THE RELATIONSHIP BETWEEN WORKING CAPITAL MANAGEMENT AND PROFITABILITY IN BUILDING CONSTRUCTION COMPANIES

Lappeenranta–Lahti University of Technology LUT

Bachelor’s Programme in Strategic Finance, Bachelor's thesis

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Examiner: University Lecturer Roman Stepanov

ABSTRACT

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The relationship between working capital management and profitability in building construction companies

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In the current economic landscape characterized by volatility and uncertainty, businesses face the challenge of balancing liquidity and profitability. To navigate these challenges and remain financially resilient, companies must be able to adapt quickly to changes in their own operations and those of their stakeholders. Working capital management is a key factor in this regard, as it involves the optimization of a company's short-term assets and liabilities which reflect the firm's current financial position and liquidity.

The management of working capital can be achieved through the implementation of the cash conversion cycle, which aims to effectively manage incoming and outgoing cash flows as well as inventory. By carefully managing the cash conversion cycle, businesses can maintain financial stability and mitigate the risk of financial distress.

The objective of this bachelor's thesis is to examine the relationship between working capital management and profitability in construction firms. The study employed financial statement data from a sample of 50 building construction companies for the period spanning 2021 to 2012, from which relevant indicators were extracted for quantitative analysis. Correlation analysis and linear regression analysis were employed as research methods.

The findings of the study indicate that certain aspects of working capital management and profitability exhibit a negative correlation. These results align with previous research on the topic and reinforce the significance of working capital management in companies.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

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Kauppatieteet

Helmi Haakana

Käyttöpääoman hallinnan ja kannattavuuden välinen yhteys rakennusalan yrityksissä

Kauppatieteiden kandidaatintyö

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Haasteet likviditeetin sekä kannattavuuden tasapainottelussa ovat yrityksille arkipäivää nykyajan nopeasti vaihtuvissa taloudellisissa tilanteissa. Yritysten on taloudellisesti varauduttava sekä muuntauduttava yhä nopeammin muutoksiin omassa sekä sidosryhmien toiminnassa.

Tällaisissa tilanteissa käyttöpääoman hallinnalla on iso rooli. Käyttöpääoma yhdistää yrityksen lyhyen aikavälin varat ja velat, ja käytännössä nämä heijastavatkin yrityksen lyhyen ajan likviditeettitilannetta. Käyttöpääomaa voidaan hallita käyttöpääomasyklin avulla, jonka tarkoituksena on hallita sisään- ja ulosmeneviä rahavirtoja sekä varastoa.

Tämän kandidaatintyön tarkoituksena on tutkia käyttöpääoman hallinnan ja kannattavuuden välistä yhteyttä rakennusalan yhtiöissä. Työssä on käytetty 50 rakennusten rakentamiseen keskittyneen yhtiön tilinpäätösdataa vuosilta 2021-2012, joista johdettiin avainlukuja kvantitatiivisen tutkimuksen toteuttamiseksi. Työ hyödyntää korrelaatioanalyysiä ja lineaarista regressioanalyysiä tutkimusmenetelminä.

Työn tutkimustulokset osoittavat, että tietyillä käyttöpääoman hallinnan osa-alueilla ja kannattavuudella on negatiivinen yhteys. Tutkimustulokset puoltavat myös aiempia tutkimuksia aiheesta, ja vahvistavat käyttöpääoman hallinnan tärkeyden merkitystä yrityksissä.

ABBREVIATIONS

Abbreviations

WCM	Working Capital Management
WC	Working Capital
CA	Current Assets
CL	Current Liabilities
CCC	Cash Conversion Cycle
DSO	Days of Accounts Receivable Outstanding
DPO	Days of Accounts Payables Outstanding
DIO	Days of Inventory Outstanding
CR	Current Ratio

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1 Introduction

Several economic crises have shaken society during the 21st century. During the IT bubble, the 2008 financial crisis and recent rapid economic changes (i.e., increasing inflation and component shortages) working capital management (WCM) has become an increasingly important part of firms' daily business.

By paying attention to WCM, companies can find ways to balance their liquidity and profitability relationship. This balance might be hard to find as too tight liquidity position in hope of increasing profitability, might lead to a decreasing sales and difficulties meeting liabilities whereas too high liquidity leads to inefficient use of assets.

According to Jose, Lancaster & Stevens (1996) liquidity management (later referred as WCM in literature) has been a popular topic in previous research as Hager (1976), Richards & Laughlin (1980), Gitman (1974) and Gitman & Sachdeva (1982) have introduced various ways to measure and increase working capital management.

The relationship between WCM and firm's profitability has been earlier investigated. For example, Makori and Jagongo (2013) tried to examine the relationship between WCM and profitability in five Kenyan manufacturing and construction firms. This research found relationship between profitability and components of WCM. Makori's and Jagongo's research findings were particularly interesting and motivated further research on the topic. This thesis seeks to expand the investigation of the relationship between WCM and profitability to a larger sample of construction companies and a broader geographical area.

Also, the investigation of the relationship between WCM and profitability in the construction industry is a topic of significant interest for several reasons. One reason for this is that the construction industry is known to be subject to liquidity fluctuations due to the nature of the business, making effective WCM a key concern for companies operating in this sector. Additionally, previous research has demonstrated that WCM has an impact on both liquidity and profitability, and examining this relationship in the context of the construction industry could provide valuable insights into how WCM strategies may differ in this specific industry.

Furthermore, studying the relationship between WCM and profitability in the construction industry could contribute to a greater understanding of how companies in this sector can

effectively balance their liquidity and profitability, which is a crucial concern for management and stakeholders. Overall, investigating the relationship between WCM and profitability in the construction industry has the potential to inform the development of effective WCM strategies for companies operating in this sector and provide valuable insights into the management of liquidity and profitability in the construction industry.

1.1 Research objectives

As WCM has been a popular research subject, this bachelor's thesis aims to combine that previous research into a single entity and bring new aspects to it with the study. The study aims to investigate the relationship between WCM and profitability. With the help of conclusions of the study, in the end this bachelor's thesis tries to highlight the importance of WCM.

The connection is investigated through chosen variables that measure liquidity and profitability. The chosen variables for liquidity measurement are days of accounts payable outstanding, days of accounts receivables outstanding and current ratio. The chosen measure for profitability is the return on equity (ROE). These variables are introduced later in the thesis.

This bachelor's thesis aims to examine the relationship between working capital management (WCM) and profitability in the building construction industry. By analyzing the impact of various liquidity measures on profitability, as measured by return on equity (ROE), this study seeks to contribute to the understanding of how WCM strategies may differ in this specific industry and how companies in this sector can effectively balance their liquidity and profitability. The chosen liquidity measures for this study include days of accounts payable outstanding, days of accounts receivables outstanding, and current ratio. By combining previous research on WCM with an examination of its effects in the building construction industry, this study aims to provide valuable insights into the management of liquidity and profitability in this sector.

1.2 Research questions and hypotheses

As the main objective of this thesis is to find possible relationship between WCM and profitability, the main research question also aims to find answer for that. The main question supported by the literature review and later by the analysis study. The main research question is:

1. Does working capital management have a connection with building construction companies' profitability?

The main research question is supported by sub-question which aims to support and explain the main question. The sub-question investigates the impact of the individual components of working capital to the profitability. The sub-question is:

1a) Do the individual components (days receivables outstanding, days payables outstanding & current ratio) of working capital correlate with the return on equity?

This thesis has developed hypotheses for the research questions. These hypotheses are reflected in the previous research and tested with the analyses done later in the thesis.

As the research questions are settled as two-tailed (looks for correlation), the hypotheses also investigate whether the correlation is zero or is not equal to zero (Leventhal 1999):

$$H_0 : \mu_1 - \mu_2 = 0 \; or \; H_1 : \mu_1 - \mu_2 \neq 0 \qquad (1)$$

The hypotheses for the main research question are as follows:

1) H_0: Working capital management does not have a connection with building construction companies' profitability.

H_1: Working capital management does have a connection with building construction companies' profitability.

This thesis suggests following hypotheses for the sub-question:

2A) H_0: Days accounts receivables outstanding do not correlate with ROE.

H_1: Days accounts receivables outstanding correlate with ROE.

2B) H_0: Days accounts payables do not correlate with ROE.

H_1: Days accounts payables correlate with ROE.

2C) H_0: Current ratio does not correlate ROE.

H_1: Current ratio correlates ROE.

1.3 Research methods and limitations

This study utilizes previous research and quantitative research methods which comprise different methods using statistical numerical or statistical data (Watson 2014). These previous research are used to support the analysis done later in the thesis.

The dataset for this study is obtained from database Amadeus. The dataset contains data from 50 construction companies balance sheets' and annual reports. This study uses a 10-year time frame for the data and it brings 500 observations to analyse.

As a research method together with literature review, this study utilizes Pearson correlation coefficient and multiple linear regression analysis. Through the implementation of various analyses, this study seeks to enhance the understanding of the topic at hand and provide a nuanced perspective on the existing literature.

1.4 Structure

This study consists of five main chapters. The study begins with the introduction which purpose is to clarify the research topic and its backgrounds. Introduction also introduces research objectives and questions, research methodology, limitations and the structure of the study.

This study can also be divided into two parts: the theoretical part and the empirical part. The chapters 1-2 consist of the theoretical part and the last chapters 3-5 consist of the empirical part of the study.

The theoretical part of this study aims to introduce the backgrounds, previous literature and research done of the topic. In the second chapter this study builds the theoretical framework which serves as a skeleton for the empirical part.

In the third chapter this study introduces the empirical data set used and the methodologies utilized in this study. Fourth chapter presents the results obtained from the tests. In the fifth chapter this study is going through conclusions based on the results of the study.

2 Theoretical framework

2.1 Working capital

Even when WCM gains fewer attention in literature than long-term financing and investment decisions, it engages most of the time and attention of a financial manager as well as it reflects the crucial liquidity of a firm (Richards & Laughlin 1980). WCM aims to stabilize firm's working capital (WC) with efficient decisions in the liquidity management. WC generally identifies the amount of funds committed to the company's short-term financing. It is calculated by subtracting current liabilities (CL) from current assets (CA).

$$WC = current\ assets - current\ liabilities \quad (2)$$

CA and CL both have components that show how the cash are divided between assets and liabilities. Term "current" in both terms refers to the period of time which in this case means a year.

2.1.1 Current assets and current liabilities

CA include all those assets that can normally be turned into cash or its equivalent within a year. This one-year rule is not always applied since some still include receivables that are to be collected beyond a year as some only include the part which is collected within a year (Herrick 1944). As observed, CA also have inconsistency and variety depending on the observer.

CL include all the short-term obligations that are due or expected to be paid within a year. When comparing CA and CL, the last mentioned has more general adherence to the one-year rule than CA (Herrick 1944). CL are easier to predict for a company since the due date and the pay date are in the company's hands.

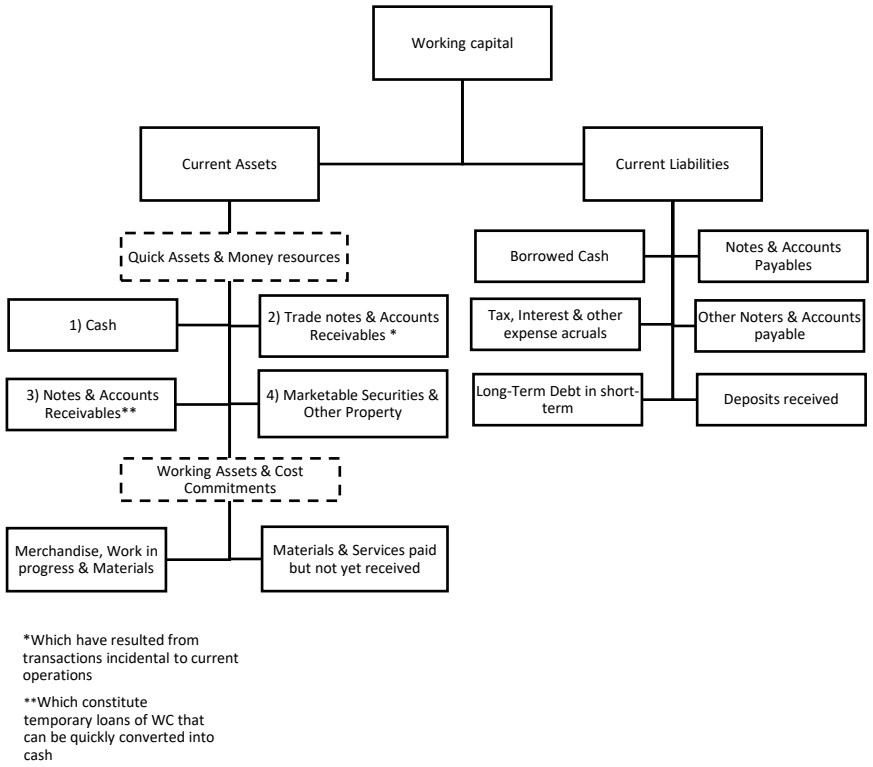

Figure 1. Current Assets and Current Liabilities (Herrick 1994)

As seen in the figure 1 below, CA and CL both consist of six underlying entries. CA can also be divided into two categories: quick assets or money resources and working or cost commitments. Quick assets and money resources mean cash, or their values that are collected in completed transactions and working or cost commitments mean assets that are invested (such as materials, services) which can also be exchanged into cash at a certain point. (Herrick 1944)

When looking these two categories deeper, Herrick (1944) states that quick assets and money resources contain: 1) cash and its equivalents; 2) trade notes and accounts receivables that have been collected via current business operations; 3) notes and accounts receivables which constitute temporary loans of WC that will automatically turn or can be turned into cash; 4) marketable securities or other property that represents occasional investments of WC and can be quickly turned into cash. Herrick (1944) also defines working assets or cost commitments as 5) merchandise, work in process, raw materials, and manufacturing

materials; 6) Other materials and services paid but not yet received that will be components of operating cost for example, operating and repair materials.

According to Herrick (1944), CL are divided into: 1) cash that is borrowed for temporary operation requirements; 2) notes and accounts payable for materials, services, merchandise and other operating requirements; 3) tax, interest and other expense accruals which also include reserves for deferred maintenance; 4) other notes and accounts payable to circumstanced as to require payment on existing current assets or the proceeds thereof; 5) long-term debt and sinking fund payments that fall into the period concerned; 6) deposits received on prospective sales and other service obligations.

This definition opens why WC indicates the short-term financial health and operational efficiency of a company. When comparing a company's WC levels in different time frames, you can determine which assets (inventory, account receivables etc.) hold the most equity in them. On the contrary, CL indicate how the company's operations are funded in the short term.

After Herrick's (1944) definition of CA and CL, there have been more simplified versions of determining these two terms. For example, Fazzari & Petersen (1993) and Nobanee & Abraham (2015) defined CA as:

$$CA = cash\ \&\ cash\ equivalents + accounts\ receivable + inventory \qquad (3)$$

As observed, these definitions of CA clarify that CA are tightly tied to companies' daily operations. Without cash, companies can't pay their bills nor make investments and without inventory, it is hard to produce or sell merchandise (excluding some industries and business models i.e. SaaS, CaaS etc.). On the contrary, it is not always approachable to have high CA as it might indicate inefficient CA use. It depends on the company which is the best CA ratio for them.

CL as well has a narrower definition which is more commonly used. According to Nobanee & Abraham (2015), CL can be formed as follows:

$$CL = account\ payables + notes\ payables + accruals \qquad (4)$$

As well as CA, CL are very likely to be linked to companies' daily business. For example, for smaller firms, CL are their only option for external financing. (Nobanee & Abraham

2015) Fazzari and Petersen (1993) also state that CL accounts for the majority of the total financing instances. Of course, CL also forms the majority of companies' short-term obligations that need to be paid. Thus, companies need to reserve enough liquidity (CA) to pay these obligations. Due to this relationship between CA and CL, it is important for companies to find a balance between expenses and revenue.

CA and CL as a part of WC, need to be managed in a way it makes them as efficient as possible. There are many ways to affect WC and a couple to mention are: the operating cycle concept and static view. The operating cycle concept investigates cash conversion cycle as the efficiency of management of the operating part of WC. The static view has traditionally used the current ratio as a key metric of a firm's liquidity. (Richard & Laughlin 1980)

2.1.2 Cash conversion cycle

According to Richard and Laughlin (1980), the operating cycle concept consists of the operating part of the WC, where income statement's measures are added to balance sheet analysis, resulting the definition of a cash conversion cycle (CCC).

There have been many types of research and definitions made of CCC but according to Jose et al. (1996), the CCC was first introduced by Gitman (1974) and later improved by Gitman & Sachdeva (1982). Later Richards and Laughlin operationalised the CCC and declared that CCC is the time between a company's purchase of resources until the cash collected from a sale as it measures how much time it takes a company to convert one dollar used to the disbursements back into a dollar (Richards & Laughlin 1980).

CCC contains four key metrics which are purchasing/production, sales, collection, and payments which bring flows to WC accounts. These metrics portray the concept of CCC by combining time intervals (usually days) derived from the company's normal receivables, inventory, and payables turnover occurrence. (Richards & Laughlin 1980)

Companies should optimize their receivables, inventories and payables so that their CCC is as small as possible. This is also supported by Soenen (1993), who suggests that the shorter the CCC is, the more it releases liquidity for the firm. By this, Soenen (1993) tried to argue that when a company has less cash tied up in its WC, it has a better liquidity position. This

is because the company has more cash available for free use, rather than being tied up in WC.

The formula of CCC is:

$$CCC = DIO + DSO - DPO \quad (5)$$

where days of accounts payable outstanding (DPO) is subtracted from the sum of days of inventory outstanding (DIO) and days of accounts receivable outstanding (DSO). (Talonpoika, Monto, Pirttilä & Kärri 2014)

According to Talonpoika et al. (2014), DIO, DSO and DPO are calculated as follows:

$$DIO = \frac{Inventory\ x\ 365}{Net\ Sales} \quad (6)$$

$$DSO = \frac{Accounts\ Receivable\ x\ 365}{Net\ Sales} \quad (7)$$

$$DPO = \frac{Accounts\ Payable\ x\ 365}{Net\ Sales} \quad (8)$$

In 2014 Talonpoika et al. also suggested that CCC should be turned into modified cash conversion cycle (mCCC) by adding advance payments to the CCC formula. By this Talonpoika et al. (2014) wanted to show that the efficiency of WCM differs when looking at mCCC instead of CCC. This study uses only the components of CCC as it is more commonly used in company reports.

As seen, DIO, DSO and DPO play a crucial part in companies' efficiency as every area must be optimized in order to make business operations as effortless and fast as possible. There have been many empirical studies on CCC optimization over the years and most of them have evidence of the connection between CCC and operation efficiency. For example, Jose et al. (1996) found a statistically negative correlation between aggressive liquidity management (in this case means lower CCC) and higher profitability.

By managing DIO, DSO and DPO it is possible to affect on company's operations from both ends. CCC has a clear connection to WC as it links to the current assets and current liabilities. By managing these, a company can save and earn a lot more as well as be more efficient.

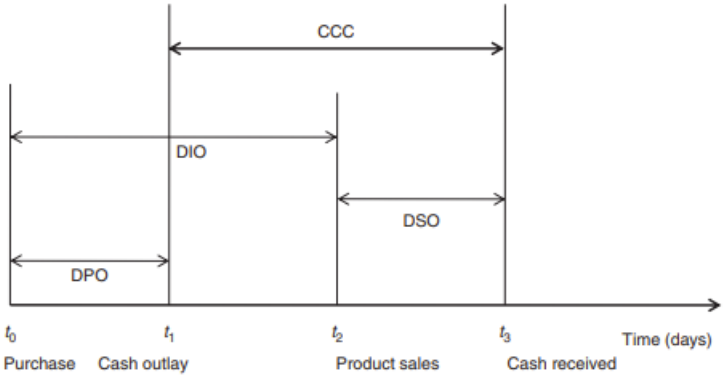

Figure 2. Cash Conversion Cycle (Talonpoika et al. 2014)

As figure 2, illustrates DIO, DSO and DPO on a timeline. The timeline starts with a purchase which can be i.e. material. The time between the purchase and cash outlay is DPO. This time period is an opportunity for a company to negotiate with their suppliers and creditors. If company gets plenty of time to pay its obligations, it releases cash to be used in other operations meanwhile.

At an ideal situation, DPO period is longer than the other cycle part as it would turn the CCC negative which means that a company has more time to pay its payables than to wait its receiving's (Moss & Stine 1993). That way company doesn't have to have the cash outlays immediately. On the contrary, according to Jose et al. (1996), if the DPO is increased too much, a company can lose its flexibility for future debt and discounts for early payments.

DIO starts as well from the purchase and ends with product sales. At an optimal point, a company does not need an inventory and it can sell its product right away to a consumer. This is a quite rare situation, especially in the construction and retail industry yet companies can reduce their inventory cycle by optimizing it. Yet again too tight inventory might cause sale losses due to stockouts (Jose Lancaster & Stevens 1996).

DSO is the time customer takes to pay its payable to a company. This, as well, is possible to negotiate with the customer as the company wants to get its receivable as soon as possible. Pre-payment is usually most favorable for a company as it gives the company a chance to fund its purchases related to working with the pre-payment. Companies can't still be too

strict with the billing policy as it might chase away the customers that require credit (Jose et al. 1996).

DPO, DIO and DSO are all metrics that indicate company's efficiency from the very beginning of production until the final cash receiving of a transaction. These metrics are used in WCM to gain efficiency throughout the production process and for this reason, this study uses DSO and DPO as liquidity variables in the later analyses. DIO is dropped from the analysis done later as it was not available in the chosen database.

2.1.3 Current ratio

WC is a good measurement when only one company is under review or the companies that are compared are in the same size category. The problem comes ahead if i.e. investor tries to compare multiple companies that differ a lot in the size. It wouldn't be appropriate to use working capital as a measurement for a company that operates with €100,000 revenue and compare it to a company whose operating revenue is €50,000,000 as the last-mentioned company's WC would be expected to be much higher than the smaller company's WC.

Certainly, the case is not always this but with different kinds of measurements, this possible problem can be solved. Due to this, this thesis uses the current ratio (CR) as a variable instead of WC since it enables the comparison between different size companies.

CR or sometimes referred as a working capital ratio, measures company's liquidity. CR is a ratio meter which is a static meter and provides a quick overview of the WC. Other this kind of meter is i.e., quick ratio (or so-called acid test ratio). These kinds of meters are commonly used as they are easy to understand and use (Bernstein, Most & Block 1981).

This thesis uses the current ratio instead of the quick ratio as it takes WC's components CA and CL into count. CR is calculated as follows:

$$CR = \frac{Current\ Assets}{Current\ Liabilities} \tag{9}$$

CR is measured through asset's liquidity which means the optimal time to transform an asset into money (Lippman & McCall 1986). All things considered, the most liquid asset is the cash itself. With high liquidity levels, firm can survive suddenly occurring expenses. On the

contrary, high liquidity levels are not always a good sign as they might indicate that a company is not putting its money into efficient use.

CR value over 1 indicates that a company can survive from its short-term liabilities and remain solvent. CR value under 1 indicates that a company can't survive from short-term liabilities if they were due once. For a company, it is approachable to seek CR fairly above 1 as it gives investors, creditors and other stakeholders a good image of the company's financial health. CR is a commonly used key indicator among the stakeholders that have already put or are going to put their money into the company.

2.2 How to measure profitability?

In this chapter, this study goes deeper into profitability as it tries to find an indicator for that. Profitability can be measured through various indicators, and it depends on the viewer which measure is the best.

For example, investors evaluate stocks through various methods as it depends on the investor's goals which measure to use. Some investors want to achieve high returns from their investments as some aim to gain stock growth in long-distance. This thesis uses ROE as a measurement for stock valuation since it measures how efficiently a company turn its equity into net profit. This can be seen as an indicator of profitability as it measures the ratio of net profit and shareholders' equity and how efficient (profitable) that ratio is.

2.2.1 Return on equity

ROE is a profitability measurement which takes count on the equity holder's returns as well as the potential growth of the holder's investment (Petersen & Schoeman 2008). As Rappaport (1986) announced, ROE is one of the most popular and widely used corporate financial performance indicators. Even though Rappaport's announcement is 30 years old, ROE is still one of the most used and known measures for performance.

DuPont Corporation introduced a model for determining ROE which has been used widely for financial analysis when evaluating companies' efficiency, quality and leverage. DuPont's formula showed that ROE contained three components shown below:

$$\frac{Net\ Income}{Equity} = \frac{Sales}{Total\ Assets} x \frac{Net\ Income}{Sales} x \frac{Total\ Assets}{Equity} \quad (10)$$

The DuPont model is a financial analysis technique that decomposes Return on Equity (ROE) into three components: net margin, asset turnover, and equity multiplier (Reilly 1997). This allows investors to examine the individual factors that contribute to a company's profitability and to compare the performance of different firms. Additionally, the DuPont model can be used to identify opportunities for improving a company's financial performance by analyzing the relative contributions of each component to ROE. An optimal level of ROE is slightly argued as it depends a lot on the industry the firm doing business. Although components of ROE are not directly connected to WC, they can still impact companies' financial performance which on the other hand can affect WC balance. Thus, this study uses ROE as a measurement for profitability.

2.3 Cash conversion cycle's relation to Return on equity

After, the theory and introduction of CCC and ROE it is crucial to investigate the relationship between these two metrics with the help of previous studies. As previously observed, low DSO and DIO together with high DPO are suggested as the best practice for companies as it results in more liquidity for the firm (Soenen 1993). The relationship between a company's WC and its liquidity position has been previously studied in academic literature. Many researchers have sought to understand the impact of WCM, specifically the component of CCC, on a firm's profitability.

For example, Sawarni, Narayanasamy & Ayyalusamy (2020) investigated the relationship between WCM and a firm's profitability. They used Tobin's Q and ROE as the dependent variables for profitability and CCC components as (DSO, DPO and DIO) independent variables. This research suggests that there is a negative relationship between a company's efficiency in WCM and its financial performance, as measured by ROE. Specifically, the study found that firms that are able to efficiently manage their WC tend to have higher ROE, indicating that they are more profitable. Conversely, firms that are less efficient in WCM may have lower ROE and potentially lower profitability. This is also supported by research

done by Lyngstadaas & Berg (2016), which found a negative relationship between profitability (measured with ROA) and DSO, DIO and DPO in 21,075 Norwegian SMEs.

Research of WCM's and profitability's relationship have consistently demonstrated similar outcomes. One significant implication that emerges from many of these studies is that efficient WCM can significantly impact a firm's financial performance as reflected in measures of profitability. While previous research has examined the relationship between WCM and profitability through the lens of various profitability components such as ROA or Tobin's Q, this study aims to investigate the connection between WCM and profitability by examining the components of the CCC and ROE.

Although previous research has not employed ROE as a metric for assessing profitability, this study utilizes ROE as a measure due to its ability to capture the impact of a company's capital structure on profitability, as well as its widespread acceptance and use as a measure of profitability.

3 Research methodology and dataset

At first section this thesis introduces chosen data and its filters. At the second section, this study presents the chosen variables and how they're collected. After that, the research methodology is presented and in the last section this study goes through analytical process regarding the chosen data.

3.1 Chosen data and variables

This study uses secondary data from listed companies' balance sheets which is collected from database called Amadeus. This database collects financial information from public and private companies across Europe (Amadeus 2022). According to Amadeus (2022) the database is maintained by Bureau van Dijk.

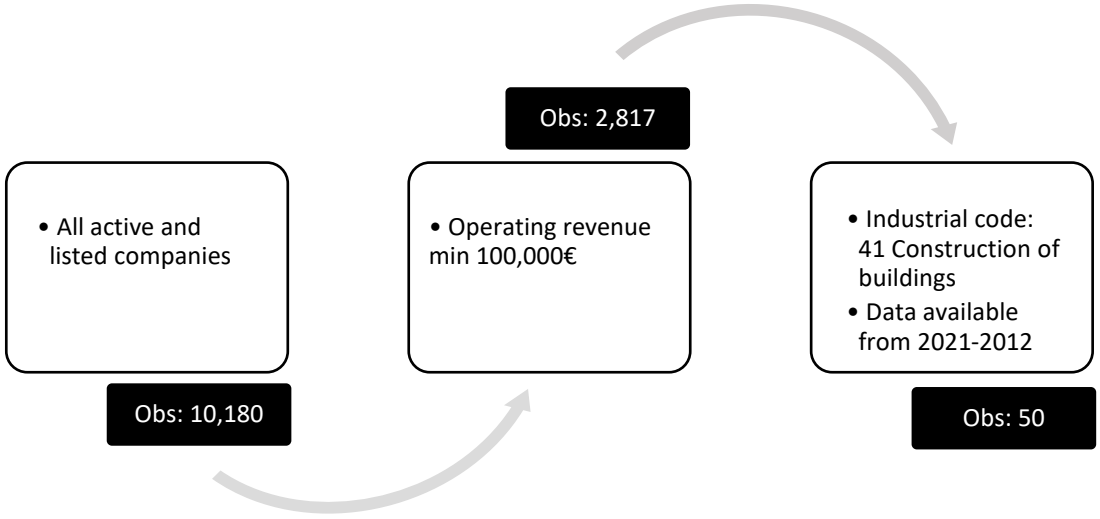

Figure 3. Illustration of the dataset filtering

Figure 3 illustrates the filters used in the creation of the dataset. This thesis used balance sheets from active and publicly listed companies. Data was narrowed so that the operating revenue of the companies was at least 100,000€ due to the better functionality of the research methods. After that, the companies were filtered by their industry and in the end, there were only companies that specify in building construction. At the end of the filter process, the data set was checked for the last 10 years in order that it had all the observation year values

available during 2021-2012. After the whole data filtering process, the observations decreased from 10,180 to 50.

These filters were used as they made the data more reliable and easier to compare. Publicly listed companies are obliged to publish financial statements annually (Official Journal of the European Union 2004). Thus, listed companies' data is more reliable as they are obliged to report their financial statements annually and the reports are examined by auditors.

The industry choice can be justified with the deviation as companies from different industries have different key metric averages. For example, according to Filbeck & Krueger (2005), varying on the industry, some companies have low accounts receivables ratios (indicates problems in cash collecting), while a company from another industry tend to have high inventory turnover (they're able to sell goods fast). Using companies' data from the same industry enables better comparison between the variables.

3.1 Chosen variables

This study uses ROE as the dependent variable. As an independent variable, this study uses CR together with CCC components DSO and DPO. These variables are used as they are measurements of profitability and liquidity. Thus, they aim to explain the connection between ROE and WCM.

These variables were also available in the database Amadeus. In the database Amadeus (2022) they are calculated as follows:

$$ROE = \frac{Net\ income}{Shareholder's\ equity} * 100 \tag{11}$$

$$DSO = \frac{Accounts\ receivables}{Operating\ revenue} * 360 \tag{12}$$

$$DPO = \frac{Accounts\ payables}{Operating\ revenue} * 360 \tag{13}$$

$$CR = \frac{Current\ assets}{Current\ liabilities} \tag{14}$$

ROE and CR are calculated in the same form as in the previous literature review. DSO and DPO have some variety in their form as accounts payables and accounts receivables are divided with operating revenue instead of net sales. According to Amadeus' website (2022), the operating revenue consists of:

$$Operating\ Revenue = Net\ sales + Other\ operating\ revenues + Stock\ variations \quad (15)$$

Also, the DSO and DPO differ from Talonpoika et al. (2014) definition as the quotient is multiplied by 360 and not by 365. These differences do not have a significant impact on the study results as they still contain the same components as the previously defined formulas in the literature review.

3.2 Research methodology

The purpose of the study is to explore the relationship between the company's profitability through ROE and the metrics that measure WCM. At first, the thesis aims to test the correlation between variable pairs as it tries to find evidence for the linear regression analysis results which will be obtained later.

3.2.1 Correlation analysis

Before the regression analysis, the dataset is testing the connection between ROE, DSO, DPO and CR by using the Pearson correlation coefficient which aims to determine the linear relationships between two variables (Deng, Deng & Cheong 2021). For example, Sawarni et al. (2020) also utilize the Pearson correlation coefficient in examining the linear relationship between pairs of variables. The Pearson correlation coefficient allows for the evaluation of the relationship between pairs of variables by considering them individually, making it a useful tool for determining the strength and direction of the association between the variables

According to Obilor & Amadi (2018), hypotheses for correlation analyses are formatted as follows:

$$H_0: \rho = 0 \quad (16)$$

$$H_1: \rho \neq 0 \quad (17)$$

Where the null hypothesis (H_0) denotes that there is no significant relationship between variables and the alternative hypothesis (H_1) denotes that there is a correlation between variables as the correlation is not zero. These kinds of hypotheses are also called two-tailed test statistical significance and they are used when the null hypothesis is not directional.(Obilor & Amadi 2018)

According to Deng et al. (2021), as the base for the Pearson correlation coefficient is covariance, it can be used as evidence to indicate the reliability of different evidence alleged. Pearson correlation coefficient is widely used in linear correlation measurement and it was first discovered by Fisher, Pearson and Galton (Ly, Marsman & Wagenmakers 2018).

The Pearson correlation coefficient is calculated as follows:

$$\mathrm{r} = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \quad (18)$$

Where r stands for the correlation coefficient, n indicates the sample size and both x and y are the chosen variables to test (Emerson 2015). This study uses a confidence interval of 95% which leaves the significance level to $\alpha = 0{,}05$.

After determining the correlation coefficient (r), it is important to test the significance of the result (so-called p-value). When reviewing the Pearson correlation coefficient's significance, the p-value can be determined with t-distribution, z-transformation or SPSS (Obilor & Amadi 2018) This study uses the t-distribution to test the Pearson correlation coefficient's significance. It is calculated as follows:

$$\mp t = r\sqrt{\frac{n-2}{1-r^2}} \quad (19)$$

Where t is the required value to test the significance of correlation coefficient result r, n stands for sample size and r is the computed correlation coefficient that is tested for significance (Obilor & Amadi 2018). The value of t indicates the student's distribution value which is the t-value for the correlation coefficient r. After determining the t-value, the obtained value is then placed into the t-distribution chart which contains the critical value limits. (Moore & Kirkland 2007) These critical value limits are calculated as follows:

$$tc = \mp t_{\frac{\alpha}{2};v} \tag{20}$$

Where tc stands for the t-distribution's critical value, α is the significance level and v stands for the sample size. If the obtained value of previously calculated t is greater than the value of tc, then the null hypothesis should be rejected. (Atomic 2022)

Although the Pearson correlation coefficient is a good measurement for variable pairs, it does not tell the cause-and-effect relationship hence it is not possible to conclude which factor affects which (Deloof 2003). Due this lack of causation, this thesis uses regression analysis to determine the causation between dependent and independent variables.

3.2.2 Regression analysis

Multiple linear regression analysis was utilized to address the main research question. This method differs from simple linear regression in that it allows for the simultaneous consideration of multiple independent variables in relation to a dependent variable, while simple linear regression only enables the examination of one independent variable in relation to a dependent variable at a time. The regression analysis aims to seek the possible connection between dependent and several independent variables as it also tries to examine how much of the outcome is explained by the independent variables (Yan & Su 2009).

Multiple linear regression analysis is calculated as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k + \varepsilon \tag{21}$$

where y stands for the dependent variable, β_0 is the $y's$ intercept, β_k stands for the slope of the simple linear regression line, x_k is the independent variable and ε marks up the random error (Yan & Su 2009).

Multiple linear regression analysis is subject to the Gauss-Markov assumptions, which are a set of conditions that are required to be met in order for the ordinary least squares (OLS) estimator to have desirable statistical properties. Regarding to Berry (1993), the assumptions are linearity, independence of errors, homoscedasticity, normality of errors, no perfect multicollinearity, no autocorrelation and exogeneity. It is generally recommended to carefully consider these assumptions when conducting multiple linear regression analysis, and there are various techniques that can be used to address violations of the assumptions if necessary.

Multiple linear regression analysis was chosen in this study as it enables comparing a set of two or more variables with multiple data observations (Jobson 1991). The regression analysis is also utilized in many other pieces of research that investigate the relationship between WCM and profitability, such as Pouraghajan & Emamgholipourarchi (2012), Samiloglu & Akgün (2016) and Sawarni et al. (2020). In this study linear regression provides an analysis tool which helps determine the possible connection between ROE and WC components.

However, must be considered that the linear dependence of the variables is rarely unambiguous. If there is a correlation between the dependent and independent variables, it still does not perfectly prove the cause-and-effect relationship between them. The result must be interpreted only as support for the theory.

4 Research results

The results of the study are presented in this chapter. First, the data set is described using simple statistical figures. After that, the correlations between the variables are examined with the Pearson correlation coefficient. At the end of the chapter, the dataset is tested with multiple linear regression analysis and the results are examined together with the results of Pearson correlation coefficient in order to answer the research questions. The results of the study are examined at a 5% significance level.

4.1 Illustrative statistics

Next, the illustrative statistics of the data set are reviewed in the table X below. These values are calculated using the data of 50 chosen building construction companies.

Table 1. Illustrative statistics of the data

Variable	Firm years	Mean.	Stdr. Deviation	Min.	Max.
DSO	500	58,7	71,8	0,1	824,3
DPO	500	71,1	86,6	0	811,3
CR	500	2,2	1,7	0,3	17,1
ROE	500	9,5	22,6	-239,6	100,1

There a was total of 500 firm years in the dataset for all the variables as the observation period was 10 years. The average DSO for the data set companies is 58,7 meaning that chosen companies are waiting for their receivables to be collected for approximately 59 days. The maximum DSO in the dataset is 915, which might indicate that the company might send invoices to its subsidiary which never pays the invoice.

The graph above indicates that the average DPO settles around 71 days. The minimum data point for DPO is 0 which might indicate that certain data set companies do not have good payment terms as their creditors require payments immediately. The zero might also be the cause of something else.

As seen in the table above, CR average for the dataset companies is 2,2. This ratio suggests that most of the dataset companies have a healthy balance between CA and CL as the ratio is above 1. Certainly, CR does not straight indicate the financial health of a company, yet the dataset's CR average is relatively good for construction companies.

The average ROE for the data set is 9,5 as the minimum value for ROE is -239,6 and the maximum value is 100,1. In general, companies in the construction industry have a low ROE as the business model is very capital-committing. Construction companies usually need equipment for running their business (heavy machinery such as trucks and cranes) and these commit a lot of money in the long term. Thus, the equity in the company is tied to the fixed assets (non-current long-term assets that the company uses in its business operations) and brings the ROE down. The negative value in the minimum ROE data point is most likely due to a certain company's negative revenue during the observation years.

4.2 Pearson correlation coefficient

Correlations between the variable pairs are examined using the Pearson correlation test. With Pearson correlation, this study investigates the relationship between variables pairs whereas multiple linear regression analysis examines the strength and direction of variables (Zou, Tuncali & Silverman 2003). Thus, the Pearson correlation coefficient is done first as it reviews the relationship between variables.

In the table below are the results obtained from the Pearson correlation test.

Table 2. Pearson correlation coefficient results

	DSO	*DPO*	*CR*	*ROE*
DSO	1			
DPO	*0,50	1		
CR	-0,09	-0,06	1	
ROE	*-0,26	*-0,19	0,04	1

Note: *Correlation is significant at the 0.05 level (two-tailed)

As observed from the table above, the connection between DSO and DPO is significantly higher than other variable pairs (0,50). According to Lei (2006), too high correlation between two independent variables sometimes causes multicollinearity, which is usually a problem as it leads to erroneous results. What is determined as a too high correlation depends on the observer and according to Lei (2006), 0,55 is not considered as too high correlation.

The 0,50 positive relationship between DSO and DPO indicates that when the receivables payment days are increasing, the payables payment days are also increasing and vice versa. CR does not have a significant correlation with any of the other variables. ROE instead has a significant negative correlation with DSO and DPO. This negative significant correlation between WCM components and profitability has been also supported in earlier research done by Deloof (2003), Lazaridis & Tryfonidis (2006) and Enqvist, Graham & Nikkinen (2014).

A negative correlation between ROE and DSO indicates that when DSO decreases, ROE increases. Based on table 2, a conclusion can be drawn that when a company receives its receivables faster, its profitability increases. As earlier observed, when CCC's components decrease it increases the efficiency and profitability of a firm. This assumption can explain the relationship between ROE and DSO as DSO decreases, ROE increases.

There are certain limitations determined by the method used and thus, it needs to be reviewed from different perspectives. According to Deloof (2003), this negative correlation can also be explained by the fact that customers require longer payment terms as they want to evaluate the quality of products purchased from companies with low profitability.

ROE and DPO as well have a negative and significant correlation, which also means that when one decreases, the other increases. This means that when DPO increases, ROE decreases and vice versa. Yet again, this can be explained from different perspectives as it is not clear which variable affects which. This result is still surprising as it is not in the line with the CCC theory where a longer DPO is ideal for a company (Moss & Stine 1993).

One explanation for this negative correlation could be the cash discounts gained from early payments, which encourage companies to pay their payables faster. Deloof (2003) instead explained this negative relationship between ROE and DPO with the assumption that companies that are less profitable wait longer to pay their obligations.

Based on the Pearson correlation coefficient analysis, conclusions can be drawn that whether the relationship between variable pairs is positive or negative. However, it does not explain how much the independent variable affects the dependent. Thus, these relationships are now further analysed with the regression analysis.

4.3 Multiple linear regression analysis

The multiple linear regression aims to find the answer to the main research question and explain the results obtained from the Pearson correlation coefficient. The multiple linear regression was first tested with the whole dataset.

Table 3. Result of multiple linear regression for the whole dataset

Multiple linear regression analysis	ROE	
	Coefficient	p-value
DSO	*-0,068	0,000
DPO	-0,020	0,121
CR	0,227	0,700
R-Square	0,071	

Note: *Correlation significant at the 0,05 level

The R-Square for the regression analysis is 0,071 which explains how many per cent this model explains y's changes. This indicates, that 7.1% per cent of ROE's change can be explained by the independent variables.

The only statistically significant coefficient is the negative connection between ROE and DSO. It shows that if DSO decreases by 1 unit (one day), ROE will increase by 6,8%. DPO also has a negative impact on ROE as if DPO decreases one unit (day), ROE will increase by 2%. This is not statistically significant as its p-value is over 0,05. CR has the biggest correlation coefficient with ROE (22,7%) however it also has the biggest p-value (0,7) which means it is not statistically significant.

When dividing the dataset into years, this study found more connections between ROE and DSO.

Table 4. Results of multiple linear regression for the year 2018

Multiple linear regression analysis (2018)	ROE	
	Coefficient	p-value
DSO	*-0,124	0,013
DPO	0,042	0,222
CR	0,684	0,449
R-Square	0,143	

Note: *Correlation significant at the 0,05 level

Above is the multiple linear regression from the year 2018 with all 50 companies' data. As the R-square shows, this regression model explains 14,3% of the ROE changes with the chosen variables. In 2018 the only statistically significant negative relationship is between ROE and DSO (-12,4%).

Table 5. Results of multiple linear regression for the year 2014

Multiple linear regression analysis (2014)	ROE	
	Coefficient	p-value
DSO	*-0,112	0,002
DPO	-0,002	0,871
CR	-0,900	0,369
R-Square	0,203	

Note: *Correlation significant at the 0,05 level

Above is the multiple linear regression analysis from the year 2014. Here as well, the only statistically significant relationship was between ROE and DSO as the coefficient was -11,2%. As observed, a negative relationship between ROE and DSO is visible through the years, yet it is not obtained every year, indicating it is not constant.

This study also found a relationship between ROE and DPO in the year 2021. It is shown in the table below:

Table 6. Results of multiple linear regression for the year 2021

Multiple linear regression analysis (2021)	ROE Coefficient	p-value
DSO	0,044	0,728
DPO	*-0,385	0,000
CR	-1,171	0,558
R-Square	0,539	

Note: *Correlation significant at the 0,05 level

The table above shows, that with 2021 data from the 50 observation companies, this study found a -38,5% coefficient between ROE and DPO. This means that when DPO decreases one unit (day), ROE increases by 38,5%. This relationship is also statistically significant as the p-value is under 0,05. This was the only statistically significant relationship observation between ROE and DPO during the observation years 2021-2012. This model could not explain the relationship between ROE and DPO, or at least it failed to explain it on a statistically significant level and constant.

5 Conclusions

This thesis aims to investigate the relationship between WCM and profitability in companies operating in the building construction sector. To address the main research question of whether there is a relationship between WCM and profitability in building construction companies, the study uses ROE as a measure of profitability and DSO, DPO, and CR as indicators of WCM.

After the first research question, this study tried to specify which components of WCM even have a relationship with profitability. This was reviewed with the sub-question “Do the individual components (days receivables outstanding, days payables outstanding & current ratio) of working capital correlate with the return on equity?”

The sub-question of whether the individual components of WCM (DSO, DPO, and CR) are associated with ROE was examined using the Pearson correlation coefficient, which assesses the relationship between pairs of variables. The hypotheses proposed that all three components would be correlated with ROE.

The results of the Pearson correlation coefficient analysis showed that the variable pairs ROE and DSO, as well as ROE and DPO, showed a correlation. These findings supported the first two hypotheses, while the hypothesis that CR correlates with ROE was rejected due to statistical insignificance at the chosen 0.05 level. Both variable pairs that supported the hypotheses were statistically significant and exhibited a negative correlation. Previous research and literature review also supported the finding of a negative correlation between ROE and DSO, though the negative correlation between ROE and DPO was not consistently supported by the literature and theories on WCM and ROE.

After the Pearson correlation coefficient test, this study aimed to answer the main research question by testing the relationship between dependent ROE and independent variables DSO, DPO and CR. This was done with multiple regression analysis and the hypothesis was “Working capital management does have a connection to the building construction companies' profitability”.

The multiple linear regression showed that one component of WCM had a connection to profitability. This component was DSO and the connection was negatively correlated with

ROE. Although one WCM's component was able to predict ROE with the regression analysis, other components (DPO and CR) were not statistically significant and thus the null hypothesis "Working capital management does not have a connection to the building construction companies' profitability" was accepted. Previous research did not fully support this study as the regression analysis did not find statistically significant causation between all the WCM components and profitability.

Contrary to previous research, this study found a negative correlation between DPO and ROE in the Pearson correlation coefficient. According to previous theory, having a short CCC, and therefore a high DPO, would be optimal for improving a company's liquidity and profitability. However, the fact that a decrease in DPO corresponds with an increase in ROE does not negate the fact that WCM has an impact on a company's profitability. A decrease in DPO in conjunction with an increase in profitability may also indicate that the company is perceived as financially stable, as it is not extending its payment periods. Further investigation into the relationship between DPO and profitability would be a valuable research topic, as each CCC component contains additional elements to consider and insights to be gained from a productivity standpoint.

The findings of this study, while including some unexpected results, add to the growing evidence that WCM can impact a company's profitability. Future research in this area could be valuable, as a deeper examination of individual components of the CCC in relation to various profitability variables could provide a further understanding of their interdependence.

In addition, future research on this topic could involve expanding the scope to include other industries or geographic regions. The construction industry, with its heavy asset commitments, differs from other industries, and it would be interesting to explore whether WCM has a similar impact on profitability in other sectors.

This study could also be expanded to consider additional profitability measures and to examine the relationship between WCM and profitability from the perspectives of different stakeholders, such as investors, creditors, and company management. Such an approach could further increase the recognition of the importance of WCM in business.

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