Item-level life-cycle model for maintenance networks – from cost to additional value. 2015. Diss.
674. TUUNANEN, JUSSI. Modelling of changes in electricity end-use and their impacts on electricity distribution. 2015. Diss.
675. MIELONEN, KATRIINA. The effect of cationic-anionic polyelectrolyte multilayer surface treatment on inkjet ink spreading and print quality. 2015. Diss.

676. OMAJENE, JOSHUA. Underwater remote welding technology for offshore structures. 2015. Diss.
677. NUUTINEN, PASI. Power electronic converters in low-voltage direct current distribution – analysis and implementation. 2015. Diss.
678. RUSATSI, DENIS. Bayesian analysis of SEIR epidemic models. 2015. Diss.
679. STRAND, ELSI. Enhancement of ultrafiltration process by pretreatment in recovery of hemicelluloses from wood extracts. 2016. Diss.
680. TANNINEN, PANU. Press forming of paperboard – advancement of converting tools and process control. 2015. Diss.
681. VALTONEN, PETRI. Distributed energy resources in an electricity retailer’s short-term profit optimization. 2015. Diss.
682. FORSTRÖM-TUOMINEN, HEIDI. Collectiveness within start up-teams – leading the way to initiating and managing collective pursuit of opportunities in organizational contexts. 2015. Diss.
683. MAGUYA, ALMASI. Use of airborne laser scanner data in demanding forest conditions. 2015. Diss.
684. PEIPPO, JUHA. A modified nominal stress method for fatigue assessment of steel plates with thermally cut edges. 2015. Diss.
685. MURASHKO, KIRILL. Thermal modelling of commercial lithium-ion batteries. 2016. Diss.
686. KÄRKKÄINEN, TOMMI. Observations of acoustic emission in power semiconductors. 2016. Diss.
687. KURVINEN, EMIL. Design and simulation of high-speed rotating electrical machinery. 2016. Diss.
688. RANTAMÄKI, JUKKA. Utilization of statistical methods for management in the forest industry. 2016. Diss.
689. PANOVA, YULIA. Public-private partnership investments in dry ports – Russian logistics markets and risks. 2016. Diss.
690. BAHARUDIN, EZRAL. Real-time simulation of multibody systems with applications for working mobile vehicles. 2016. Diss.
691. MARTIKAINEN, SOILI. Development and effect analysis of the Asteri consultative auditing process – safety and security management in educational institutions. 2016. Diss.
692. TORVINEN, PEKKA. Catching up with competitiveness in emerging markets – An analysis of the role of the firm’s technology management strategies. 2016. Diss.
693. NORONTAUS, ANNUKKA. Oppisopimuskoulutus yritysten tuottamana koulutuspalveluna: tavoitteista vaikutuksiin. 2016. Diss.
694. HALMINEN, OSKARI. Multibody models for examination of touchdown bearing systems. 2016. Diss.

