



# **Visibility of activities driving the performance of accounts receivable management**

Exploring effective visual communications

Kiira Kajoskoski

Master's Thesis  
International Business Management  
2021

MASTER'S THESIS	
Arcada	
Degree Programme:	International Business Management
Identification number:	
Author:	Kiira Kajoskoski
Title:	Visibility of activities driving the performance of accounts receivable management: Exploring effective visual communications
Supervisor (Arcada):	Carl-Johan Rosenbröijer
Commissioned by:	-
<p><b>Abstract:</b></p> <p>This study was an action research aiming to increase the efficiency of accounts receivable management. The purpose of the study was to enhance visibility of activities driving the performance of accounts receivable management by exploring effective visual communications. The assumption was that effective visual communications enhance visibility. Literature review investigated the concepts of accounts receivable and performance measurement. A few of the most common outcome metrics were introduced. Measuring outcome metrics, however, is too late in terms of improvement. Therefore, to contribute to performance, visibility of activities driving the performance is needed. This requires defining these activities and the indicators to measure them. As a response a model to define leading indicators was proposed. Conceptual framework was built around visual communications by exploring visual perception, visual attention and visual representations. A definition for an effective visual communication was provided. As an outcome, a selection of visual communications representing accounts receivable leading indicators was produced. The study concluded that a graph serves a purpose defined by the designer, who decides the approach towards the data. Therefore visibility is dependent on the designer's understanding of the design principles, human sensory capabilities and also the substance in question. The concept of substance was not addressed in the study.</p>	
Keywords:	Accounts receivable, working capital, performance measurement, visibility, leading indicator, visual representation, visual communication, action research
Number of pages:	82
Language:	English
Date of acceptance:	

# TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION .....</b>	<b>7</b>
1.1	Background and problem statement .....	8
1.2	Aim of the study .....	9
1.3	Theoretical framework .....	9
1.4	Method .....	11
1.5	Limitations .....	12
1.6	Definitions .....	12
1.7	Structure of the thesis .....	13
<b>2</b>	<b>ACCOUNTS RECEIVABLE.....</b>	<b>14</b>
2.1	An overview of working capital .....	14
2.1.1	<i>Working capital defined</i> .....	14
2.1.2	<i>Optimization of working capital management</i> .....	15
2.1.3	<i>Role of accounts receivable</i> .....	16
2.2	Accounts receivable management .....	16
2.2.1	<i>Elements of receivables management</i> .....	17
2.2.2	<i>Order to cash process</i> .....	19
2.2.3	<i>Optimization of accounts receivable management</i> .....	20
2.3	Performance measurement.....	20
2.3.1	<i>Different approaches to performance measurement</i> .....	21
2.3.2	<i>Lagging indicators of accounts receivable</i> .....	22
2.3.3	<i>Model for defining leading indicators</i> .....	26
<b>3</b>	<b>VISUAL COMMUNICATIONS .....</b>	<b>29</b>
3.1	Visual perception .....	29
3.1.1	<i>Visual information processing</i> .....	29
3.1.2	<i>Gestalt principles of visual perception</i> .....	30
3.1.3	<i>Memory</i> .....	34
3.2	Visual attention .....	37
3.2.1	<i>Visual attention defined</i> .....	37
3.2.2	<i>Pre-attentive attributes</i> .....	38
3.2.3	<i>Chartjunk and cognitive load</i> .....	39
3.3	Visual representations .....	42
3.3.1	<i>Short introduction to graphical representations</i> .....	42
3.3.2	<i>Graphical integrity and graphical excellence</i> .....	43
3.3.3	<i>Evolution of Excel chart design</i> .....	45

<b>4</b>	<b>METHODOLOGY .....</b>	<b>49</b>
4.1	Action research.....	49
4.1.1	<i>Definition and purpose of action research</i> .....	49
4.1.2	<i>Various aspects of action research</i> .....	50
4.1.3	<i>Research process</i> .....	51
4.2	Introduction to research data.....	53
4.2.1	<i>Relational database</i> .....	53
4.2.2	<i>Data set</i> .....	53
4.2.3	<i>Cross-tabulation</i> .....	54
<b>5</b>	<b>RESULTS.....</b>	<b>55</b>
5.1	Visibility of activities driving the performance.....	55
5.1.1	<i>Definition of an accounts receivable leading indicator</i> .....	55
5.1.2	<i>Defining leading indicators driving DSO</i> .....	56
5.1.3	<i>Findings from data</i> .....	59
5.2	Effective visual communications .....	60
5.2.1	<i>Definition of an effective visual communication</i> .....	60
5.2.2	<i>Best practices for designing visual communications</i> .....	60
5.2.3	<i>Visual communications of leading indicators driving DSO</i> .....	61
<b>6</b>	<b>DISCUSSION .....</b>	<b>71</b>
6.1	Recommendations for future product development .....	73
<b>7</b>	<b>CONCLUSIONS .....</b>	<b>74</b>
	<b>References .....</b>	<b>77</b>

## Figures

Figure 1. Theoretical framework .....	9
Figure 2. Working Capital .....	15
Figure 3. A model for defining leading indicators .....	28
Figure 4. Gestalt principle of proximity (Ware 2012 p. 182).....	31
Figure 5. The Coca-Cola Company, poster of International Day of Happiness (see Busche).....	31
Figure 6. Gestalt principle of common region (Ware 2012 p.188) .....	32
Figure 7. Gestalt principle of similarity (Ware 2012 p. 183) .....	32
Figure 8. Gestalt principle of connectedness (Ware 2012 p. 184) .....	32
Figure 9. Gestalt principle of continuity (Ware 2012 p. 184) .....	33
Figure 10. A shape of a Christmas tree (Busche).....	33
Figure 11. The logo of Fedex (Busche).....	34
Figure 12. Gestalt principle of closure: a circle and a broken ring (Ware 2012 p. 187) 34	
Figure 13. The flow of information through the memory system, as conceptualized by Atkinson and Shiffrin (Baddeley 2013 p. 9).....	35
Figure 14. Pre-attentive processing (Ware 2012 p. 152).....	38
Figure 15. Moiré vibration (Tufte 2001 p. 108) .....	40
Figure 16. Anscombe's Quartet (Anscombe 1973).....	42
Figure 17. A sample slides from a slide set "Creating and editing charts in Microsoft Excel" (Aitkin 2003).....	45
Figure 18. An example of visual communications created in Excel 2012 (Cook).....	46
Figure 19. An example of a default chart created in Excel 2016 .....	47
Figure 20. Examples of quick design layouts Excel 2016.....	47
Figure 21. An example of visual communications created in Excel 2016 .....	48
Figure 22. Action reflection cycle and its sequences (McNiff 2013 p. 57).....	49
Figure 23. Action research process.....	51
Figure 24. An example of SQL database table.....	53
Figure 25. Applying the model to define the leading indicators driving DSO.....	57
Figure 26. Average balance past due of the accounts past due over 90 days .....	62
Figure 27. Largest accounts with balances past due over 90 days .....	63
Figure 28. Balances past due over 90 days and current balances.....	64

Figure 29. Largest accounts past due (Top 10) .....	65
Figure 30. Largest accounts past due (Top 10) – the indicators.....	66
Figure 31. Average days past due per account .....	67
Figure 32. Collection status of past due invoices .....	68
Figure 33. Expected amount of uncollectible receivables .....	69
Figure 34. Average payment terms per account .....	70

## **Tables**

Table 1. Pre-attentive visual properties (cp. Ware 2012 pp. 154-155).....	38
Table 2. Leading indicators driving DSO.....	58
Table 3. Current attributes .....	59
Table 4. Additional attributes .....	60

# 1 INTRODUCTION

The amount of data in the world has increased exponentially during the past two decades. Simultaneously the expectations to leverage it efficiently in decision-making have grown. The data is at hand, but arduous to interpret. Business intelligence techniques have been employed to transform raw data into information providing an outlook to company's past, current and future events (Gordon 2013 p. 141). Descriptive, predictive and prescriptive analytics are involved from analyzing simple statistical measures to explaining the relationships between data inputs and outputs to finally guide decision makers towards a solution before the decisions are actually made. (Nielsen 2018.)

Technology has enabled people to spend less time gathering and aggregating data (Rodriguez & Kaczmarek 2016 p. 20). According to Rodriguez & Kaczmarek the amount of time spent on creating visual representations of data has increased. The job description of the management accountant is also shifting from data producing to data translating, increasing the importance of skills needed to analyze the outcome (Nielsen 2018).

Vision captures more information than all other senses combined. Somewhat twenty billion neurons of the brain are devoted to processing and analyzing visual information. The pattern-finding mechanism they provide is an elemental constituent of human's cognitive activity. Effective visual communications harness these capabilities minimizing the conscious effort needed to absorb the data. The study conducted by Hirsch et al. (2015) showed that leveraging visualizations in management accounting reports increased decision quality. The conclusion is supported by Helweg-Larsen & Helweg-Larsen (2007), who argue that people untrained in finance find business visualizations more appealing than financial statements expressed in numbers. Rodriguez & Kaczmarek (2016 p. 20) have noticed that the audience reviewing financial data has got more diverse, which increases the need for digestible information. According to Tufte (2001 introduction), well-designed data graphics are usually the simplest and the most powerful method for analyzing and communicating statistical information.

## 1.1 Background and problem statement

Accounts receivable management aims to convert receivables into cash as soon as possible, but the execution is not that straightforward. According to Taylor (2011), companies tend to withhold the payments of their invoices to preserve cash, causing an impact across the economy. On the other hand, even though the businesses have set accounts receivable policies, the policies are not enforced effectively or deployed at all. Deloitte argues the habit is culture driven, and the companies prioritizing sales tend to extend credit, offer discounts and ignore payment terms regardless of the price, if the deal gets sealed. Ignoring the strategic significance of accounts receivable and treating it as it was an administrative task, leads to situation, where the customers are unintentionally provided with free financing (cp. Deloitte; Taylor).

Enhancing visibility of activities driving the performance of accounts receivable management gives valuable information about the current risks and weaknesses, such as lack of planning and focus, infirm policies and their poor implementation. It also contributes to performance by indicating the efficiency of the activities that impact on achieving the high-level target of converting receivables into cash as soon as possible.

The research conducted by the author is twofold. On the one hand a theory and conceptual framework is built around accounts receivable leading indicators and visual communications, but on the other hand a business problem related to lack of visibility is addressed. The commissioning party is kept anonymous and will therefore not be introduced. The business problem concerns an accounting software that holds the information needed in order to evaluate the performance of accounts receivable management, but currently the information is not leveraged comprehensively. The software provides very limited amount of standard reports summarizing the balances of accounts receivable ledger, but it does not present any indicators evaluating the performance or graphical representations supporting the analysis.

As an outcome of the study a set of visual communications are produced giving guidance on how to represent data effectively.



## 1.2 Aim of the study

In order to increase the efficiency of accounts receivable management, the aim of the study is to enhance visibility of activities driving the performance of accounts receivable management by exploring effective visual communications.

The following research questions are formulated to investigate the topic:

- How the efficiency of accounts receivable management is measured?
- How visibility of activities driving the performance of accounts receivable management is provided?
- What is the definition of an effective visual communication?
- How effective visual communications enhance visibility?

Consequently, the purpose of the thesis is to examine a data set containing accounts receivable ledger data of accounting software “X” to discover to what extent it includes the necessary attributes to create visual communications.

## 1.3 Theoretical framework

The theoretical framework of the thesis consists of two areas, which are accounts receivable management and visual communications (see Figure 1).

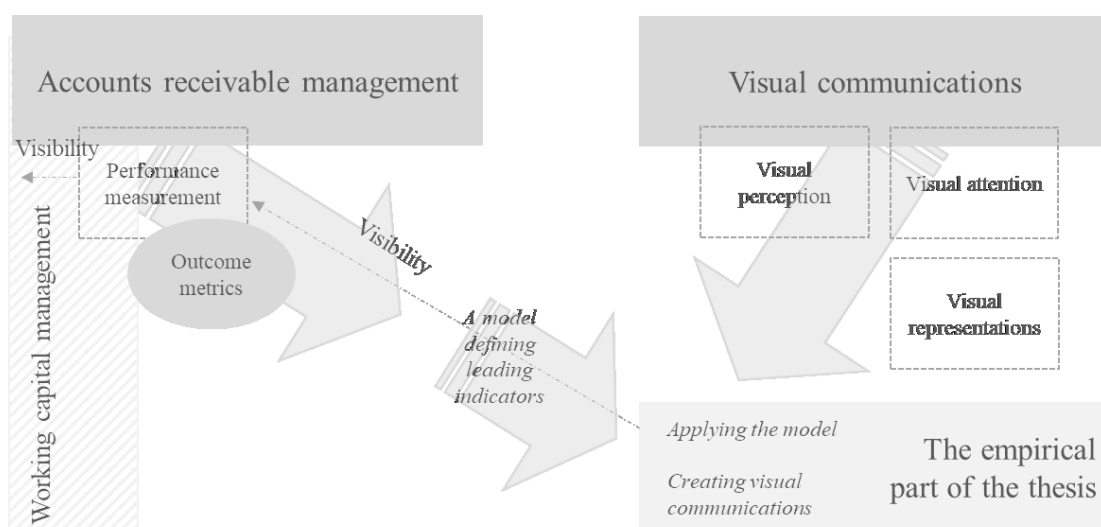


Figure 1. Theoretical framework

As an outcome, the empirical part of the thesis proposes effective visual communications to enhance visibility of activities driving the performance of accounts receivable management.

First, to understand the importance of accounts receivable management in terms of overall profitability of the company, the concept of working capital is explained. Sharma's (2008) book explains briefly the concepts within working capital management giving a foundation for further examination of selected concepts. Sagner's (2010) work, designed for business professionals, provides real-life examples of working capital management techniques. The study conducted by Boisjoly et. al (2020) is referred in order justify the significance of working capital management in terms of company valuation. The role of accounts receivable management in freeing tied-up working capital is discussed reviewing various papers and studies published by consulting agencies. In his master thesis Kimani (2013) explored the principles and practice of effective accounts receivable management, and despite the context is somewhat distant, the definitions are applicable. The different approaches to performance measurement are explored reviewing books written by Eckerson (2010), Parmenter (2015) and Meyers (2003). Eckerson's book provides a conceptual approach to performance dashboards, whereas Parmenter's and Meyer's work challenge the traditional balanced scorecard approach introduced by Kaplan and Norton (1992). Papers and articles published by consulting agencies and financial professionals are reviewed to build a consensus for accounts receivable outcome metrics. The term "leading indicator" is introduced, and as an outcome of the first part a model defining leading indicators is proposed.

At the second part of the literature review, a conceptual framework is built around visual communications by exploring visual perception, visual attention and visual representations. The book written by Ware (2012) provides an extensive overview on information visualization research and techniques. Baddeley's (2013) book explores the complex context of memory and its limitations. The theory of visual attention, which is discussed focusing on pre-attentive attention, is investigated reviewing a book written by Zhang & Lin (2013). Sweller's (1988) cognitive load theory is addressed together with the concept of "chartjunk" introduced by Tufte (2001), to explore the intersection of attention and memory. Visual representations of data are explored by reviewing a classic written by

Edward Tufte. Tufte is one of the pioneers, a prolific expert on the topic long before data visualization became mainstream within business intelligence tools. His book, which is among the most significant references of the thesis, discusses the theory and practices in the design of statistical graphs. To conclude, a short review of the evolution of visual communications in Excel is provided.

## **1.4 Method**

This thesis is an action research aiming to enhance visibility of activities driving the performance of accounts receivable management in order to increase its efficiency. Effective visual communications are explored as a tool offering insights. In addition, the purpose of the study is to provide recommendations for future product development to a company offering accounting software “X”. A data set stored in the software’s accounts receivable ledger is examined to discover to what extent it includes the necessary attributes to create visual communications representing the selected indicators measuring the activities contributing to performance.

First, an extensive literature review is conducted to build a theoretical framework around the performance measurement of accounts receivable management and visual communications. The literature includes academic sources, such as books, journals and studies, as well as different non-academic writings published by consulting agencies and business professionals. The author contributes to academic theory by providing definitions for an accounts receivable leading indicator and an effective visual communication. Based on the literature the author proposes a model to define leading indicators. Reflecting the literature and the knowledge gained during the research process, the author applies the model in practice to define leading indicators driving the performance of accounts receivable management. Finally, visual communications representing the selected indicators are proposed.

## 1.5 Limitations

As an outcome this thesis proposes visual communications to enhance visibility of activities driving the performance of accounts receivable management. The visuals are created using Microsoft Excel 2016 and the discussion during the thesis does not take into account any later versions of Excel.

Secondary data referred in the thesis is limited to sources that are either publicly available or accessible to the students of Arcada. During the time of writing very limited amount of academic literature exploring the performance measurement of accounts receivable management existed.

The concept of data is intentionally left out of scope of the thesis. The data set selected for analysis in creating visual communications, is reviewed perfunctory but the relationships and connections of the fields (and attributes) within different tables in the database is not analyzed.

## 1.6 Definitions

### *Accounts receivable*

Accounts receivable are assets for the company referring to the amount of money the customers owe to the company. It is income that has been earned and invoiced by the company, but has not yet been received as the customers have not fully paid their debts. (Sharma 2008 p. 120.) In practice, accounts receivable are loans given to customers that agree to pay the outstanding balance by a certain date (GoCardless).

### *Performance*

Performance as defined in the Cambridge Dictionary is “the act of doing something, such as your job”, and in business English it also refers to “how successful an investment, company, etc. is and how much profit it makes; how well a computer, machine, etc. works; how well someone does their job or their duties.”

## ***Visibility***

The term visibility refers to the extent to which a company's management or analysts can estimate its future performance. Having high visibility in the organization enables the management to optimize operations to reach better performance. (Kenton 2021.) In the scope of the thesis, visibility of activities driving the performance of accounts receivable management provides opportunities for rearranging and planning the focus of the operations accordingly. Visibility is the degree to which something is known about. Therefore visual communications are explored as a tool in revealing data and enhancing visibility of issues and aspects that would otherwise be ignored or considered less important.

## **1.7 Structure of the thesis**

This study consists of seven chapters. First chapter provides an introduction to the topic explaining its relevance and aim. It also introduces a foundation for theoretical framework and method. Second chapter defines the key concepts of working capital and accounts receivable, and discusses their relationship. It also explores the outcome metrics measuring the performance of accounts receivable management, and finally introduces the concept of leading indicators providing a model to define them. Third chapter builds theoretical framework around visual communications by discussing visual perception, visual attention and visual representations. Chapter 4 introduces briefly the methodology and research data. Chapter 5 provides definitions for the key concepts of an accounts receivable leading indicator and an effective visual communication. To conclude, visual communications representing accounts receivable leading indicators are presented as an outcome. To summarize the findings, chapter 6 addresses discussion and ideas for future product development. Finally, chapter 7 evaluates the results from a broader perspective.

## 2 ACCOUNTS RECEIVABLE

This chapter discusses working capital management, the role of accounts receivable in freeing tied up working capital, and finally, performance measures indicating the efficiency of accounts receivable management. Few of the most frequently used outcome metrics measuring the results are presented. To conclude this part of the literature review, the author proposes a model to define leading indicators. The purpose of the model is to provide visibility of activities impacting on the performance and on the outcome.

### 2.1 An overview of working capital

Working capital is one of the most fundamental indicators of a company's financial health and strength, and a measure for the management to inspect the operations. Strong working capital means the company can easily fund its day-to-day business. Effective handling of short-term liabilities and short-term assets ensures that as little working capital as possible is tied to the business. This requires the company to efficiently reduce its inventories and collect its receivables. (Sharma 2008 p. 25.) Boisjoly et al. (2020) point out that working capital can also be a competitive advantage for businesses.

#### 2.1.1 Working capital defined

Within working capital there are two concepts to define: gross concept and net concept. The term *working capital* may refer to both depending on the consideration, since there is no universal definition (cp. Sagner 2010 p. 1; Sharma 2008 p. 26). *Gross working capital* refers to the total current assets of the company. *Net working capital* on the other hand refers to arithmetic difference between current assets and current liabilities. (Sharma p. 26). In the example illustrated in Figure 2, gross working capital consists of current assets of 70 million, whereas net working capital is the arithmetic difference between current assets and current liabilities totaling to 42.5 million.

Current assets are resources that are cash or to be converted into cash in a normal course of operations within one year. Correspondingly, current liabilities are commitments requiring cash settlement within a year. That said, working capital is the difference between

cash or resources soon to be converted into cash and commitments that soon require cash. (Sharma 2008 p. 26.)

### Balance Sheet (as of December 31, 2019)

Assets		Liabilities and Owner's Equity	
Current assets	70 000 000	Current liabilities	27 500 000
Cash	5 000 000	Accounts payable	17 500 000
Short term investments	17 500 000	Notes payable	8 000 000
Accounts receivable	30 000 000	Accrued expenses	2 000 000
Inventory	15 000 000		
Prepaid expenses	2 500 000		
Gross Working Capital		<b>Current assets – Current liabilities = Net Working Capital</b>	
Fixed assets	60 000 000	Long-term liabilities	40 000 000
Plant and equipment	100 000 000	Loan payable	40 000 000
Depreciation	-40 000 000	Owner's equity	62 500 000
		Common stock	15 000 000
		(30 000 shares)	
		Retained earnings	47 500 000
<b>Total assets</b>	<b>130 000 000</b>	<b>Total liabilities and net worth</b>	<b>130 000 000</b>

Figure 2. Working Capital

#### 2.1.2 Optimization of working capital management

Working capital management uses various techniques and strategies in managing inventories, accounts receivable, accounts payable and cash. It maintains the balance between investments in current assets and the level of current assets. Overall trends and areas requiring a closer look are monitored using financial tools such as Ratio analysis. The level of working capital should not be too low or too high. Too high working capital indicates the levels of inventory are too high and receivables demand more supervision and control, or that funds idle with no returns on their investment. The greatest danger of inadequate working capital is illiquidity. (Sharma 2008 pp. 26-30.)

According to Deloitte, optimization of working capital management delivers improved operational efficiency, adds liquidity to fund growth, reduces debt levels, lowers costs and maximizes shareholder returns. In their study Boisjoly et al. (2020) concluded that en-

agement to continuous improvement and working capital management programs affected positively on the market values of the companies. They also noticed that the different measures of working capital are highly correlated with one another suggesting that companies that perform well on one metric, also perform well on the others.

### **2.1.3 Role of accounts receivable**

Optimizing accounts receivable management is one of the core strategies in freeing tied-up working capital. Based on their study Kortman et al. (2020) saw receivables as a major area of opportunity. According to a study conducted by Visma Duetto Oy (2017), four out of five Finnish small- and medium-sized companies have to collect invoices that are past due (N=153). Protecting cash by withholding payments may be a good, yet short-sighted idea, since the money owed will be collected at some point with a higher price paid by the entire economy (cp. Taylor 2011).

According to Taylor (2011), receivables are often the largest entry on a balance sheet, and traditionally seen more as an administrative concern than strategically important. Taylor proposes a strategic and customer-centric approach to credit, collections and complaints management to increase the company's profitability and to reduce financial risks that incur due to late payments and write-offs. Regular risk evaluations based on customer's payment history and behavior might predict the future bad debt.

## **2.2 Accounts receivable management**

Managing accounts receivable is critical to company's overall cash flow management. Sharma (2008 p. 125) defines the main objective of accounts receivable as "[...] to collect dues and to assist in meeting cash flow requirements". Accounts receivable management impacts on the company's financial health and long-term survival, and is therefore recommended priority for any company.

According to Hrishikes the main objective of accounts receivable management is to maximize the value of the company by maintaining a balance between liquidity, risk and profitability (see Kimani 2013 p.14). This means having a control over the cost of credit and



maintaining it as low as possible while keeping investments – that is accounts receivable, at optimal level (Kimani p.15).

Effective management of receivables offers possibilities to improve customer service and cash management. It also decreases costs and ensures

- the capital is not tied to customer accounts that are long overdue
- debtors are not becoming bad
- big receivable balance is not indicating the company has problems collecting its receivables
- the company is not holding on to old receivables that should be written off

(Sharma 2008 p.120.)

*Bad debt* is an uncollectible debt that is a potential write-off in the future. *Write-off* is the amount that will eventually be removed from accounts receivable for not being paid (Sharma 2008 p. 135).

### **2.2.1 Elements of receivables management**

According to Sharma (2008 p. 120) and Ramesh (see Kimani 2013 p. 17), the management of accounts receivable can be divided into following components:

- 1) Establishing and implementing the receivables policies that assure consistency on decision-making and have important influence on the company's volume of sales.
- 2) Assessing the creditworthiness of the customer before giving the credit by committing a credit analysis.
- 3) Establishing efficient debt collection system and deciding on collection policies to obtain payments of past due accounts.

*Credit Policy* is a company's policy on granting and collecting credit. It is a document that covers all aspects of credit sales and debt collection practices. It determines the credit period, credit standards, collection efforts and the terms of credit sale. (Sharma 2008 p. 121.) The purpose of credit policy is to avoid extending credit to customers unable to pay back (see Kimani 2013 p.17).

*Terms of sale or credit terms* refer to the conditions under which the company sells its customers on credit. They are statements of the credit period and any discounts offered for timely payment; for instance a payment term of “2/10, net 21”, means that a two percent discount is given if the payment is made within ten days, otherwise the account must be paid within 21 days. Cash discounts are used in attracting customers and encouraging early payments to reduce accounts receivable and increase the profits. (Sharma 2008 p. 121; cp. Kimani 2013 p.19.)

*Credit analysis* is used in determining if the customer will receive credit and what are the conditions given (Sharma 2008 p. 125; cp. Kimani 2013 p.20). The five credit factors, also known as “the five C’s of credit” are the basis for accurate credit granting decisions:

- 1) *Capacity* refers to the borrower’s ability to repay; repayment is expected from daily operations or recurring sources
- 2) *Capital* relates to the borrower’s ability to meet obligations and protect against risk; financial strength is evaluated by analyzing the borrower’s capital structure
- 3) *Collateral* is the security or asset the borrower has to guarantee the credit
- 4) *Character* refers to the borrower’s integrity and management skills; proven experience and past records are reviewed as well as the compliance with loan terms
- 5) *Conditions* include the terms the lender has a direct control (such as the amount of loans and loan terms) and also the situational conditions, such as loan agreements, personal liability, insurance and additional collateral

(Sharma p. 128-129.)

Once the credit is granted, accounts receivable management monitors the outstanding invoices trying to detect changes in payment behavior, in order to assess the liquidity of the receivables portfolio and to generate cash flow forecasts.

*Collection policy* can reduce problems related to accounts receivable. Collection involves sending overdue delinquency notices, contacting the customer by phone, employing a collection agency and finally, taking legal actions against the customer. (Sharma 2008 p. 130.)

### **2.2.2 Order to cash process**

Order to cash (O2C) process is set of activities associated with providing goods and services to customers and collecting payments in return (Parravicini 2015 p. 151). Both Parravicini and Shapiro et. al. (2004) emphasize the importance of O2C process in overall customer satisfaction. The target of the process is to deliver the right product to the right place at the right time for the right price, and preferably to do so on the first try (Parravicini pp. 151-154).

An efficient O2C process increases cash flow, and a couple of important decisions are directly related to accounts receivable management: the amount of credit given to a customer and the credit terms agreed. Many of the objectives of the process have indirect impact on the performance of accounts receivable management. Therefore, a short introduction to the business activities of the O2C process is justified.

According to Parravicini (2015 pp. 151-153) the process can be divided into six phases:

- 1) “Preparation” that happens prior to an order and includes the review of internal records (pricing conditions) and databases to enter the order
- 2) “Order taking” to collect the order, check the customer credit and discounts given, and ensure the product availability in order to confirm the order to the customer
- 3) “Order fulfilment” to check the current product availability, to prepare an invoice and to pick up the order from warehouse for dispatching it to the customer
- 4) “Delivery of goods and services” to physically deliver the goods
- 5) “Customer invoicing” to send the invoices to customers
- 6) “Cash collection” to collect invoices that are due for payment; often a kind reminder is sent first, followed by a formal request of payment and finally further actions, such as blocking deliveries or taking legal actions

Finance department is often responsible for the “delivery to cash” part of the process (Parravicini 2015 p. 155). In their article Shapiro et al. (2004) point out that customer invoicing is frequently designed to serve the needs of the seller instead of those of the customer. Therefore inaccurate or obscure invoices are not extraordinary. In fact, the invoices may even be flawless, but they are just too complicated to interpret.

### **2.2.3 Optimization of accounts receivable management**

Strong accounts receivable management optimizes cash flow. In their guide GoCardless explores a two-step approach in optimizing first the internal processes and then the customers. To improve the process they propose the following steps to be taken:

- 1) Defining the objectives and performance indicators
- 2) Reviewing credit policies and assessing customer credit limits on regular basis
- 3) Performing regular checks to ensure the customer data stored in the database is correct
- 4) Streamlining invoicing workflow to generate accurate invoices
- 5) Enabling automation to reduce human errors and free up time for other activities

Once the internal processes are optimized, optimizing the customers further reduces cash flow risks. This is done by

- 1) sending timely reminders on a tone that is more urgent each time it is sent to a single customer
- 2) calling to a customer that has a habit of paying late
- 3) charging interest on the outstanding invoices and being clear about them in the terms of the invoice
- 4) offering discounts to customers that pay early
- 5) cutting off credit as a last resort and stating clearly how it can be rectified

(GoCardless.)

Defining objectives and performance indicators is the first step to take when optimizing accounts receivable. Both GoCardless and Deloitte emphasize the importance of frequent monitoring to reveal deviations over time and to discover the root causes of unfavorable development.

## **2.3 Performance measurement**

A metric is a measurement of anything that can be measured. Metrics, however, tell little about the performance. *A performance indicator* is a metric that compares performance to time-based targets indicating if the output of the business activity is in line with the

strategic objectives. (Eckerson 2010 p. 198.) According to Eckerson, performance measures are used in transferring the company's strategy and goals into concrete actions; "What gets measured gets done". When driving improvement or change, performance measures are among the most powerful tools. (Eckerson p. 197.)

### **2.3.1 Different approaches to performance measurement**

The balanced scorecard introduced by Kaplan and Norton gave the management a summarized view of the company's performance from four different perspectives simultaneously: financial perspective, internal business perspective, innovation and learning perspective and customer perspective. The three operational measures were considered as drivers of future financial performance. (Kaplan & Norton 1992.) Kaplan and Norton argued that performance measures were mainly aimed to monitor the implementation of strategic initiatives (see Parmenter 2015 p. 300). Since then the balanced scorecard approach has diffused rapidly. It is widely used within performance measurement and compensation, even though it was originally intended to communicate the company's strategy and strategic performance (Meyer 2003 p. 42).

Both Parmenter (2015) and Meyer (2003) criticize the balanced scorecard approach on performance measurement. Parmenter (p. 161) believes performance measures are mainly intended to ensure the workforce doing their daily duties focuses on the company's critical success factors, which in fact are "operational issues that need to be done will day-in, day-out". Critical success factors drive performance measures, and are therefore vital to key performance indicators (Parmenter p. 165). Meyer, on the other hand, argues that performance measures are meant to give insight into future. However, measuring the future is difficult and measuring the past may not be enough (Meyer p. xii, 49). As a solution Meyer (p. 113) proposes a new approach to performance measurement. The activity-based profitability analysis (ABPA) assumes that understanding the engaged activities, their costs and revenues, it is possible to measure and improve the performance.

Traditionally performance measures have been referred as "KPIs" (key performance indicators) that have been divided into lagging and leading indicators. A lagging indicator

looks at past activities and a leading indicator is considered to be forward-looking. Parmenter (2015 pp. 15-19) argues that the traditional balanced scorecard approach does not focus adequately enough on current or future-oriented measures and that not all performance measures are KPI's (p. 3). According to Parmenter (p. 12), KPIs are those indicators that have the greatest impact on the company's current and future success. In addition, they are non-financial, frequently measured, reported to CEO, simple to communicate to all staff, tied to a team or cluster of teams and tested to ensure their impact on performance is positive. KPIs are current- or future-oriented, and as most organizational measures measure past activities, they can never be considered KPIs (Parmenter pp. 16-17). In addition to KPIs, Parmenter (pp. 3-15) introduces the three types of performance measures pointing out that most measures the companies use are actually a mix of the four types.

- 1) Key result indicators (KRIs) focus on past activities, they can be financial or non-financial and they give the board an overall summary of how the company is performing.
- 2) Result indicators (RIs) are past-, current- or future-oriented, they can be financial or nonfinancial and they tell the management how all teams combined are producing results.
- 3) Performance indicators (PIs) are past-, current- or future-oriented, they are nonfinancial and they tell the management how a single team is performing aligned to company's strategy.

The purpose of this chapter was to point out that there are various approaches towards performance measurement, and that the division to lag and lead is not always that straightforward, as is not the pre-eminence of balanced scorecard either. The different approaches are reflected in chapter 2.3.3 proposing a model to define the indicators measuring the efficiency of activities that contribute to performance.

### **2.3.2 Lagging indicators of accounts receivable**

Was it a key result indicator as argued by Parmenter (2015), or a financial KPI, most performance indicators expressed in monetary values are lagging measures, also known as *outcome metrics*.

This chapter introduces few of the most frequently named outcome metrics that are followed to monitor the efficiency of accounts receivable management. They measure past activities that have already happened, and are therefore accurate and easy to measure, but more difficult to improve. According to YayPay outcome metrics may reveal patterns and problems to solve. Following the trend over time is essential in detecting changes of performance and efficiency.

According to a whitepaper published by SunGard Datasystems (2014), 66 % of the companies identify invoice age as the top driver for setting priority around collection. However, a very limited amount of earlier academic research investigating accounts receivable performance indicators exists.

### ***Days sales outstanding (DSO)***

= *(Accounts receivable / total credit sales) x number of days in period*

DSO is an important metric measuring the liquidity of the company's current assets. According to SunGard Datasystems (2014), it is the most commonly used KPI. It represents the average number of days it takes to convert credit sales into cash; that is the average collection period at the end of a month, quarter or year. The lower it is the less time it takes to collect receivables. (Grant 2020; HighRadius Corporation.) Luangrath (2017) defines DSO as “the value of receivables outstanding or waiting to be collected from customers, expressed in the equivalent number of days of revenue.”

DSO is a measurement of time and depends on the industry, which should be acknowledged when benchmarking. Generally, the closer the DSO aligns to company's credit terms, the better it is; ideally it should not exceed the payment terms by more than a half. In the long run, high DSO may lead to cash flow problems. Increasing DSO may also refer to dissatisfied customers that are paying late on purpose, or to sales that are made to less credit-worthy customers or to payment terms that need to be longer in general. DSO may vary from month to month, and therefore monitoring the trend is an important consideration in evaluating the performance of accounts receivable management. (Grant 2020; HighRadius Corporation; YayPay.)

The most common way of calculating DSO is the rolling average for n months; DSO is calculated in three, six or twelve months' intervals. The method smooths out seasonal variations and is suitable for companies experiencing a lot of fluctuation in revenues, but are interested in following the trend. Exhaust method calculating DSO at the end of each month or quarter is more effective when evaluating the performance of accounts receivable team. It puts more weight to the current month's revenue and acknowledges the difference in the number of days per month. A sufficient visibility is achieved by following a trend line of at least 13-months. (Luangrath 2017.)

***Best possible days sales outstanding (BPDSO)***

= *(Current accounts receivable / total credit sales) x number of days in period*

BPDSO is the value achieved if every customer paid within the agreed payment terms. A weighted average based on value of sales by payment term can be used to consider the different payment terms offered. BPDSO is an important reference when determining if the DSO represents a good performance. An increasing gap between DSO and BPDSO may reveal deficiencies in the credit and collection processes. Therefore following the trends provides important insight into the business. (Luangrath 2017.)

Reaching BPDSO would mean that no receivables are overdue. This may indicate that the performance is exceptional, but also that the payment terms are too generous. (Luangrath 2017.)

***Average days delinquent (ADD)***

= *DSO - BPDSO*

ADD is the difference between DSO and BPDSO: the lower the better (YayPay; Henning 2019). It indicates how many days it takes from customers to pay their bills once they become overdue. A low number means that accounts receivable team is efficient in sending reminders and following up overdue invoices. High number may refer to problems in accounts receivable management and customer base itself; policies and credit terms may need adjusting. (Henning.)



### ***Collection effectiveness index (CEI)***

= *(the amount collected / the amount available for collection) x 100, where*

*the amount collected = beginning receivables + credit sales – ending total receivables  
and*

*the amount available for collection = beginning receivables + credit sales – ending current receivables (that is receivables that are not overdue)*

CEI is the percentage of accounts receivables that are collected in a given time period. It compares the amount of account receivables collected to the amount that was available for collection. It measures the company's ability to turn invoices into cash and is therefore a good indicator of overall effectiveness of accounts receivable processes and teams. (HighRadius Corporation; Singh 2017.) The productivity of each team member can be followed by monitoring the indicator per collector (HighRadius Corporation). Rather than all invoices, CEI focuses on invoices presently due, and is therefore more suitable indicator than DSO for companies, whose sales are seasonal. (YayPay).

The closer the index is to one hundred, the higher is the degree of collection effectiveness. Low percentage indicates the company needs to review its credit and collection policies. Following the trend on a weekly or monthly basis reveals if CEI has increased or declined. An increase can refer to a large invoice that was collected still leaving multiple small ones uncollected, which is not ideal. However, increasing CEI can compensate decreasing sales, as the amount of cash getting collected is higher. (HighRadius Corporation; Singh 2017.)

### ***Accounts receivable turnover (ART)***

= *Net credit sales / [(Beginning accounts receivable + ending accounts receivable) / 2]*

Accounts receivable turnover ratio measures the company's effectiveness in extending credit and collecting debts. Typically it is calculated on annual basis. (Wood 2020.) In practice it measures how often the accounts receivable team collects accounts over a one-year period (Henning 2019).

A high ratio indicates the customers are paying their debts quickly, which improves the company's cash flow and supports the payment of its own debts. A high ratio suggests the company is financially stronger in general and will most likely have less write offs than a company with a lower ratio. (Wood 2020.) Wood, however, points out that too high ratio can mean that credit policies are aggressive, which can lead to lower sales if credit is not extended to customers with slightly lower ratings. Low accounts receivable turnover ratio suggests that the collection policies are ineffective, credit is given too softly, or that bad debts are damaging the company's cash flow.

ART is based the on average of customers that pay extremely quickly and those that pay inexcusably slowly, and therefore it cannot be used in identifying bad customers or those that are due. It can only show trends and help in assessing the average time it takes to collect credit. The ratio can be skewed based on the start and endpoint, since accounts receivable may vary during the year. Following the "account aging" metric ensures the ART gives a realistic view of the customers' payments. Finally, when comparing ART's between companies, the different sizes and capital structures of the companies should be acknowledged, Wood (2020) concludes.

### **2.3.3 Model for defining leading indicators**

The purpose of leading indicators, also known as *driver metrics* is to measure the activities impacting on the result measured using lagging indicators (Eckerson 2010 p. 199). High level metrics, such as DSO, follow the performance of accounts receivable management, but do not explain its deviations (Deloitte; GoCardless; Luangrath 2017). *Leading indicators* measure activities that happen during a time period of which outcomes are measured. They are actionable and predictive, and unlike lagging metrics, they foster proactivity. Therefore they are also more difficult to determine and measure. Leading indicators give time to make the necessary adjustments in order to reach the target, and they can be used in predicting if the current activities are enough to meet the targets by the end of the period. (Eckerson p. 199.) Leading indicators provide visibility of activities that contribute to performance.

Most of the non-financial KPIs are often, but not always, forward-looking and therefore they are generally considered leading indicators providing explanations and context for financial KPIs (Meyer 2003 p. 33). Non-financial KPIs can as well be expressed in numbers, even though they are not directly associated with finances, but focus on other aspects of the business.

Leading indicators are not easy to define. In his book Parmenter (2015) argues that performance measures are brainstormed from critical success factors, whereas Kaplan and Norton (1992) put more emphasis on strategic initiatives. Eckerson (2010 p. 201) suggests first to consider the result measured by an outcome metric, and then to go backwards to discover the drivers impacting on the outcome.

Established on the literature reviewed the author proposes a model for defining leading indicators (see Figure 3). The model is explained as follows;

- The starting point for defining leading indicators, as recommended by Eckerson (2010), is the desired *result*, which is often defined by the management and presents the high-level target that can be derived from strategic objectives. The extent to which this result has been fulfilled at the end of a given time period is measured using an *outcome metric*, that may be referred as KPI.
- To reach the result and the outcome metric, the direction of the operations is decided. This direction sets the main *objectives*, which are business unit level processes and goals. These objectives guide the operations.
- *Success factors* refer to functional, operational level objectives that attained lead to fulfilment of the higher-level objectives and the result. Success factors, however, cannot be measured (cp. Parmenter 2015 p. 161). They present the favorable outcomes of daily activities.
- *Activities* are daily activities ensuring the favorable outcomes every day in order to reach the objectives (that is operational level goals) that set the direction to reach the result. The performance of daily activities can be measured. Therefore, a *leading indicator* is a measurement of a daily activity. Visibility of activities driving the performance is achieved monitoring these measurements.

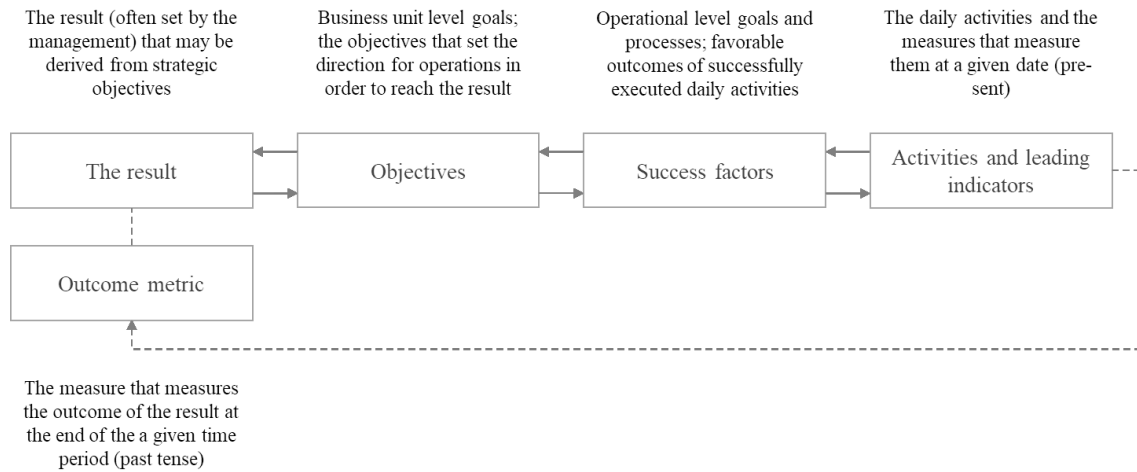


Figure 3. A model for defining leading indicators

Chapter 5.1.2 examines the model in the context of accounts receivable management aiming to identify leading indicators driving DSO. Consequently the activities having the greatest impact on the high-level target of converting receivables to cash as soon as possible are discovered.

## **3 VISUAL COMMUNICATIONS**

This chapter builds a conceptual framework around visual communications by examining visual perception and visual attention that explain how visual information is processed and perceived. In his book Ware (2012) states that “human visual system is a pattern seeker of enormous power and subtlety. The eye and the visual cortex of the brain form a massively parallel processor that provides the highest bandwidth channel into human cognitive centers.” Therefore seeing and understanding are closely involved.

### **3.1 Visual perception**

#### **3.1.1 Visual information processing**

Visual perception can be defined as the ability to interpret the information that is received through one’s eyes. Vision directs the actions. According to Ware (2012 p. 21), the model of human visual perception includes three stages. First the visual information is processed by large arrays of neurons in the eye and in the primary visual cortex at the back of the brain. The neurons work in parallel to extract primitive features, such as color, orientation, texture, contour or motion, from every corner of the visual field simultaneously. This happens extremely fast and completely automatically. Information is derived bottom-up and the processing is data-driven, which means if an icon on a display changes color, the neurons react immediately whether we like it or not.

At the second stage, rapid active processes divide the visual field into regions and simple patterns, such as areas of the same color or texture (Ware 2012 p. 22). Visual queries that are key to visual thinking, happen when looking for patterns. A search for a positive trend in a graph is a visual query. (Ware p. 179.) At this stage active attention drives perception from top-down (Ware p.180). Both Ware (p. 22) and Ullman (see Ware p. 180) emphasize that only a limited amount of patterns become bound and are held for a few seconds under attentional processes. Chapter 3.2 discusses attention, which is an important and integrated part of visual perception.

At the highest stage, one to five objects are simultaneously held in visual working memory, which holds the visual objects of immediate action. Visual thinking process is dependent on the capacity and limitations of working memory. Contents of working memory are drawn not only from the input of the eye, but from long-term memory, which stores the past experiences giving meaning to external visual information. (Ware 2012 p. 378.) Beyond the visual processing stages interfaces to subsystems of the brain, such as verbal linguistic subsystems and action systems, connect words to images or muscle movements (Ware pp. 22-23).

Ware (2012) emphasizes that the visual system is not straightforward; even though the patterns are easily seen when presented in certain ways, they become invisible if displayed in other ways. Understanding how perception works helps in designing visual communications that represent the data in a way the important patterns stand out and the information is communicated clearly.

### **3.1.2 Gestalt principles of visual perception**

Gestalt principles describe the essentials of pattern perception, which is valuable when organizing data in a way that human mind can interpret important structures quickly and efficiently (Busche; Ware 2012 p. 181). Gestalt psychology argues that human mind and behavior should be considered as a whole, and that the mind tends to perceive objects as groups or elements of more complex systems (Busche). In the early twentieth century, Gestalt was applied to the field of visual perception by Wertheimer, Kohler and Koffka, who produced a set of Gestalt laws of pattern perception. Over the years the original set of laws has been refined by contemporary Gestalt theorists, yet the principles are still accepted today. (See Busche.)

In his book Ware (2012) discusses the eight laws that are proximity, similarity, connectedness, continuity, symmetry, closure, relative size and common fate, whereas Busche defines simplicity, figure-ground, proximity, similarity, common fate, symmetry, continuity, closure, common region and element connectedness in her article. Few of the principles are explained next as a combination of the original work and later adjustments.

**Proximity** is one of the most useful principles in design. Proximity relationships decide how a matrix of dots is perceived (see Figure 4). Objects that are located near to each other are perceived to belong in the same group. The principle of proximity can also be used to guide either horizontal or vertical scanning. (Ware 2012 pp. 181-182.)



Figure 4. Gestalt principle of proximity (Ware 2012 p. 182)

One of the most well-known examples of applying the principle of proximity is the poster expressing a smile (see Busche). It was published by the Coca-Cola Company in 2013, and it was supposed to celebrate happiness, which is one of the company's core values. A shape of a smile was created using bottles that were placed near each other in a way that the human mind perceived a picture of a smile (see Figure 5).



Figure 5. The Coca-Cola Company, poster of International Day of Happiness (see Busche)

**Closed contour or common region (“enclosure”)** is even a stronger organizing principle than proximity. If the information is located inside a closed contour, the perceptual tendency to consider that it is related, is very strong. Correspondingly, the information outside the contour is considered to be “something else”. When regions have simple shape, a line is a sufficient divider, but with more complex shapes color or texture can be used to define regions as illustrated in Figure 6. (Ware 2012 p. 186-187.)



**Figure 6.14** An Euler diagram enhanced using texture and color can convey a more complex set of relations than a conventional Euler diagram using only closed contours.

Figure 6. Gestalt principle of common region (Ware 2012 p.188)

The principle of **similarity** states, that similarity of the elements determine how they are grouped. In Figure 7 similarity causes the rows to appear more clearly due to the shape of individual pattern elements. Color and texture can be used to visually separate rows and columns. (Ware 2012 pp. 182-183.)

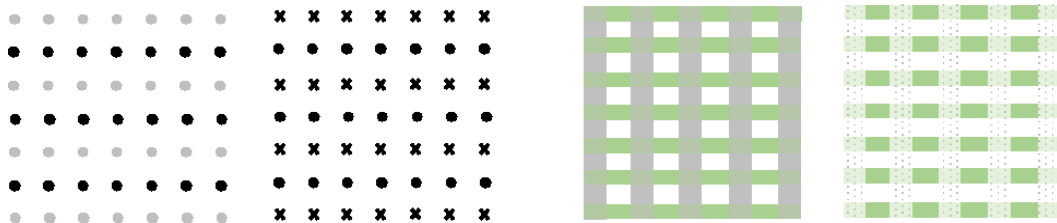


Figure 7. Gestalt principle of similarity (Ware 2012 p. 183)

**Connectedness** (“**connection**”, “**element connectedness**”) is the strongest grouping principle and fundamental to node-link diagram where the nodes are connected to each other by lines. If there is a connecting line between the two shapes, they are considered as part of a group no matter the proximity, color, size or shape of the visual elements – there may be two red dots, but there is no line to connect them, so they are not perceived as a group (see Figure 8). (Ware 2012 pp. 183-184.)



Figure 8. Gestalt principle of connectedness (Ware 2012 p. 184)



The principle of **continuity** inflicts the eyes to seek for the smoothest path and naturally create a continuity even to where it may not exist. The sources and destinations of connecting lines are easier to identify if the lines are smooth than if they contain abrupt changes in direction (see Figure 9) (Ware 2012 p. 183).

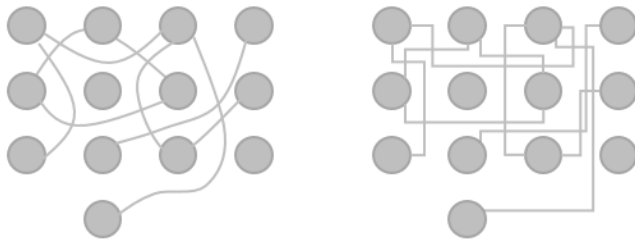


Figure 9. Gestalt principle of continuity (Ware 2012 p. 184)

Continuity can also be used in creating shapes in unexpected ways as in the Christmas card published by Publicis Singapore (see Figure 10), where a shape of a Christmas tree is created using the sharpened pencil's thing green line (Busche). The green line is assumed to continue uninterrupted even behind the Christmas tree, even though the back is not visible to the eye.



Figure 10. A shape of a Christmas tree (Busche)

**Closure** states that elements, which are part of a closed figure are seen as belonging to the same group (Busche). “A closed contour tends to be seen as an object” (Ware 2012 p. 186). Busche explores the logo of Fedex, where there is a white arrow hidden between the letters “E” and “X” that are placed tightly next to each other, creating an illusion of

closure. Once the eye has caught the shape of an arrow, it is difficult to look at the logo without not seeing it (see Figure 11).



Figure 11. The logo of Fedex (Busche)

If possible, a set of individual elements are rather perceived as a single shape than individual items. Also, when there are items that are assumingly missing from the picture, human mind tends to fill in the gap creating a shape that is faultless and complete, as items are more likely seen closed than broken (Ware 2012 p. 186). Figure 12 illustrates the Gestalt principle of closure: the two items are seen differently depending on their positioning.



Figure 12. Gestalt principle of closure: a circle and a broken ring (Ware 2012 p. 187)

### 3.1.3 Memory

The well-known phrase “I see” refers not to seeing but to understanding, since perception and cognition are closely related at the higher levels of human cognitive processing (Ware 2012 p. xvi/preface). “If I can’t picture it, I can’t understand it,” said Albert Einstein. The things seen are connected to past experiences and existing knowledge, fostering understanding and creating new information. Using colors, shapes and other retrieval cues strategically in graphs and illustrations eases the observer’s effort in digesting the information. Understanding the basics of the memory and its limitations helps in designing effective visual communications.

Memory is an array of interacting systems registering, storing and retrieving information. Until 1960s many psychologists presumed there was only one kind of memory. In the

early 1970s a distinction between short-term memory and long-term memory was recognized. By the end of the decade, the systems of short- and long-term memory had also been subdivided further, and an agreement that memory can broadly be divided into three components: sensory memory, short-term memory and long term memory was widely accepted. (Baddeley 2013 pp. 8-9.)

One of the most typical and influential models was “the modal model of memory”, a theory proposed by Atkinson and Shiffrin in 1968 (see Figure 13). The modal model of memory assumes that information coming from the environment is fed to a short-term store by a series of sensory registers that select and collate sensory information. Short-term memory controls, manipulates and encodes new information into a more durable long-term store from which the information can be retrieved. (Baddeley 2013 p. 9, p. 37.)

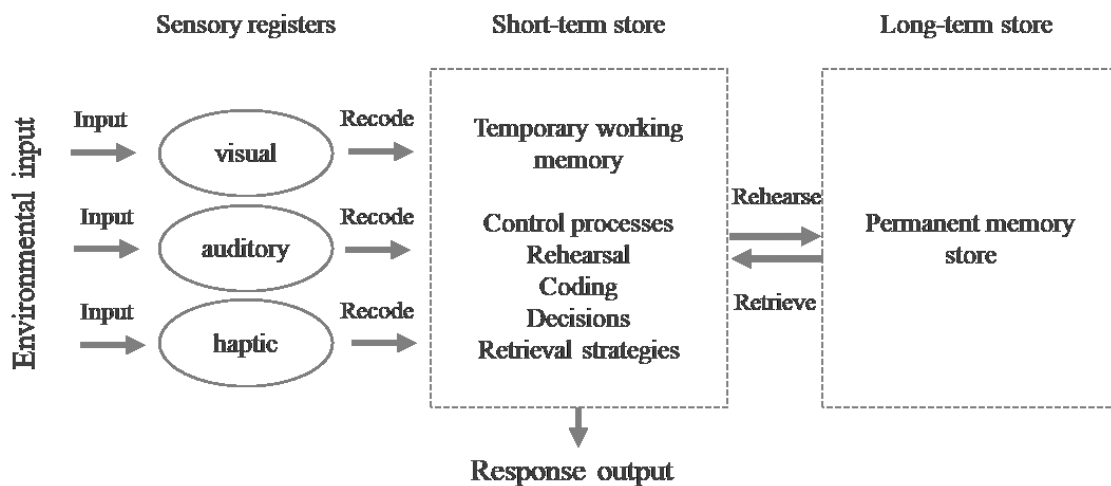


Figure 13. The flow of information through the memory system, as conceptualized by Atkinson and Shiffrin (Baddeley 2013 p. 9)

**Ionic memory**, the register for the visual system, also known as **visual sensory memory**, is one of the series of sensory memory systems that hold information from a fraction to second to just a few seconds after which the information is either discarded or transferred to working memory. It is traditionally considered pre-attentive as we see millions of things every day, but remember a very limited number of those. Hence, attention and focus are required to transfer a subset of information into visual working memory. Ionic memory is weak in detecting change between two visual images, even when the change is relatively large. “Change blindness” is connected to capacity limitations in visual scene

perception; ionic memory can only hold one array at a time and a new array overwrites information from the first array. (See Persuh et al. 2012.) Ionic memory is tuned to a set of pre-attentive attributes, visual cues that are powerful tools if used strategically in visual communications. Pre-attentive attributes are discussed in chapter 3.2.2.

Baddeley refers **working memory** as a subcomponent of the overall system, a complex set of interacting subsystems that hold and manipulate material selected for processing. Mental arithmetic, reasoning and problem solving require temporary storage. The role of short-term memory is to function as a working memory. (Baddeley 2013 pp. 42-43.)

**Short-term memory** is a system capable of holding several interrelated pieces of information in mind at the same time. Information is stored over brief intervals of time and considered irrelevant once the task is completed (Baddeley 2013 pp. 15-20). In his well-known paper “The magical number seven, plus or minus two: some limits on our capacity for processing information”, Miller proposed as a law of human cognition and information processing that humans can effectively process only seven (plus or minus two) units of information at any given time. However, a unit of information does not refer to the number of input sequence, but to number of group of items that go together. By “chunking” the information human is able to increase the number of items available for recall. (Baddeley pp. 23-25; Miller 1956).

**Long-term memory** represents information stored for considerable periods of time. In the early 1970s Tulving outlined the distinction between the two types of long-term memory: episodic memory that is capable of recollecting personal experiences, and semantic memory storing common knowledge of the world, such as the names of colors and the sounds of letters (Baddeley 2013 p. 16). Long-term memory’s primary purpose is to store information, and quite often we know more than we can remember at any given time. Retrieval cues, also introduced by Tulving, are prompts that help us to locate otherwise inaccessible information or a memory trace that is too weak on itself. They are information about the situation, circumstances and the context in which the memory was made; a piece of information that triggers the original memory. (Baddeley pp. 159-161.)

Semantic memory is concerned with concepts and ideas that are related to words but are not in themselves words. Spoken language has a strong relationship to meaning and therefore images can help humans in recalling items stored in long-term verbal memory. (Baddeley 2013 pp.139-140.)

## **3.2 Visual attention**

### **3.2.1 Visual attention defined**

Even though the human eye sees millions of things every second, not all the details are registered. If the observer closes their eyes and someone makes some changes on the scene, most observers fail to spot the differences, since the observer can only focus their attention on a small area of the visual field. (Zhang & Lin 2013 p. 3.) The visual field is a bit more than 180 degrees, but visual acuity is not distributed evenly (Zhang & Lin p. 5; Ware 2012 p. 50). Resolution is highest at the center of retina, which is called the fovea, and that is where attention process happens (Ware p. 146; Zhang & Lin p. 5). “Visual attention is selective awareness of the sensory world or selective responsiveness to stimuli” (see Zhang & Lin p. 29). Attention is therefore crucial to all perception (Ware p. 383.)

Neisser and Hoffman propose that attention is divided into two stages: pre-attention and attention. Pre-attentive processing does not depend on attention, but happens extremely fast and automatically. During pre-attentive stage the whole visual field is processed simultaneously without capacity limitations. It is parallel processing based on a single feature such as color, orientation, size or shape. Detecting this individual feature is a prerequisite for selecting the stimulus for further processing. Therefore, pre-attentive stage provides the necessary information for attentive processing. (See Zhang & Lin 2013 p. 7.)

In attention stage that occurs after pre-attention, one target is processed at a time. Attention is integrated with human experience, intention and knowledge, which at times guide it in bounding the features together or selecting the most supreme one. (Zhang & Lin 2013 p. 7.) Focused attention is needed to relate the features to each other (Zhang & Lin p. 30).

### 3.2.2 Pre-attentive attributes

Pre-attentive processing determines the visual objects that are most likely to get the observers attention, and easiest to find in the next fixation. Using certain colors and simple shapes the objects “pop out” from their surroundings pre-attentively, which happens prior to conscious attention. (Ware 2012 p. 152.), at the first stage of visual attention process (Zhang & Lin 2013 p. 7). John Tukey, the pioneer of big data and visualization, said “The greatest value of a picture is when it forces us to notice what we never expected to see.” This is what pre-attentive attributes are all about. Figure 14 illustrates how using color as pre-attentive attribute the task of calculating how many times number “3” appears in a table, gets a lot faster in table (b) than in table (a). This is because the color is pre-attentively processed in the observer’s sensory memory without conscious effort. (Ware p. 150.) Studies have shown that it is possible to see maximum four objects in a group at a glance before explicit counting is necessary (Ware p. 154).

(a)	(b)
45693479830165763015	45693479830165763015
15790266051246310457	15790266051246310457
23456798987163024563	23456798987163024563
15786074589345314671	15786074589345314671

Figure 14. Pre-attentive processing (Ware 2012 p. 152)

According to Ware (2012 pp. 154-155), there are four basic visual properties that are pre-attentively processed: color, form, motion and spatial position, which apply to a set of attributes listed in table 2. Corresponding to previous example, a vertical line would show at a glance if all the other lines were horizontally orientated, as well as if one of the lines was thicker than the others.

Table 1. Pre-attentive visual properties (cp. Ware 2012 pp. 154-155)

<i>Visual property</i>	<i>Attributes</i>
<i>Color</i>	Hue (the measure of the color), intensity (saturation and lightness)
<i>Form</i>	Line orientation, line length, line width, line collinearity, size, curvature, spatial grouping, blur, added marks and numerosity

<i>Motion</i>	Flicker, direction of motion
<i>Spatial position</i>	2D position, stereoscopic depth, convex/concave shape from shading

*Highlighting* is the most apparent application of pre-attentive processing. It is an effective tool making selected information stand out from other information. In a visually complex environment, where the display already employs color, texture and shape, the graphical dimension selected for highlighting should be the one least used in the design in order to stand out. (Ware 2012 p. 158.)

Based on current research there is no pre-attentive attribute that would be stronger or more salient than the others, but it depends on the strength of the feature – for instance vividness of the color – and the context (Ware 2012 p. 156-157). In general the strongest effects are based on color, orientation, size, contrast and motion or blinking (Ware p. 155-156): bright blue draws more attention than a muted blue and larger font size has stronger emphasis than italics. Therefore, it is possible to employ pre-attentive attributes to create a visual hierarchy to indicate the observer how to process the information. Where ease of search is critical, strong pre-attentive cues should be used before weak ones (Ware p. 156).

### 3.2.3 Chartjunk and cognitive load

Attention can be drawn to a certain data point or visual element by using pre-attentive attributes strategically. Attention can also be guided elsewhere causing the message the data was supposed to deliver to get lost. To avoid losing the attention Tufte (2001) recommends eliminating the clutter that might distract attention away from data.

The first step in designing visuals is always to consider the message the graphic is expected to transmit. Every bit of ink on a graphic should serve the purpose of delivering this message, since every bit of ink requires mental power to process – and potentially attracts attention. *Data-ink ratio* refers to amount of data-ink, which is the non-erasable core of a graphic, compared to total ink used to print the graphic. The higher the ratio, the more there is ink that cannot be erased without losing some data-information. According

to Tufte (2001 pp. 93-96), graphical design should always aim to maximize the share of data-ink. One way to do it, is to reduce the amount of *non-data-ink*, such as mesh and gridlines and *redundant data-ink* used for decorations or reinforcement of the data measures. Regardless of its use, both of these are often *chartjunk* provided routinely to explain the design even though there would be no need (Tufte p. 107). As a result, chartjunk makes the visuals appear more complicated than necessary requiring more mental power to process them.

*Unintentional optical art* is one of the most common forms of chartjunk. Tufte (2001 pp. 108-112) describes it as contemporary optical art relying on moiré effects aiming to produce an appearance of vibration and movement (see Figure 15). He argues that computer programs, such as Excel encourage the use of moiré effects for instance by enabling the labeling with patterns, even though there is no proved benefit of using them, but quite the opposite.



Figure 15. Moiré vibration (Tufte 2001 p. 108)

According to Ware (2012 p. 35) texturizing surfaces is not “chartjunk” if the texture is applied to create 3D visualizations. Texturizing surfaces can help the eye in perceiving the orientation, shape and spatial layout of the surface (Ware p. 36). However, most pattern-finding mechanisms of the brain work in 2D and therefore applying 3D to bar charts and scatterplots is not effective (Ware p. 239).

The second form of chartjunk is *the grid* or to specify, the dark gridlines, which have no value in generating information (Tufte 2001 p.113). They tend to draw attention from the data to the axis and disturb in identifying the essentials of data. *The self-promoting graphics* that are used in a graph to make it look more interesting, are the third form of chartjunk. Tufte (pp. 116-120) argues that the leverage of such effects (for instance 3D)



is an attempt to brag about new technologies or simply be graphically preposterous because of the attention – even though it is the design that gets the attention, not the data.

The use of graphical elements can cause the visualization to appear more complex than it is (Tufte 2001 p. 153.) If the data is complicated making the graphics to turn into a puzzle, the use of multiple layers, that is multiple viewing depths and multiple viewing angles, enables more coherent communication. According to Tufte (pp. 154-155) graphics can be designed to have at least three viewing depths, which are

1. what is seen from a distance
2. what is seen in detail
3. what is seen underlying the graphic

*Cognitive load* relates to the used amount of working memory capacity. As stated earlier in the thesis, working memory is limited and can hold approximately seven plus or minus two chunks of information at any given time. According to Sweller (1988), a problem that requires large amounts of items to be stored in short-term memory, may cause an excessive cognitive load; the more information to digest the more cognitive load. In his paper Sweller argues that due to the limitations in short-term memory, learning experiences should be designed to reduce cognitive load in order to promote schema acquisition. Therefore, to design visual communications that contribute to learning instead of hindering it, the amount of cognitive load the graphic produces should be minimized.

### 3.3 Visual representations

#### 3.3.1 Short introduction to graphical representations

“Anscombe’s Quartet” from 1973 created by a British statistician Francis J. Anscombe, is a well-known example presenting the power of human visual system in recognizing relationships and trends. In his paper Anscombe fought against the notion that “numerical calculations are exact, but graphs are rough”, and that “computers should do *both* calculations *and* graphs”. To defend his work Anscombe introduced four groups of numbers, each with eleven pairs, and proved that by merely looking at the numbers in a table, it is difficult to see any differences in the patterns or trends among the groups of numbers, but when creating a graph, the differences between the groups get vividly clear (see Figure 16).

Data set	1-3	1	2	3	4	4
Variable	x	y	y	y	x	y
Obs. no. 1 :	10.0	8.04	9.14	7.46	8.0	6.58
2 :	8.0	6.95	8.14	6.77	8.0	5.76
3 :	13.0	7.58	8.74	12.74	8.0	7.71
4 :	9.0	8.81	8.77	7.11	8.0	8.84
5 :	11.0	8.33	9.26	7.81	8.0	8.47
6 :	14.0	9.96	8.10	8.84	8.0	7.04
7 :	6.0	7.24	6.13	6.08	8.0	5.25
8 :	4.0	4.26	3.10	5.39	19.0	12.50
9 :	12.0	10.84	9.13	8.15	8.0	5.56
10 :	7.0	4.82	7.26	6.42	8.0	7.91
11 :	5.0	5.68	4.74	5.73	8.0	6.89

TABLE. Four data sets, each comprising 11 (x, y) pairs.

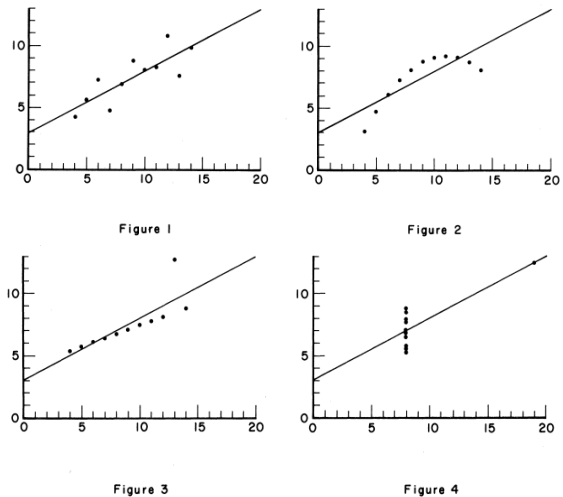


Figure 16. Anscombe's Quartet (Anscombe 1973)

When presenting columns of numbers along with a graph presenting the same information, people tend to look at the graph first trying to understand the scale and the underlying interconnections. Numbers are examined afterwards for more detailed information. (Helweg-Larsen & Helweg-Larsen 2007.)

The purpose of graphical representations is to increase the observer’s understanding of the data. Data visualizations reveal outliers, trends, correlations and patterns. They make

comparisons providing answers to questions of “what and when” explaining the top performers or most prevalent attributes as well their change over time. Visualizations establish connections revealing if a data set is a subset to another, and if and how a data set impacts on the results of another set. In addition they also solve complex questions and guide to conclusions by facilitating deeper evaluation. (Rodriguez & Kaczmarek 2016 pp. 25-33.)

In order to a visual representation to be powerful and efficient, it should rely on the advantages of human visual perception and its capabilities, however, as Rodriguez & Kaczmarek (2016) state in their book, it is merely a starting point. In addition, visual representations should be

- *universal* so that they can be shared across the globe
- *immediate* so that they can be quickly reviewed and understood
- *concise* so that they require only a little space and enable to see more with less
- *inviting* so that they are aesthetically appealing and attract to take a closer look
- *memorable* so that they are recalled and recognized
- *revealing* so that they disclose information that would otherwise be missed or stay hidden
- *reusable and versatile* so that they fit different needs and are reusable in different media applications

(Rodriguez & Kaczmarek pp. 36-42.)

### **3.3.2 Graphical integrity and graphical excellence**

Visual representation of the data represents the underlying numbers and therefore the visual representation should always be consistent with the numerical presentation. Table outperforms graphics when the data set is small, but in order to display large data sets, carefully designed graphics present the information often more efficiently. (Tufte 2001 p. 56.) In his book Tufte studies the distortion in data graphics, and provides several examples of lying graphics that have peculiarities of perspective, distorting decorations, deceptive design and data variations or other visual and statistical tricks that exaggerate or underestimate things.

Tufte (2001 pp. 55-77) summarizes the six principals that elicit *graphical integrity*:

- 1) the representation of numbers in the graphic is directly proportional to the numerical quantities represented
- 2) labeling is used to overcome graphical distortion and to explain the data
- 3) data variation is visibly presented, whereas design variation is not
- 4) in time-series displays of money, deflated and standardized units of monetary measurement are often better than unadjusted rates
- 5) the use of two (or three) varying dimensions to show one-dimensional data should be avoided
- 6) context is essential and the graphic must be truthful in making comparisons

The purpose of a graphic is to reveal data, and to communicate complex ideas clearly, efficiently and precisely. Despite graphic design gives the opportunity for being creative, *graphic excellence* requires telling the truth about the data (Tufte 2001 p. 51). In his book Tufte (p. 13) explores excellence in statistical graphics concluding the following requirements for graphical displays

- to show the data
- to induce the viewer to focus on the information substance rather than about the graphic design or something else
- not to distort the message the data is carrying
- to present many numbers in a small space
- to make large data sets coherent
- to guide the eye in comparing different pieces of data
- to reveal the data at several levels from the big picture to fine details
- to serve a purpose of describing, exploring, summarizing or decorating
- to be seamlessly integrated with the statistical and verbal descriptions of a data set

### 3.3.3 Evolution of Excel chart design

In the early 2000s Microsoft Excel was one of the most common financial tools used in business and despite the emergence of business intelligence programs, it is still one of the most preferred tools (Half 2018), since there really is nothing like Excel. In 2017 roughly 750 million people worldwide used it (Cocking 2017). Over the past couple of decades, the development of visual communications in Excel has been significant. The progress is easily exhibited looking at the charts created with Excel 2003 and comparing them to charts created with Excel 2016. Figure 17 introduces a few slides from a slide set published by Griffith University in 2003. The gridlines of the chart are black as well as all the font and shape outlines. The background of the plot area is gray by default and 3D effects are leveraged carelessly. Even the chart title is printed in bold.

**Chart (3-D type)**

Labels: Chart title, Data label, Legend, Value (Z) Axis, Value (Z) Axis title, Category (X) axis title, Category (X) axis.

#### Choosing the right chart type

- A **Column** chart compares values directly
- A **Stacked Column** chart compares parts of several totals
- **Pie** chart compares parts of one total
- **Line** chart compares values over time
- **Y Scatter** charts are good for showing comparisons of numbers such as scientific or statistical data

16

**Chart (3-D type)**

Labels: Chart title, Data label, Legend, Value (Z) Axis, Value (Z) Axis title, Category (X) axis title, Category (X) axis.

#### Make your chart more effective - Editing a Chart

- Make formatting changes
- Revise chart items
- Change chart colours
- Revise fonts
- Apply a shadow effect
- Change the order of data series
- Change the data series from rows to columns or vice versa
- Change a chart value axis

17

Figure 17. A sample slides from a slide set "Creating and editing charts in Microsoft Excel" (Aitkin 2003)

It is worth remarking that the slides recommend using built-in Excel effects in order to make the presentation more “effective” Similar examples are easy to find: such as the graph illustrated in Figure 18. The design includes a variety of decorations, which are used just for fun since they serve no purpose at all in explaining the data. Showing a table underneath the bars does not add any value, unless the purpose of the chart is to communicate the exact values for the revenue and the number of page views. That decision would make both the value axis labels and the axis titles useless. Looking at the visualization it is also unclear where the attention should be appointed to, since the most visible element of the graph is the green background.



*This line graph comparing page views to revenue was created using Excel and took about 15 minutes to create.*

*Figure 18. An example of visual communications created in Excel 2012 (Cook)*

Tufte (2001 p. 111) referred to this phenomenon when arguing that “This form of chartjunk is a twentieth-century innovation, and computer graphics are multiplying it more than ever”. Having said that, Tufte (p. 92) encapsulated the fundamental principle of good statistical graphics by saying “Above all else show the data”.

Excel has applied, at least to some extent, the principles Tufte (2001) talked about in his book. One might argue, that they have taken Excel to where it stands today. The default graphs are more discreet; the fonts and gridlines are gray, and the background of the plot area is white. In general, the attention has been shifted from the visual elements to the data making the data more visible (see Figure 19). However, Excel visualizations at their current state do not yet entirely fulfil Tufte’s utopia. On top of it, a functionality for quick

editing has been added to later versions of Excel enabling the user to select the preferred chart design by simply clicking a button. Examples of the most courageous designs show how design can distract the attention away from the data and the message (see Figure 20).

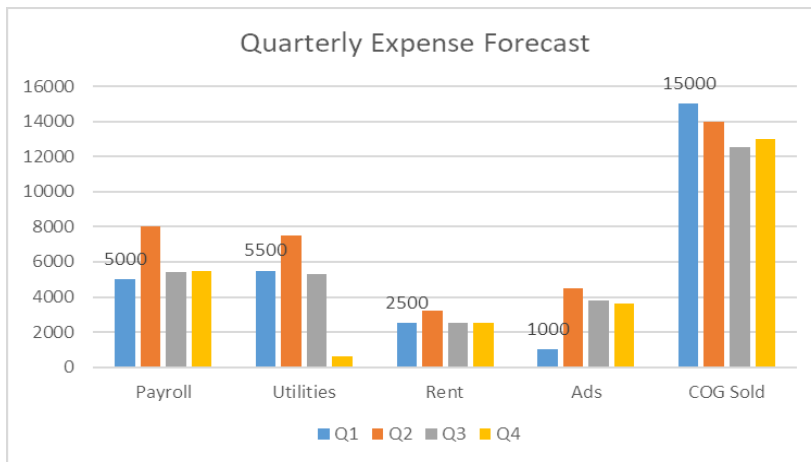


Figure 19. An example of a default chart created in Excel 2016

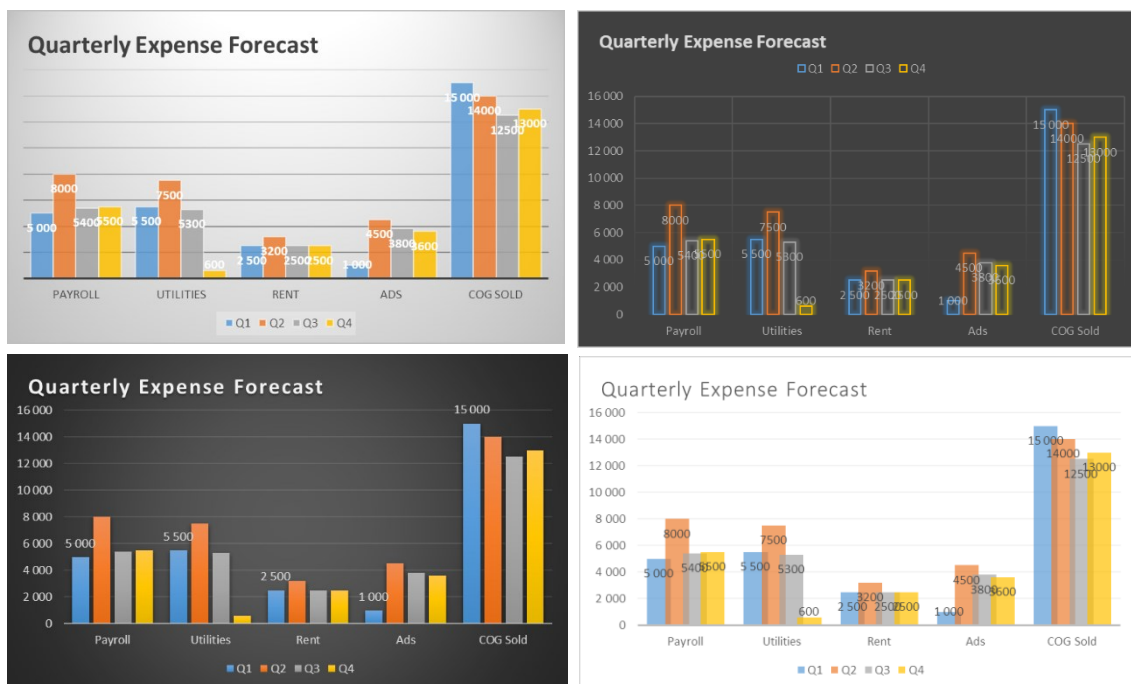


Figure 20. Examples of quick design layouts Excel 2016

In order to represent the data in a way it reserves as little working memory as possible, the first thing to do, is to decide what information the observer should get when looking at the chart. The chart should speak for itself. In the example chart, data labels are added to data series describing the numbers of the first quarter. Therefore, one might assume

that knowing those numbers is of greatest importance, however the chart itself does not indicate it very clearly, and despite the small effort, they eyes follow the gridlines trying to figure out the currency amounts of the other quarters as well. A lot of time and effort is put into a task that may not be necessary at all.

If the chart was aimed to describe the first quarter figures, is it worth knowing the exact numbers of the other quarters or is it decent enough to know approximately how much higher or lower they are than those of the first quarter? This decision is fundamental and will eventually guide the entire process of creating the chart; it will determine what is considered data-ink and what is considered non-data-ink. Figure 21 illustrates a situation where the emphasis is put on the first quarter numbers – although that would have been clear without saying, since color is used pre-attentively.

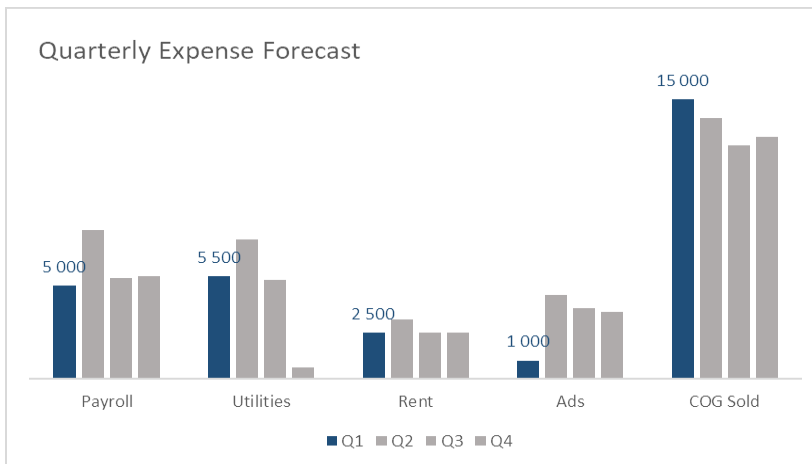


Figure 21. An example of visual communications created in Excel 2016

The purpose of this chapter was to summarize the key considerations for creating effective visual communications. The default charts of Microsoft Excel 2003 and 2016 were reviewed to demonstrate the increased awareness of the possibilities that effective visuals have in explaining the data. Microsoft Excel has already adapted many of the principles Tufte (2001) talked about in his book, but in order to achieve graphical excellence at its best, a visual designer, who is half an artist and half a data analyst, is still required to define the purpose of the graph. This decision is central in defining the approach towards the data, and eventually, in making the design decisions communicating the message to the audience.



## 4 METHODOLOGY

This chapter introduces action research, which was the selected research method. First action research is defined, and next a brief overview on action research as a field of study is provided. Finally, the research process of the thesis is explained and the data set used as a source data in creating visual communications is introduced.

### 4.1 Action research

#### 4.1.1 Definition and purpose of action research

Kurt Lewin, who is often referred to as the originator of action research (Adelman 1993) developed a theory of action research as a spiral of steps involving planning, action and fact finding about the results of the action (Reason & Bradbury 2008 p.4). Lewin's work came generally known as an action-reflection cycle of planning, acting, observing and reflecting, which was followed by more contemporary subsequent models (see Figure 22) (McNiff 2013, p. 56-57). Definitions of action research emphasize this empirical and logical problem-solving process (Reason & Bradbury p. 4).

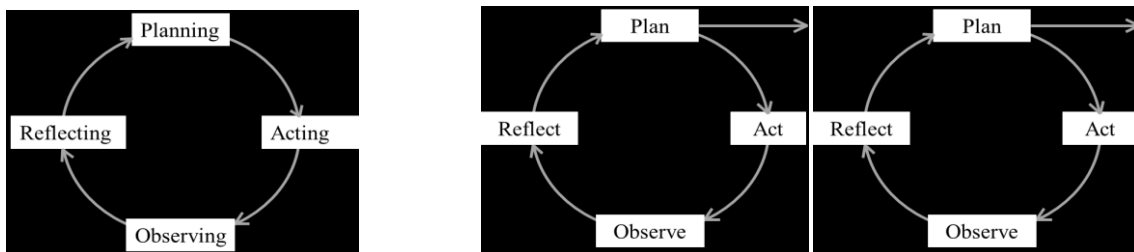


Figure 22. Action reflection cycle and its sequences (McNiff 2013 p. 57)

Reason & Bradbury (2008 p. 4) set the following definition for action research:

Action research is a participatory process concerned with developing practical knowing in the pursuit of worthwhile human purposes. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities.

Among business researchers action research is defined as a method producing results by involving the members of an organization around a concern that genuinely interests them. Iterative process of problem identification, planning, action and evaluation is involved in

experimenting and solving real problems - leading eventually to re-education, changing patterns of thinking and action. Action research is aimed to contribute both to academic theory and practical research. (See Bryman & Bell 2013 p. 413.) Eden and Huxman (see Bryman & Bell p. 414.) define the following outcomes:

- It has implications relating to situations other than the one that is studied
- It is usable in everyday life but concerns also with a theory
- It leads to generation of emergent theory deriving from data through gradual steps
- The findings have practical implications and the researcher must notify the participants of what is the expected take away of the project

And according to Reason & Bradbury (2008 p. 4), the primary purpose of action research is

[...] to produce practical knowledge that is useful to people in the everyday conduct of their lives. A wider purpose of action research is to contribute through this practical knowledge to the increased well-being – economic, political, psychological, spiritual – of human persons and communities, and to a more equitable and sustainable relationship with the wider ecology of the planet of which we are an intrinsic part.

#### **4.1.2 Various aspects of action research**

Action research is a diverse and growing field of study, which emphasizes action and practice. It uses various methods and tools to achieve change and increase the researcher's understanding. Understanding is generated from action and for action. (Dick 2015.) In his paper, Dick (see Dick 2015), who reviewed 314 entries in The SAGE Encyclopedia of Action Research, identified the following aspects that unite the many varieties of action research:

- Action research is a collection of diverse methods that are united by values, intentions and processes.
- Action research is almost always participatory; it empowers those involved and those involved are involved as equals.
- Action research is action oriented pursuing change and improvement.
- Critical, effortful reflection is essential as it generates understanding and sparks new insights.
- Action research process is cyclic integrating the action and critical reflection to determine how the desired changes are achieved and theorized.

In business and management, action research is of particular interest in exploring organization’s processual problems, such as learning and change. The researcher is a member of the organization and has preunderstanding that is knowledge, insight and experience of the processes being studied. This is both an advantage and a challenge, since the role duality may affect the data generated if the research threatens existing organizational norms. Using organizational consultants is another form of practicing action research, but is not an unproblematic approach either. (See Bryman & Bell 2013 pp. 414-415.)

### 4.1.3 Research process

Action research is a method used for improving practice and contributing to change. The purpose of the thesis was to enhance visibility of activities driving the performance of accounts receivable management in order to increase its efficiency. By exploring the principles of visual design the author gained understanding and knowledge of how to design visual communications that reveal data. Creating a model to define the indicators measuring the activities driving the performance the author was able to define leading indicators driving DSO. During the research process the author contributed both to academic theory and practice. Figure 23 illustrates the phases of the research process and the steps taken during each phase.

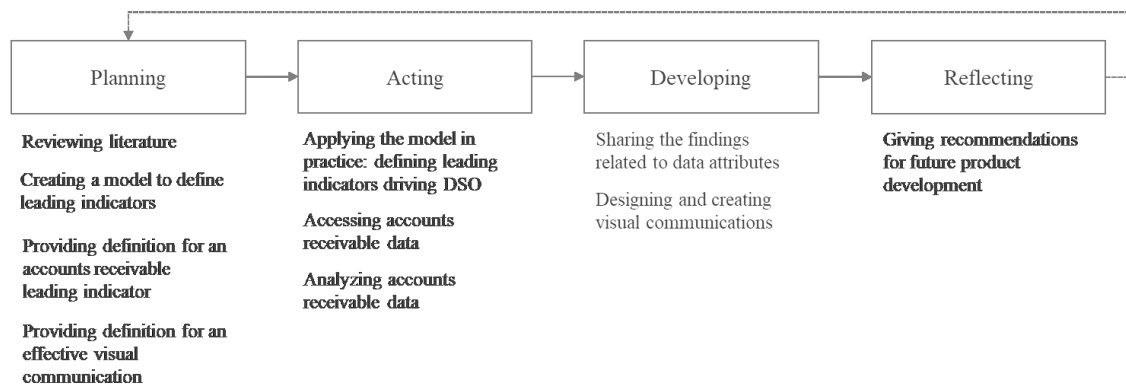


Figure 23. Action research process

At the *planning phase*, a literature review studied working capital management and accounts receivable optimization as a strategy in freeing tied-up working capital. The importance of performance indicators was recognized. The general concept of performance measurement was explored through academic literature, but when narrowing down to

performance measurement of accounts receivable management, very little if any academic literature was available. Most frequently named outcome metrics were identified, but in order to explain the deviations of the performance, the literature suggested to look into leading indicators. However, it did not clearly state which metrics were considered leading indicators of accounts receivable. Having acknowledged this, the author contributed to academic theory by proposing a model to define leading indicators.

During the planning phase, theoretical framework was also built around visual communications. Reflecting it, the author proposed best practices for designing visual communications and provided a definition for an effective visual communication.

The purpose of the *acting phase* was to define leading indicators driving the performance of accounts receivable management. The author provided a definition for an accounts receivable leading indicator, and applied the model to define leading indicators driving DSO. DSO indicates how fast the receivables are converted to cash, and is therefore one of the key metrics measuring the performance of accounts receivable management. Providing visibility of the activities that drive it, enable adjustments in daily activities to improve performance. During the acting phase, the author also analyzed a data set stored in accounts receivable ledger of accounting software “X” to discover to what extent it included the necessary attributes to visualize leading indicators driving DSO. The author got access to data and transferred it to Microsoft Excel 2016 for further analysis.

At the *developing phase*, the author documented the findings related to data set, and reflected both the literature and the knowledge gained during the research to design effective visual communications enhancing the visibility of activities driving the performance of accounts receivable management. The graphics were created using Microsoft Excel 2016.

Finally, at the *reflecting phase*, the author reflected the results and provided recommendations for future product development.

## 4.2 Introduction to research data

### 4.2.1 Relational database

The data used as a source data in creating visual communications was structured data stored in a relational database (SQL). In relational database the data is stored in tables, and a database may contain one or many tables. A table consists of zero or more records. A record is a collection of fields, a data set applying to a single item; a row in a table. (Chaple 2020; Wilton & Colby 2005 pp. 14-16.) The columns contain characteristics that describe the rows, and the column headings are called *attributes*. (Chaple). For its given structure, structured data is easy to input, store and analyze. Figure 24 presents a table in SQL database.

attribute	ESINENO	KOONITH	TOSNO	TOSLAJI	HANKHE	KPPVM	HAKOODI	PAIKA	PAIKA2	PAIKA3	PKOODI	PKOODI2	PKOODI3	SMJPROS	SMJPROS2	SMJPROS3	TILNO	KLISTNK
1	2	NULL	2	NULL	2016-01-01 00:00:00.000	2016-01-01 00:00:00.000	1	50.00	0.00	0.00	5	1	1	25.00	0.00	0.00	1160	9009
2	3	NULL	3	NULL	2017-01-01 00:00:00.000	2017-01-01 00:00:00.000	1	50.00	0.00	0.00	5	1	1	25.00	0.00	0.00	1160	9100
3	7	NULL	7	NULL	2004-05-31 00:00:00.000	NULL	1	3.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1160	9100
4	8	NULL	8	NULL	2017-01-01 00:00:00.000	NULL	1	3.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1160	9100
5	9	9	9	MU	2017-09-20 00:00:00.000	2017-01-01 00:00:00.000	1	50.00	0.00	0.00	5	1	1	25.00	0.00	0.00	1160	9009
6	10	10	10	NULL	2017-09-20 00:00:00.000	2017-09-20 00:00:00.000	1	25.00	0.00	0.00	5	1	1	25.00	0.00	0.00	1070	9100
12	12	NULL	12	NULL	1991-01-01 00:00:00.000	1991-01-01 00:00:00.000	1	50.00	0.00	0.00	5	1	1	17.00	0.00	0.00	1080	9009
13	13	NULL	13	NULL	1973-01-01 00:00:00.000	1973-01-01 00:00:00.000	1	40.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1080	9009
10	15	15	15	NULL	1992-01-01 00:00:00.000	1992-01-01 00:00:00.000	1	40.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1080	9100
11	16	16	16	NULL	1992-01-01 00:00:00.000	2017-01-01 00:00:00.000	1	15.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1080	9009
12	17	17	17	NULL	2007-05-30 00:00:00.000	2007-05-30 00:00:00.000	1	25.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1160	9100
13	19	19	19	NULL	2016-12-31 00:00:00.000	2016-12-31 00:00:00.000	1	4.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1070	9009
14	20	20	20	NULL	2016-12-31 00:00:00.000	2016-12-31 00:00:00.000	1	12.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1080	9100
15	21	21	21	NULL	1999-03-29 00:00:00.000	1999-04-01 00:00:00.000	1	40.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1080	9100
16	22	22	22	NULL	2009-01-01 00:00:00.000	2017-01-01 00:00:00.000	1	2.00	0.00	0.00	1	1	1	0.00	0.00	0.00	1070	9100
17	23	kk1234	1995	K2	2015-06-16 00:00:00.000	NULL	1	0.00	0.00	0.00	0	1	1	0.00	0.00	0.00	1600	1000

Figure 24. An example of SQL database table

### 4.2.2 Data set

A data set is a collection of data relating to a subject. Even though the database terms often define data set as the contents of a single table (Techslang), the author uses the term when referring to a set of data that was exported from accounts receivable ledger of accounting software “X” to Excel for further analysis. The accounts receivable ledger module of the software provides a functionality to browse and review invoice data in a view that corresponds to a spreadsheet. This data is a collection of fields from several tables in a database. An “export to Excel” feature was applied to export the data from the software to Excel.

The data set contained rows, and each row represented an invoice sent to a customer. The attributes (that is columns) described invoice information relevant to its collection, such as the customer name, invoice amount, days past due, invoice date and due date. The data set consisted of 809 debit invoices and 108 credit invoices available for collection at a given date. The number of individual invoiced customers was 341.

The purpose of the analysis was to verify that the column data contained the necessary attributes in order to explore and create visualizations representing accounts receivable leading indicators.

### **4.2.3 Cross-tabulation**

Looking at the raw data does not reveal patterns, trends or probabilities, and therefore cross-tabulation in Excel pivot table was done to explore the research data. Cross-tabulation is a method often performed to categorical data, where data is divided into categories. One data point can only belong to one category. Cross-tabulation reveals the relationships between different categorical variables. It discloses the change in correlations from one variable grouping to another giving insights that cannot be seen just looking at the raw data. (Aprameya 2016.)

The author used cross-tabulation to analyze the aging of accounts receivable to reveal the inefficiencies within collections. Excel pivot tables were also used to group raw data. Raw data consisted of individual invoices, which were grouped based on account to do comparisons.

## **5 RESULTS**

The purpose of this chapter is to reflect the literature reviewed to provide definitions for an accounts receivable leading indicator and an effective visual communication. The model defined in chapter 2.3.3 is applied in practice to define leading indicators driving DSO. The findings related to research data are presented and the principles of visual design are summarized to outline the best practices for creating effective visual communications. Finally, the visual communications revealing insights about the activities driving the performance of accounts receivable management are presented.

### **5.1 Visibility of activities driving the performance**

Providing visibility of activities driving the performance of accounts receivable management requires defining these activities and the indicators to measure them. As suggested by the author introducing the model in chapter 2.3.3, these activities are “daily activities ensuring the favorable outcomes every day in order to reach the objectives (that is operational level goals) that set the direction to reach the result.” The measures of daily activities are called leading indicators, and therefore monitoring leading indicators of accounts receivable provides visibility of activities driving the performance of accounts receivable management.

#### **5.1.1 Definition of an accounts receivable leading indicator**

The literature reviewed defined leading indicators as actionable and predictive measures fostering proactivity. Derived from the general definition of a leading indicator, the author recognized the following characteristics:

Leading indicators of accounts receivable

1. Are considered to be predictive measures of daily activities contributing to performance of accounts receivable management.
2. Are expected to deliver early information on the future write-offs.

### 5.1.2 Defining leading indicators driving DSO

One of the main targets of accounts receivable management is to convert receivables into cash as fast as possible. This outcome is measured using DSO, which is among the most commonly leveraged accounts receivable outcome metrics. Measuring DSO is useful in evaluating the company's ability to contract its accounts and manage its receivables, and in addition it can be used to benchmark between competitors (Luangrath 2017). DSO is also one of the key performance indicators followed to analyze working capital (Boisjoly et al. 2020; Korman et al. 2020; Luangrath 2017). DSO was selected for analysis due to its significance and frequent use.

The model sets the following questions to consider when defining leading indicators:

1. What is the desired result? (May be derived from strategic objectives.)
2. What is the outcome metric (KPI) defined to measure the result?
3. What should be the direction of the operations to achieve the target? What are the main objectives?
4. Which factors within operations indicate the daily activities have been successfully executed? What are the factors, the favorable outcomes of which enable achieving the objectives?
5. What are the activities executed to deliver the favorable outcome? How are these activities measured?

The performance of accounts receivable management team is seldom the only factor impacting on the accounts receivable outcome metrics. As described by Shapiro et al. (2004) the order to cash process involves also management making the decisions, sales department generating the orders, customer service registering them and different other functions fulfilling them. Accounts receivable team steps in when billing the order and collecting overdue invoices. Important decisions related to customer creditworthiness and payment terms are often made by managers sitting elsewhere. To summarize, every phase prior to billing impacts on the customers' ability and willingness to pay to their bill. Alongside the smoothness of customer-facing processes, the quality of the product or the service impact on customer satisfaction, which is proved by various studies (that were out of scope of the thesis), and is more or less general knowledge.



DSO measures the amount of days it takes to convert receivables into cash, or in other words, how fast the customers pay their bills. The operations are guided by objectives such as “First class product/service quality”, “Effective order to cash process” and “Reaching the best possible DSO” (which Luangrath 2017 and Voorheis 2019 recognize as one of the drivers impacting DSO). Fulfilling these objectives requires the accounts receivable team to success in their daily activities. The success is defined by success factors, such as “Billing and collection processes are accurate” and “Customers agree with the payment terms” which fulfilled enable achieving the objectives. Delivering these favorable outcomes requires activities, and to provide visibility of the activities and the team’s performance, indicators are needed.

Leading indicators of DSO are measures that indicate how well the team is performing in their daily activities aiming to convert receivables into cash as soon as possible. The indicators describe the current situation and if problems or underperformance exists, the metrics reveal it before it is too late. By providing visibility of activities driving DSO, leading indicators offer possibilities to impact on future performance of accounts receivable management. Figure 25 illustrates how the model presented in chapter 2.3.3 is applied in defining leading indicators driving DSO.

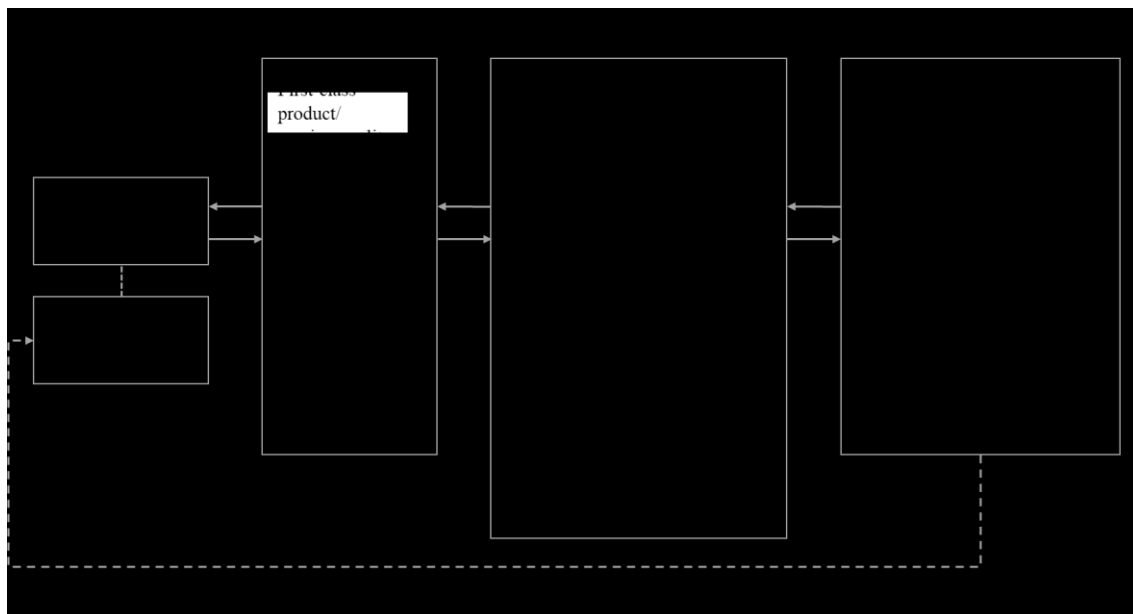


Figure 25. Applying the model to define the leading indicators driving DSO

The author recognized ten activities to track and defined leading indicators to measure them (see Table 3). Despite the activities or indicators may not be limited to these, the following metrics explain a great deal of deviations in DSO.

Table 2. Leading indicators driving DSO

<i>Measurable activities</i>	<i>The purpose</i>
<i>Leading indicators</i>	
<i>Customer claims</i>	
<i>Number of customer claims</i>	To explain the relationship between customer claims and past due days
<i>High-risk accounts</i>	
<i>Average balance past due of accounts past due over 90 days</i>	To recognize high-risk accounts in order to prevent write-offs; to monitor average balances in order to follow performance
<i>Average balance of the largest accounts past due over 90 days</i>	
<i>Past due accounts</i>	
<i>Top X accounts past due (% of total billing, % of balance past due)</i>	To guide in prioritizing collections and recognizing potential write-offs
<i>Invoice aging of the Top X accounts</i>	
<i>Average days past due per account</i>	
<i>Collections</i>	
<i>Number of invoices requiring collection efforts</i>	To monitor the status of past due invoices and foster proactivity; to follow the percentage the receivables past due are expected to remain uncollectible
<i>Expected amount of uncollectible receivables (% of total receivables past due)</i>	
<i>Days past due</i>	
<i>Average days past due per aging category</i>	To monitor the average days past due per aging category; to monitor the % of receivables past due past due to monitor and prioritize collections
<i>% of receivables past due</i>	
<i>Credit memos</i>	
<i>Number of credit memos</i>	To monitor the accuracy of billing and to understand late payments
<i>Extended-terms requests</i>	
<i>Number of requests</i>	To monitor extended-terms requested by the customer to predict customers' future payment behavior/financial situation

<i>Credit period</i>	To monitor the average payment term for outstanding invoices by account to identify extended payment terms given
<i>Average payment terms (per account)</i>	
<i>Aging of accounts receivable</i>	To follow the payment behavior of the largest accounts to prioritize collections in order to reach best possible DSO
<i>Aging of accounts receivable report</i>	
<i>Cash discounts</i>	To monitor the cash discounts given and used
<i>Number of cash discounts</i>	
<i>Value of cash discounts</i>	

### 5.1.3 Findings from data

The data set explored contained invoice information exported to Excel from the accounts receivable ledger of accounting software “X”. The data set was examined to discover the attributes it contained, and to verify if the data was sufficient in order to create visual communications displaying accounts receivable leading indicators. Table 3 introducing the indicators and their purpose provided a framework for the examination.

The following attributes of the data set were considered important in analyzing the performance of accounts receivable management: (1) days past due, (2) outstanding balance and (3) collection status (see Table 4).

Table 3. Current attributes

<i>Attribute</i>	<i>Type of field</i>
<i>Days past due</i>	Numerical value; the difference between current date and invoice due date (the value can be negative if not past due)
<i>Outstanding balance</i>	Numerical value; invoice total
<i>Collection status</i>	Categorical value; 0,1,2 or 101

In order to create visualizations the additional attributes presented in Table 5 were added to source data; in practise three columns were added. A categorial value describing the number of days an invoice was past due was given to each invoice (that is row) in order to explore the aging of accounts receivable.

Table 4. Additional attributes

<i>Attribute</i>	<i>Formula for calculation</i>
<i>Balance past due</i>	Show balance if (SUMIF) days past due > 0
<i>Payment term</i>	Due date minus invoice date
<i>Aging category</i>	Categorical values 1 to 6: (1) current that is not past due, (2) 1-15 days, (3) 16-30 days, (4) 31-60 days, (5) 61-90 days and (6) over 90 days.

## 5.2 Effective visual communications

Visual representations of data reveal things, of which the eye would not have acknowledged reading a report where the facts are represented with numbers and letters.

### 5.2.1 Definition of an effective visual communication

This thesis has described the importance of thoughtful design as well as the core principles that make visual communications effective. Based on the literature reviewed, the author proposes the following definition for an effective visual communication:

- 1) A visual communication of data represents the underlying numbers and translates them into visual format.
- 2) The important data is represented using more distinct graphical elements, which acknowledges the human sensory capabilities.
- 3) Less working memory is reserved, which reduces the effort required to understand comparisons, establish connections and draw conclusions.

“At their best, graphics are instruments for reasoning quantitative information” (Tufte 2001 introduction).

### 5.2.2 Best practices for designing visual communications

When creating effective visual communications, the purpose of the graph defines how the data is represented. To minimize the cognitive load the graph produces, the amount of

data-ink is maximized and pre-attentive attributes are applied to guide the attention. Tufte (2001) introduced the principles of visual design, and in their book Rodriguez & Kaczmarek (2016) propose a set of three major principles that ensure the visualization is reliable and effective. As stated by Rodriguez & Kaczmarek (pp. 387-388):

1. Cater to your audience
  - Focus on the audience, the purpose, and the storyline for each visualization. Know your audience well enough so that you can anticipate the series of questions they will have of the data.
2. Provide clarity
  - Present the data with the utmost accuracy, transparency, and clarity. Be straightforward so that each visualization properly represents the data.
3. Be efficient
  - Strive to create effortless experiences for your audience. The visualization should work so that your audience doesn't have to.

Reflecting Tufte's (2001) recommendations and those of Rodriguez & Kaczmarek (2016) the author proposes best practices for designing effective visual communications of accounts receivable:

1. Define the purpose of the graph
  - What is the message the graph is expected to transmit?
2. Consider deleting everything else but the data
  - Which visual elements are needed to explain the data?
3. Consider using pre-attentive attributes
  - Which visual elements need highlighting in order to transmit the message as fast as possible?
4. Consider revising
  - What is the message the graph delivered?

### **5.2.3 Visual communications of leading indicators driving DSO**

To conclude, this chapter presents a selection of the visual communications the author created. The purpose of the graphics is to enhance visibility of actions that impact on the performance of accounts receivable management. A brief commentary is provided alongside the graphics to summarize the design decisions made. The set of selected visual communications represent leading indicators measuring: (1) High risk accounts, (2) Past due accounts, (3) Collections and (4) Credit period.

## High-risk accounts

High-risk account is a customer who is likely to be a written off in the future. Debts that are due more than 90 days have the lowest probability of being paid back (Averkamp).

### *Average balance past due of the accounts past due over 90 days*

A graph representing the past due balances of accounts, whose invoices are past due more than 90 days reveals quickly the largest accounts (see Figure 26).

### *Indicator: Average balance past due of the accounts past due over 90 days*

- Provides an overview of the big picture, and following a trend over time, exposes deviations. Explaining the deviations requires taking a closer look to the largest accounts past due.

### Average balance past due of the accounts past due over 90 days

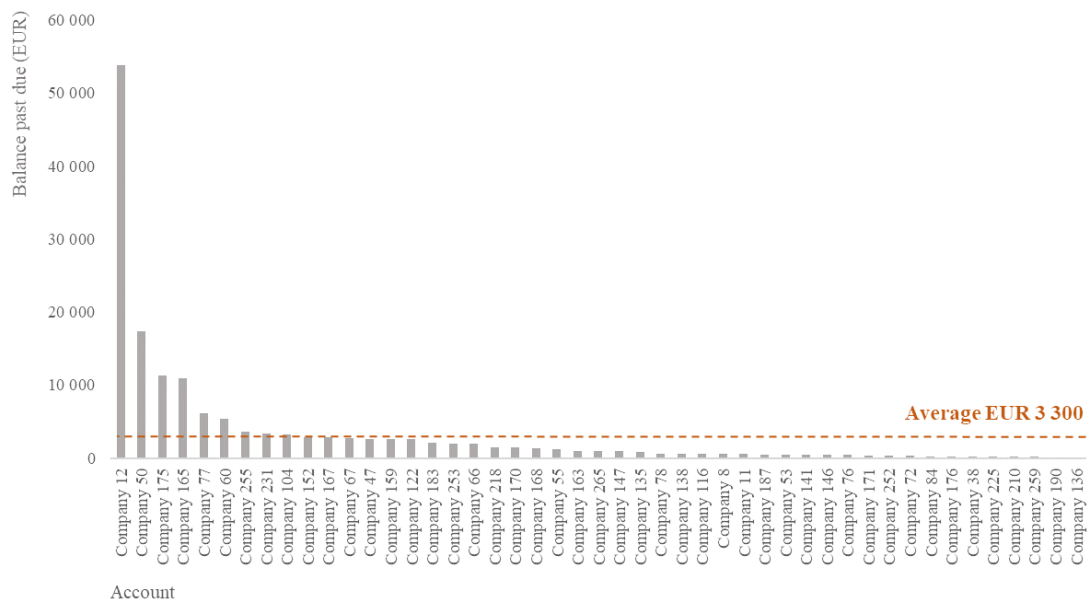


Figure 26. Average balance past due of the accounts past due over 90 days

## Design decisions

The information in the graph is positioned to support the natural “zig-zag” motion the eyes do when scanning across the screen; the first things to see are placed on the upper-left corner. By default, Excel aligns the text blocks (such as the titles) horizontally and vertically centered, but to establish a sense of cohesion the elements are aligned left and right. Orange font represents information that is supposed to catch the attention. The text

expressing the average balance past due at a given time provides quickly the information the audience is expected get when looking at the graph.

If the purpose of the chart was to guide the attention towards the largest accounts past due, a small change in preattentive usage of color would change the way the visual information is processed (see Figure 27). Changing the chart title accordingly strengthens the message the graph is supposed to deliver.

### Largest accounts with balances past due over 90 days

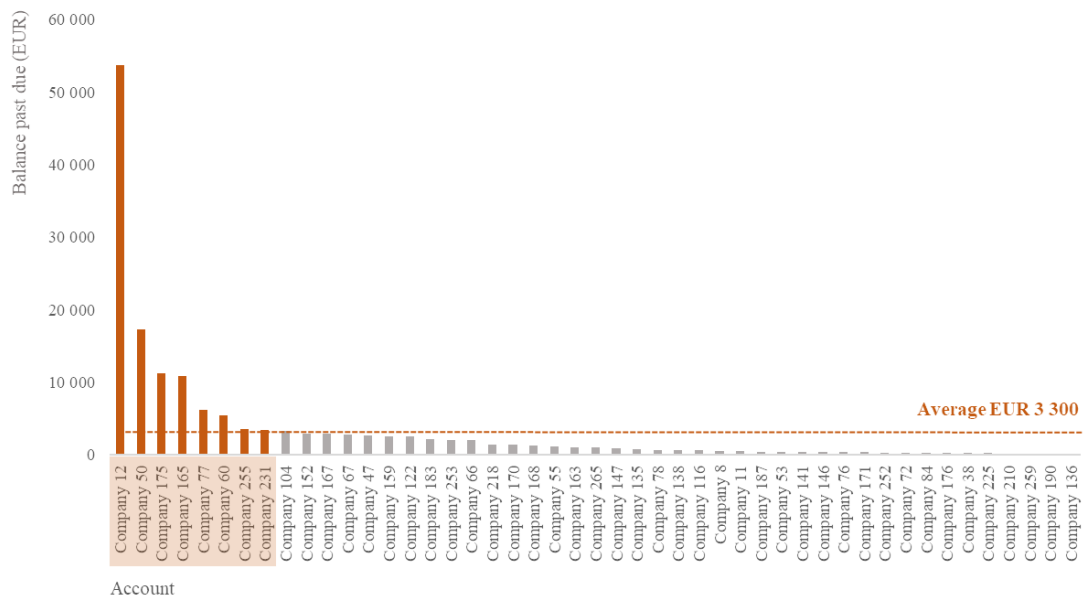


Figure 27. Largest accounts with balances past due over 90 days

Displaying the full list of accounts underneath the graph may not be efficient if the number of accounts is large. To get an overall view of the accounts the graph would fulfil its purpose without the horizontal axis.

## High-risk accounts

If there are accounts with larger balances past due over 90 days, a drill-down to their balances may reveal important insights.

### *Balances past due over 90 days and current balances*

Examining the amount of past due receivables and current balances not past due of the largest accounts reveals if the account is important in terms of current sales (see Figure 28). Current balance indicates the customer relationship is still considered active. High amount of past due receivables may predict the current receivables are becoming bad as well, or on the other hand, invoices that should have been credited or written off may still exist in the books.

*Indicator: Average balance past due of the largest accounts past due over 90 days*

- Provides an overview of the largest accounts past due and supports in prioritizing collection efforts. Requires drilling-down to customer accounts to find out the number and euro amounts of their past due invoices.

### Balances past due over 90 days and current balances

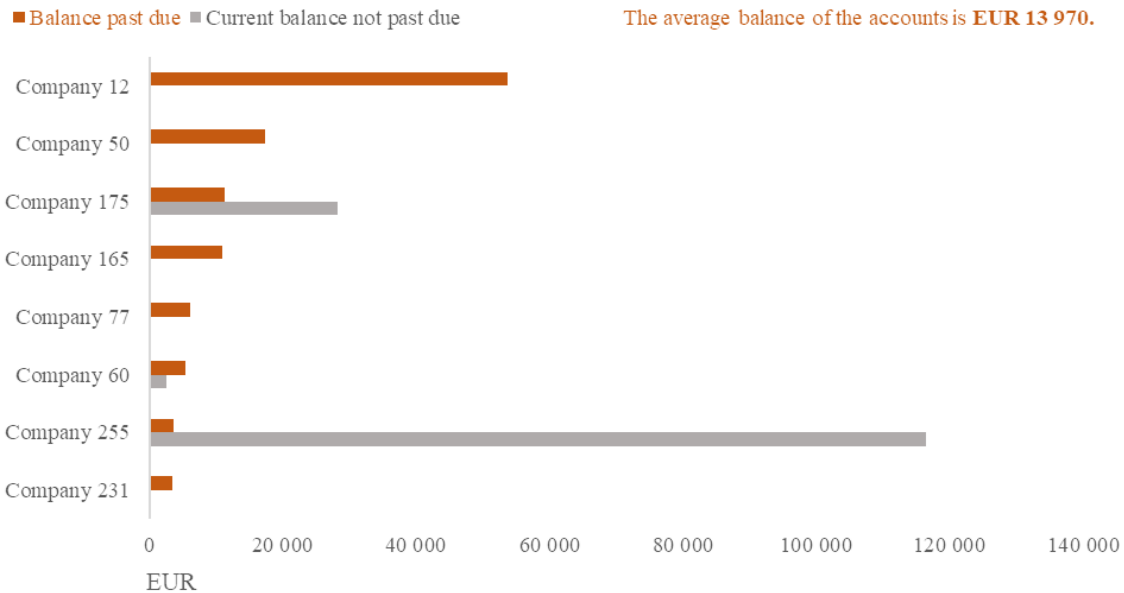


Figure 28. Balances past due over 90 days and current balances

### *Design decisions*

The data is arranged in descending order based on the balance past due in order to quickly learn which one of the accounts has the largest balance past due. The selected chart type



is “clustered bar” due to the significant difference between the smallest and the largest value. The legend is placed underneath the chart title to require as little scanning from the eyes as possible. An orange text indicating the average balance past due is placed on the upper-right corner to catch the attention.

### Past due accounts

Monitoring past due accounts provides insights into customers’ paying behavior and indicates if the debts are becoming bad.

#### *Largest accounts past due (Top 10)*

A graph displaying the accounts with the largest balances past due gives an overview of the accounts that may need more attention (see Figure 29). Including both the amount past due and the amount of current receivables not past due reveals if the account is important in terms of current sales. A high amount of receivables past due is a potential indicator of the current receivables to become past due as well. Data labels indicating the average number of days the balances are past due per account support in deciding if the account requires taking a closer look.

#### Largest accounts past due (Top 10)

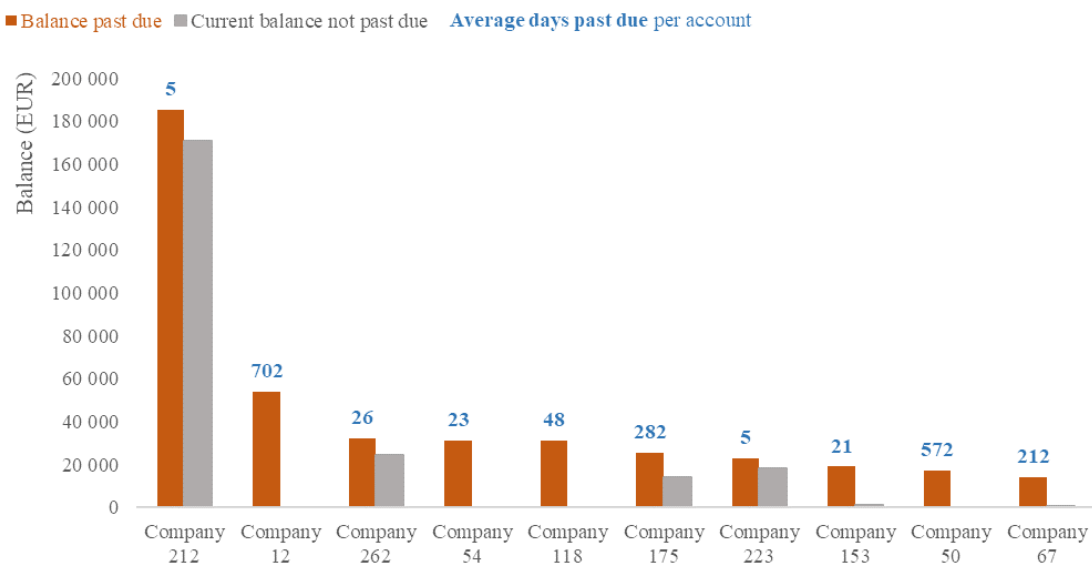


Figure 29. Largest accounts past due (Top 10)

### Design decisions

A clustered column is often the most appealing option, if the difference between the largest and the smallest value is moderate. The data is again sorted in descending order based on the amount of balance past due. The different colors used in the graph are applied in the legend to support in processing the information. The average days past due is added as a data label to indicate the number of days the invoices in average are past due per account. Pre-attentive attributes are employed in data labels and legend text to create visual hierarchy.

### Largest accounts past due (Top 10) – the indicators

Taking a closer look to Top 10 accounts, whose balance past due is the largest, reveals their significance in terms of total billing and the balance past due. Analyzing the invoice aging of the accounts provides insights into current situation exposing if the invoices are long due and should be written-off. (See Figure 30.)

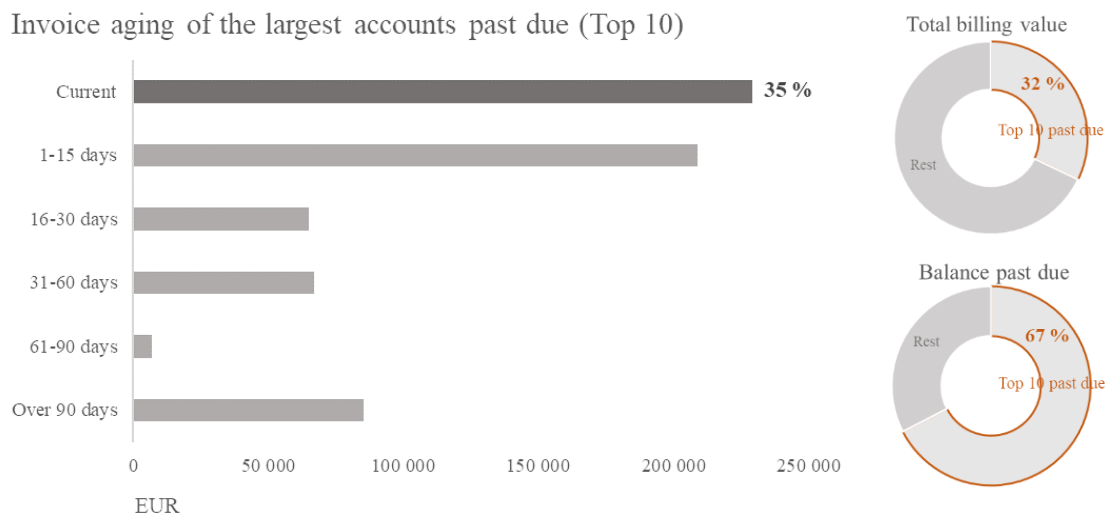


Figure 30. Largest accounts past due (Top 10) – the indicators

### Design decisions

The aging of accounts receivable of the Top 10 accounts is presented on the left to indicate the efficiency of accounts receivable management. An indicator stating the percentage of current invoices (that is 35 %) is added to quickly register the current situation. A darker shade of gray is used to encourage pre-attentive processing.

Doughnut charts are added to compare the balances of the Top 10 accounts past due and the rest of the customer base. A couple of indicators reveal quickly how significant the Top 10 accounts past due are in terms of total billing (that is 32 %) and balance past due (that is 67 %). Orange color is used to draw attention and give guidance on processing the information. In order the graph to appear united and coherent, only one color is used alongside the shades of gray.

## Past due accounts

### *Average days past due per account*

Scatterplots are often used in exploring relationships between two variables. In the current case a scatterplot is used to explore the average number of days the invoices are past due per account (see Figure 31). The purpose of the diagram is to indicate the efficiency of the collections and reveal outliers that might need attention or immediate write-off.

*Indicator: Average days past due*

- Gives an overview of the overall effectiveness of the collections.

Average days past due per account

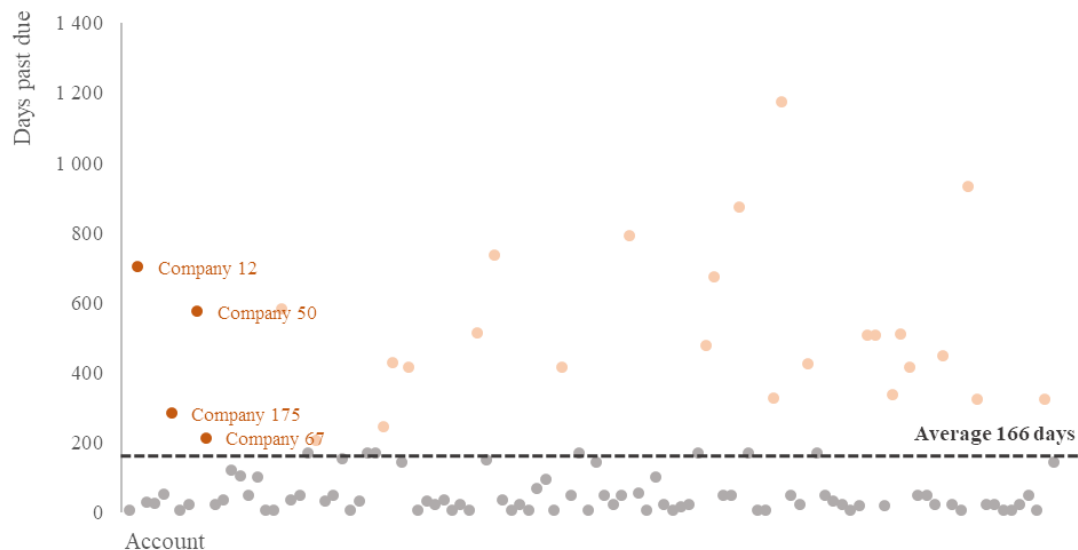


Figure 31. Average days past due per account

### *Design decisions*

The line indicating the average days past due is printed in darker font to draw attention. Including the number of average days past due (that is 166) reveals quickly the changes

if followed frequently. The accounts, who are past due above the average days are marked with orange. Higher color saturation and data labels indicate that few of the accounts require more attention than the others.

## Collections

### *Collection status of past due invoices*

A graph representing the collection status of past due invoices can reveal inefficiencies within collections, or indicate that the software is not used in most systematic way (see Figure 32). To monitor the collection status of past due invoices, the invoices were grouped to categories based on their age.

*Indicator: Number of invoices requiring collection efforts*

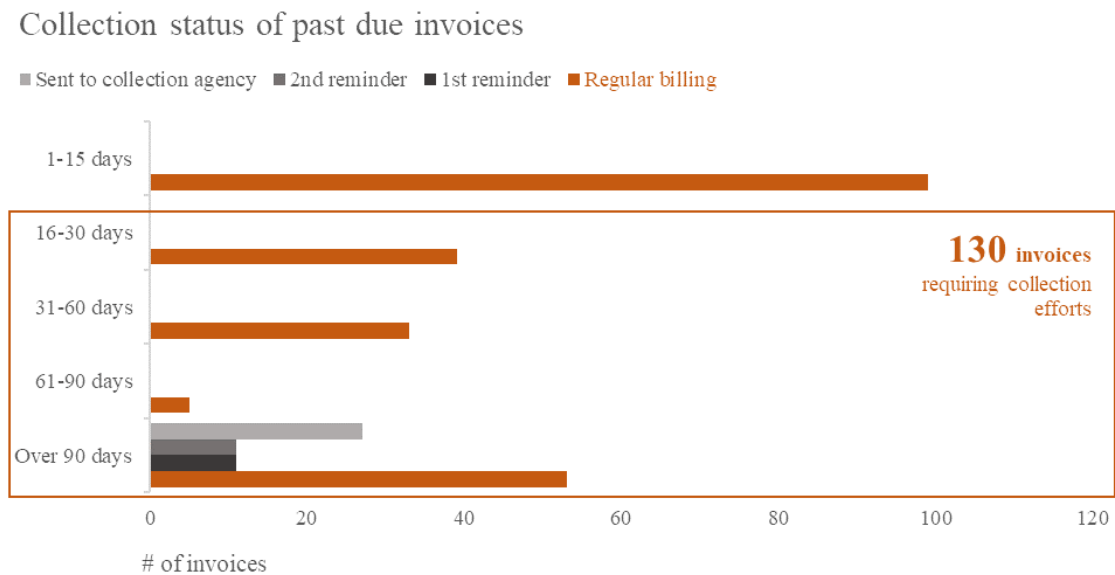


Figure 32. Collection status of past due invoices

### *Design decisions*

Due to Gestalt principle of closed contour the categories located inside the orange rectangle are considered related. An indicator showing the number of total invoices requiring collection efforts is printed in larger font to pop out. Orange color is chosen to indicate invoices that are still within regular billing process even though they are past due: the more orange, the more inefficiencies.

## Collections

### *Expected amount of uncollectible receivables*

Estimating the probability of an invoice not being paid back can be used to calculate the expected amount of uncollectible receivables; the more the invoice is past due the more likely it remains unpaid (Averkamp).

A graph displaying the amount of potential write-offs can be used in planning and directing the collection efforts where they matter the most in terms of financial consequences (see Figure 33). The invoices are grouped based on their age to explore the significance of each group in evaluating how much effort should be directed to their collection. The amount of total receivables past due is included to demonstrate how large share of total receivables past due is likely to remain uncollected.

*Indicator: Percentage of total balance past due expected to be written off*

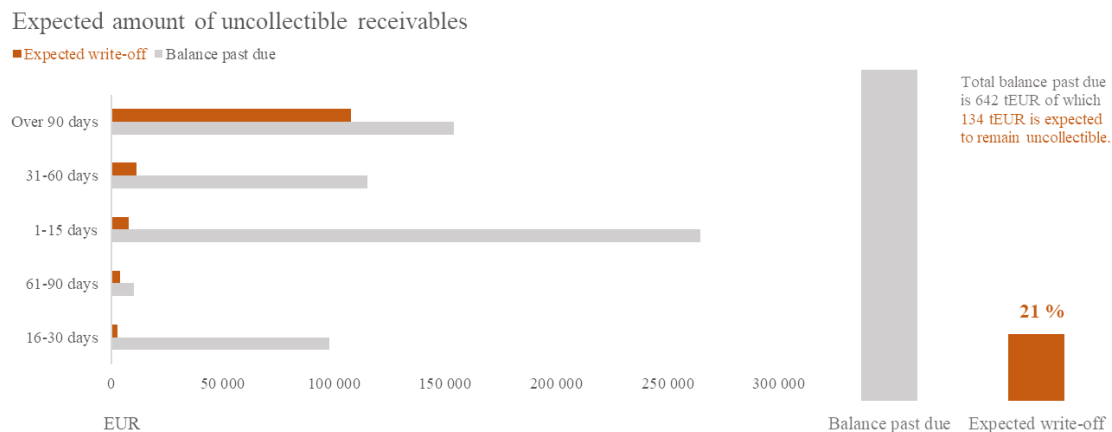


Figure 33. Expected amount of uncollectible receivables

### *Design decisions*

The categories are sorted in descending order based on the amount of receivables expected to remain uncollectible. The purpose is to see quickly how the days past due and the balance past due contribute to the expected amount of uncollectible receivables. The columns representing the total amounts are placed on the right without any axis information; a text is added to provide additional information about the total balances. An indicator (that is 21 %) showing the estimated amount of future write-offs is marked with

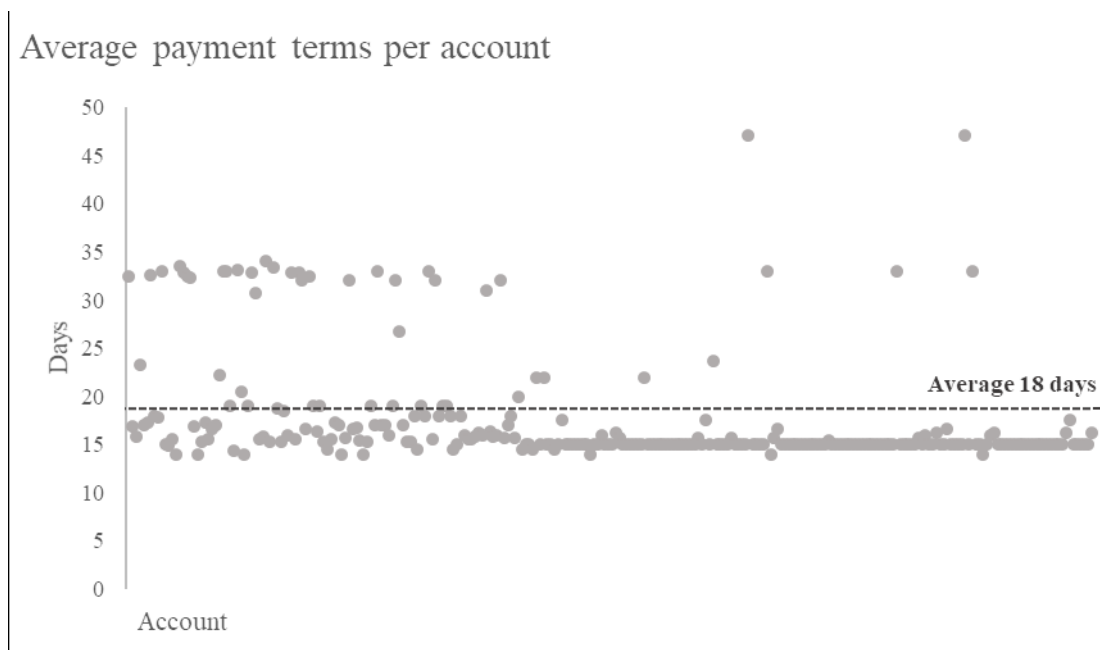
orange. Without using pre-attentive attributes the location in the lower-right corner would indicate the information is the least important in the graph.

## Credit period

### *Average payment terms per account*

A scatterplot representing the average payment terms of outstanding invoices per account can reveal outliers in terms of extended-payment terms given to customers (see Figure 34). The graph reveals the most frequently used payment terms and gives an overview of the current situation providing an average payment term.

*Indicator: Average payment terms given*



*Figure 34. Average payment terms per account*

### *Design decisions*

The line indicating the average payment term is marked with darker font to pop out. If the purpose of the graph was to indicate the outliers, selected data points could be marked with orange and data labels could be added to show the name of the account.

## 6 DISCUSSION

Aiming to increase the efficiency of accounts receivable management, the purpose of this study was to enhance visibility of activities driving the performance of accounts receivable management by exploring effective visual communications. Four research questions were formed to investigate the topic: (1) How the efficiency of accounts receivable management is measured; (2) How visibility of activities driving the performance of accounts receivable management is provided; (3) What is the definition of an effective visual communication and (4) How effective visual communications enhance visibility? In addition, a business problem regarding data set attributes was addressed. This chapter summarizes the key findings.

According to the literature reviewed, the performance and efficiency of accounts receivable management is often measured using outcome metrics, such as DSO, BPDSO, ADD, CEI and ART. Norton and Kaplan (1992) would call these KPI's, whereas Parmenter (2015) talks about key result indicators. Outcome metrics measure the outcomes of past events concluding whether the high-level targets set for accounts receivable management are met or not. They indicate the level of efficiency and following a trend over time the changes in efficiency get exposed, but the deviations are not explained. Measuring outcome metrics is easy but often too late in terms of improvement. Therefore, to contribute to performance, visibility of activities driving the performance is needed.

Providing visibility of activities driving the performance requires defining *these activities* and *the indicators to measure them*. As defined by the author, “the activities impacting on the performance are the daily activities ensuring the favorable outcomes every day in order to reach the objectives (that is operational goals) that set the direction to reach the result.” The measures of these activities are called leading indicators. The literature reviewed was not able to define leading indicators of accounts receivable management, and in order to provide visibility the author proposed a model to define them. The model was applied to define leading indicators driving DSO. The activities dealing with customer claims, high-risk accounts, past due accounts, collections, days past due, credit memos, extended-terms requests, credit periods, aging of accounts receivable and cash discounts

were discovered to be most profound. These activities were measured using leading indicators, such as “Average balance past due of accounts past due over 90 days”, “Invoice aging of the largest accounts past due (Top 10)”, “Average days past due”, “Number of invoices requiring collection efforts”, “Percentage of total balance past due expected to be written off” and “Average payment terms given”. The study was able to discover leading indicators, however it remains for future research to investigate how they should be employed to improve the performance of accounts receivable management, and how the activities are involved in achieving the result.

The design principles of visual representations were studied using Edward Tufte’s (2001) book as a primary reference. Even though some parts of the book may be controversial, it was a valuable support in defining effective visual communications. As defined by the author, “an effective visual communication is a visual representation that represents the underlying numbers and translates them into visual format. It represents the important data using more distinct graphical elements, and acknowledges the human sensory capabilities. By doing so, it reserves less working memory reducing the effort required to understand comparisons, establish connections and draw conclusions.”

Visual communications reveal data. Monitoring leading indicators of accounts receivable would not be as fast or efficient using standard reports or tables. Effective visual communications enhance visibility by representing the data in a manner it is easy to digest and understand. Learning same things by reading a report or interpreting inefficient graphics would produce significantly more cognitive load and potentially exceed the resilience of working memory causing to lose visibility.

As part of the research, the author examined a data set containing accounts receivable ledger data of accounting software “X” aiming to discover if it included the necessary attributes to create visual communications representing accounts receivable leading indicators. The author discovered three attributes that were most notable: days past due, outstanding balance and collection status. Additional attributes were added to source data in order to do cross tabulations. These were balance past due, payment term and aging category. The last one was a categorical value defined by the author as follows: 1 = current,



not past due, 2 = past due 1-15 days, 3 = past due 15-30 days, 4 = past due 31-60 days, 5 = past due 61-90 days and 6 = past due over 90 days.

The author provided a set of visual communications representing accounts receivable leading indicators, and introduced the design decisions with a few sentences. The intention was to produce an outcome that describes what an effective visual communication is and what are the key considerations when designing one. The amount of literature available discussing information visualization is vast. Action research was the selected research approach to build a framework around effective visual communications, which was a concept defined by the author to discuss the intersection of data visualization and storytelling with data. These two concepts, however, were not discussed during the thesis, as information research literature was the cornerstone of the theoretical framework.

The thesis concluded that effective visual communications enhance visibility, and to produce effective visual communications a designer's contribution is central in defining the approach towards the data. Therefore visibility is dependent on the designer's understanding of the design principles, human sensory capabilities and also the *substance in question*. The concept of substance was not addressed in the study.

The purpose of the thesis was not to provide an analysis of the performance of accounts receivable management of the company owning the research data, and therefore an opportunity and need for such an analysis remains and is a recommendation for future research.

## **6.1 Recommendations for future product development**

Having proved the importance of defining and measuring leading indicators that drive performance, a recommendation is given to product management to consider including a functionality to support such analysis in accounting software "X". According to HighRadius, the most effective way of representing performance indicators would be to provide visual reporting in a form of a dashboard. Therefore, a more thorough study investigating

the database, in a given framework, is recommended in order to understand the relationships between different fields. The purpose of the study would be to examine the most efficient and correct way of creating visuals using the database as a source.

Creating graphics using other platforms than Excel, enables features that were out of scope of the thesis, such as the drill-down or mouseover text. Applying them in graphics increase user experience but may impact on the effectiveness of the visual communications.

The aging of accounts receivable was the context around which the visual communications were built, and according to SunGard Datasystems 66 % of the companies they investigated used invoice age as their top driver in prioritizing collections. However, SunGard Datasystems argue that risk grade has proved to be more effective tool, even though only 7 % of the companies used it. Currently, accounting software “X” does not store customer risk grades, but assigning them to each account would enable to use it to develop targeted activities to reduce collections risk. Predictive analytics apply statistical techniques, such as clustering, expert rules, decision trees, simulations and neural network, to large amounts of data in order to recognize patterns (Nielsen 2018). These advanced analytics could be applied in proposing the risk grade.

The technology has enabled to use even prescriptive analytics, which use optimization to advice the best possible outcome, and the ways it can be addressed and achieved in terms of minimizing or maximizing some objective (Nielsen 2018). In the present case prescriptive analytics could apply a model to historical accounts receivable data and then predict future customer payment behavior and adjust the collection efforts based on it.

## **7 CONCLUSIONS**

In a world full of data, the managers are struggling with information overload and facing challenges in discovering the essential (cp. Rodriguez & Kaczmarek 2016 p. 20). The development of technology and advanced analytics has set new demands for management accountants (see Nielsen 2018). To increase the efficiency of decision-making processes, reporting process is becoming more visual. This requires the management accountant to

use visualization techniques to support the business in translating data into insights. (Nielsen.)

The purpose of effective visual communications is to reveal data. The basic assumption in the thesis was that the designer creating the graphics has a specific message in mind they want to communicate to the audience. It is important to differentiate this point of view from just showing every possible message the data might hold letting the audience to decide which one to grasp. Understanding the capabilities and limitations of human perception and memory that guide how the information is processed, is central in assuring the message gets delivered. Changing a visual element strategically can change the way the graph is interpreted.

According to Tufte's (2001) principle of graphical integrity, variations in design should be avoided. Consistent use of chart types, colors and pre-attentive attributes requires less processing power causing less cognitive load. It enables the audience to learn new things faster, and eliminates confusion that may distract the attention from data. Therefore aiming to surprise the audience with an interesting visual element does not increase efficiency. Some chart types are also more effective than others. Tufte's argument is quite frank but justifiable: "The only worse design than a pie chart is several of them". Pie-charts are not very accurate in comparing the relative sizes of the categories. They rely on area, which according to Cleveland & McGill, is judged less accurate than length (see Ware 2012 p. 168). However, length is weaker in expressing larger variations; if one or two categories are significantly larger than the others, area represents it more effectively (Ware p. 169).

When there is a need to show exact numerical values, Tufte (2001 p. 178) argues that tables are the best option. But to interpret a table, reading is required. The information is processed by human verbal system, whereas a graph interacts with human visual system that is a lot faster at processing information. Written natural language, however is the most universal way of communication (Ware 2012 p. 331). Therefore, the combination of images and words is often the most effective if the two are linked strategically and the text supports the visuals (cp. Tufte p. 178; Ware pp. 331-332).

The thesis concluded that the efficiency of the design depends on the designer and their understanding of design principles and human sensory capabilities. The industry knowledge and knowledge of the substance in question determine the viewpoint the data is approached by the designer. This knowledge contributes to visibility. Therefore, the thesis supports earlier research findings (see Nielsen 2018) arguing that the future of accounting professionals looks somewhat different than the past. The focus is shifting from recording the past to predicting the future. Analytical techniques support in discovering the purpose of the graph, and effective visual communications define how it can be captured and communicated to others. Management accountants become designers. It remains for future research to investigate how machine learning and artificial intelligence shape this role further.

## REFERENCES

Adelman, C., 1993, Kurt Lewin and the Origins of Action Research, *Educational Action Research*, Vol. 1., No. 1., pp. 7-24. Available from <https://doi.org/10.1080/0965079930010102> Accessed 13.8.2020.

Aitkin, N., 2003. Creating and editing charts in Microsoft Excel 2003. Available from [https://www.slideshare.net/bud\\_00/creating-editing-charts-in-microsoft-excel-2003-presentation](https://www.slideshare.net/bud_00/creating-editing-charts-in-microsoft-excel-2003-presentation). Accessed 24.3.2021.

Anscombe, F. J., 1973. Graphs in Statistical Analysis, *The American Statistician*, Vol. 27, No. 1. pp. 17-21. Available from <https://doi.org/10.2307/2682899> Accessed 24.3.2021.

Aprameya, A., 2016. Cross Tabulation: How It Works and Why You Should Use It. Available from <https://humansofdata.atlan.com/2016/01/cross-tabulation-how-why/> Accessed 27.4.2021.

Averkamp, H. 2020. Accounts Receivable and Bad Debts Expense. Available from <https://www.accountingcoach.com/accounts-receivable-and-bad-debts-expense/explanation/5> Accessed 13.4.2021.

Baddeley, A., 2013, *Essentials of Human Memory (Classic Edition)*, Taylor & Francis Group, London. Available from ProQuest Ebook Central. Accessed 18.1.2021.

Boisjoly, R., Conine, T. & McDonald, M., 2020, Working capital management: Financial and valuation impacts, *Journal of Business Research*, Vol. 108 pp. 1-8. Available from ScienceDirect. Accessed 20.4.2020.

Bryman, A. & Bell, E., 2013, *Business Research Methods*, 3<sup>rd</sup> edition, Oxford University Press, New York.

Busche, L. Simplicity, symmetry and more: Gestalt theory and the design principles it gave birth to. Available from <https://www.canva.com/learn/gestalt-theory/> Accessed 11.8.2020.

Chaple, M. 2020. A Database Attribute Defines the Properties of a Table. Available from <https://www.lifewire.com/attribute-definition-1019244> Accessed 27.4.2021.

Cambridge Dictionary, "Performance". Available from <https://dictionary.cambridge.org/dictionary/english/performance> Accessed 15.3.2021.

Cocking, S. 2017. Seven reasons why Excel is still used by half a billion people worldwide. Available from <https://irishtechnews.ie/seven-reasons-why-excel-is-still-used-by-half-a-billion-people-worldwide/> Accessed 6.4.2021.

Deloitte, Strategies for optimizing your accounts receivable. Part of Deloitte working capital series. Deloitte LLP and affiliated entities, Canada. Available from <https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/finance/ca-en-FA-strategies-for-optimizing-your-accounts-receivable.pdf> Accessed 3.5.2020.

Dick, B., 2015, Reflections on the SAGE Encyclopedia of Action Research and what it says about action research and its methodologies, *Action Research*, Vol. 13, No. 4, pp. 431-444. Available from SAGE Journals. Accessed 13.8.2020.

Eckerson, W.W., 2010, *Performance Dashboards: Measuring, Monitoring, and Managing Your Business*, John Wiley & Sons, Incorporated, New York. Available from ProQuest Ebook Central. Accessed 26.4.2020.

GoCardless. The Complete Guide to Optimizing Your Accounts Receivable. GoCardless Ltd., London, United Kingdom. Available from <https://gocardless.com/guides/posts/optimising-accounts-receivable/> Accessed (downloaded) 6.5.2020.

Gordon, K., 2013, *Principles of Data Management: Facilitating information sharing*, BCS Learning & Development Limited, Swindon. Available from: ProQuest Ebook Central. Accessed 24.4.2020.

Grant, M. 2020. Days Sales Outstanding – DSO Definition. Investopedia, 23 January 2020. Available from <https://www.investopedia.com/terms/d/dso.asp> Accessed 30.4.2020.

Half, R. 2018. Is Excel for Finance Work On the Decline in the US? Benchmarking the Accounting & Finance Functions 2019 report, a joint effort of Robert Half and the Financial Executives Research Foundation (FERF). Available from <https://www.roberthalf.com/blog/salaries-and-skills/excel-for-finance-professionals-still-king-of-the-spreadsheets> Accessed 6.4.2021.

Helweg-Larsen, R. & Helweg-Larsen E., 2007, Business visualization: a new way to communicate financial information, *Business Strategy Series*, Vol 8, No 4, pp. 283-292. Available from Emerald Insight. Accessed 22.3.2021.

Henning, J., 2019. 4 Key Accounts Receivable Metrics. Bill Gosling Outsourcing, 19 September 2019. Available from <https://www.billgosling.com/blog/4-key-accounts-receivable-metrics> Accessed 4.5.2020.

HighRadius Corporation. The Perfect A/R Dashboard: 5 Reporting Dashboards Fundamental for Every Credit and A/R Leader. E-book. Available from <https://info.highradius.com/hubfs/The%20Perfect%20AR%20Dashboard.pdf> Accessed 20.4.2020

Hirsch, B., Seubert, A. & Sohn, M., 2015, Visualisation of data in management accounting reports: How supplementary graphs improve every-day management judgments, *Journal of Applied Accounting*, Vol. 16, No. 2, pp. 221-239. Available from Emerald Insight. Accessed 22.3.2021.

Kaplan, R. & Norton, D., 1992, The Balanced Scorecard - Measures that Drive Performance, *Harvard Business Review*, Jan-Feb 1992. Available from <https://hbr.org/1992/01/the-balanced-scorecard-measures-that-drive-performance-2> Accessed 14.3.2021.

Kenton, W., 2021, Investopedia. "Visibility". Available from <https://www.investopedia.com/terms/v/visibility.asp> Accessed 12.4.2021.

Kimani, J. W., 2013, *Principles and practice of effective accounts receivable management in Kenya: a case of selected manufacturing firms in Thika municipality*, master's degree thesis, Kenyatta University, Department of Accounting and Finance, Kenya. Available from <https://ir-library.ku.ac.ke/handle/123456789/10197> Accessed 8.5.2020.

Kortman, R., Siemes D., Brunner, R., Van Reet L., Schieck C., Leidig S. & Zwinkels M., 2020. Working Capital Report 2019/20 - GSA & Benelux Region. PricewaterhouseCoopers GmbH Wirtschaftsprüfungsgesellschaft. Available from <https://www.pwc.de/de/deals/working-capital-report-2019-20.pdf> Accessed 20.4.2020.

- Luangrath, L., 2017. Using DSO to Measure Your Accounts Receivable Performance, REL, a division of The Hackett Group, Inc. Available from <https://www.thehackett-group.com/dso-measure-us-1705/> Accessed (downloaded) 4.5.2020.
- McNiff, J., 2013, *Action Research: Principles and Practice*, 3<sup>rd</sup> edition, Taylor & Francis Group, London. Available from: ProQuest Ebook Central. Accessed 13.8.2020.
- Meyer, M.W., 2003, *Rethinking Performance Measurement: Beyond the Balanced Scorecard*, Cambridge University Press, Cambridge. Available from ProQuest Ebook Central. Accessed 14.3.2021.
- Miller, G. A., 1956, The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review*, Vol. 63, No. 2, pp. 81–97. Available from <https://doi.org/10.1037/h0043158> Accessed 20.1.2021.
- Nielsen, S., 2018, Reflections on the applicability of business analytics for management accounting – and future perspectives for the accountant. *Journal of Accounting & Organizational Change*, Vol. 4, No. 2. pp. 167-187. Available from EmeraldInsight. Accessed 29.4.2021.
- Parmenter, D., 2015, *Key Performance Indicators: developing, implementing and using winning KPIs*, 3<sup>rd</sup> Edition, John Wiley & Sons, Inc., Hoboken, New Jersey. Available from ProQuest Ebook Central. Accessed 26.4.2020.
- Parravicini, M., 2015, *A Guide to Sales Management: A Practitioner's View of Trade Sales and Organizations*, Business Expert Press, New York. Available from ProQuest Ebook Central. Accessed 18.3.2021.
- Persuh, M., Genzer, B. & Melara, R. D., 2012, Ionic memory requires attention, *Frontiers in Human Neuroscience*, Vol. 6, No. 126. Available from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3345872/> Accessed 19.1.2021.
- Reason, P. & Bradbury, H., 2008, *The SAGE Handbook of Action Research: Participative Inquiry and Practice*, 2<sup>nd</sup> edition, Sage Publications Ltd, London.
- Rodriguez, J. & Kaczmarek, P., 2016, *Visualizing Financial Data*, John Wiley & Sons, Incorporated, Hoboken. Available from ProQuest Ebook Central. Accessed 23.3.2021.



Sagner, J., 2010, *Essentials of Working Capital Management*, John Wiley & Sons, Incorporated, Hoboken. Available from ProQuest Ebook Central. Accessed 19.4.2020.

Shapiro, B., Rangan V. and Sviokla J., 2004, Staple Yourself to an Order, *Harvard Business Review*, July-August 2004, Available from <https://hbr.org/2004/07/staple-yourself-to-an-order>

Sharma, D., 2008, *Working Capital Management: A Conceptual Approach*, Global Media, Mumbai. Available from: ProQuest Ebook Central. Accessed 19.4.2020.

Singh, A., 2015. Accounts receivable indicator: Collection effectiveness index (CEI). 26 April 2017. Available from <https://medium.com/@ezycollectadwords2/accounts-receivable-indicator-collection-effectiveness-index-cei-ea6f1c561fdb> Accessed 5.5.2020.

SunGard Datasystems Inc., 2014. Credit & Collections, Global Benchmarking Study, White Paper. Available from <https://nacm.org/pdfs/surveyResults/sungardCreditCollectionsBenchmark.pdf> Accessed 27.4.2020.

Sweller, J., 1988, Cognitive load during problem solving: effects on learning. *Cognitive Science*, Vol 12, pp. 257-285. Available from [https://doi.org/10.1207/s15516709cog1202\\_4](https://doi.org/10.1207/s15516709cog1202_4) Accessed 11.3.2021.

Taylor, T., 2011. The Role of A/R in Optimising Working Capital. 29 March 2011. Available from <https://www.theglobaltreasurer.com/2011/03/29/the-role-of-a-r-in-optimising-working-capital/> Accessed 21.4.2020.

Techslang. What is a Data Set? Available from <https://www.techslang.com/definition/what-is-a-data-set/> Accessed 28.4.2021.

Tufte, E., 2001, *The Visual Display of Quantitative Information*, 2<sup>nd</sup> edition, Graphics Press LLC, Cheshire, Connecticut.

Visma Duetto Oy, 2017, Perintätutkimus: Kuinka suomalaisyritykset hoitavat perintää. Press release, 10 April 2017 and full report available from <https://media.visma.fi/pressreleases/perintaetutkimus-joka-neljaes-pienyritys-ollut-perinnaen-kohteena-silti-yritysperrinnaen-kaeytaentoejajae-tunnetaan-huonosti-1899669> Accessed (downloaded) 21.4.2020.

Voorheis, J., 2019, Customer Payment Terms - A Key Driver of DSO - and Cash. 27 October 2019. Available from <https://www.linkedin.com/pulse/customer-payment-terms-key-driver-dso-cash-jeffrey-voorheis/> Accessed 20.3.2021.

Ware, C., 2012, *Information Visualization: Perception for Design*, 3<sup>rd</sup> edition, Elsevier Science & Technology, San Francisco. Available from ProQuest Ebook Central. Accessed 30.7.2020.

Wood, M., 2020. Accounts Receivable Turnover: Formula, Definition, Examples. Available from <https://www.fundera.com/blog/accounts-receivable-turnover-ratio> Accessed 12.5.2020.

Zhang, L., & Lin, W., 2013, *Selective Visual Attention: Computational Models and Applications*, John Wiley & Sons, Incorporated, New York. Available from ProQuest Ebook Central. Accessed 9.3.2021.

YayPay. The Ultimate AR Collections Benchmarks Report. Available from <https://www.yaypay.com/accounts-receivable-collections-benchmarks> Accessed and downloaded 27.4.2020. Accessed 20.4.2020