KPI BENCHMARKING IN ACCOUNTS PAYABLE SAAS PRODUCT – CASE DOOAP

Lappeenranta–Lahti University of Technology LUT

Industrial Engineering and Management Master's Thesis

2023

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Examiners: Professor Juhani Ukko

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ABSTRACT

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This thesis contains Accounts Payable Key Performance Indicators (KPIs) in a benchmarking context. The thesis has been assigned by Dooap Inc. Its desired outcome is to map KPI measures for benchmarking purposes. Methods of managing Accounts Payable, the efficiency of invoice processing, and financial metrics have been searched from the literature. In the empirical part of the thesis, a benchmarking report has been carried out using the Power BI software with data from the Dooap's database.

The thesis presents the process of invoice handling along with related best practices such as automation, artificial intelligence, and process measurement. The methodology for benchmarking and a comparison of reporting tools have been conducted. The research of Key Performance Indicators is focused on their measurability within Dooap. The thesis evaluates reporting tools that facilitate straightforward benchmarking and metric construction. The calculation approach for KPIs has been elucidated to allow their application in other institutions as well.

Lastly, a Power BI report has been introduced for internal use of Dooap Inc., encompassing benchmarking of selected financial and performance metrics. The report can provide insights into development of Accounts Payable processes. However, the report is not suitable for all uses. Consequently, the report's development possibilities have been examined in terms of KPI metrics and in terms of report's technical implementation.

TIIVISTELMÄ

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LUT Teknis-luonnontieteellinen

Tuotantotalous

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KPI mittareiden esikuva-analyysi ostoreskontra SaaS-tuotteessa – Case Dooap

Tuotantotalouden diplomityö

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Tämä diplomityö käsittelee ostoreskontran suorituskykymittareita ja niiden esikuva-analyysiä. Työ on toteutettu Dooap Oy:n toimeksiantona. Sen tavoitteena on kartoittaa suorituskykymittareita, joille esikuva-analyysi olisi mahdollista rakentaa. Ostoreskontran hallinnan menetelmiä, laskujen käsittelyn tehokkuutta, sekä ostoreskontraan liittyviä taloudellisia mittareita on etsitty kirjallisuudesta. Työn empiriaosassa on toteutettu esikuva-analyysi Power BI ohjelmistolla Dooapin tietokannasta saatavalla aineistolla.

Työssä esitellään laskujen käsittelyn prosessi, sekä siihen liittyviä parhaita käytäntöjä, kuten automaatio, tekoäly ja prosessin mittaaminen. Esikuva-analyysin metodologia, sekä raportointivälineiden vertailu on tehty. Suorituskykymittareiden tarkastelu on suunnattu siten, että niitä olisi mahdollista mitata Dooapissa. Työssä vertaillaan raportointivälineitä, joilla esikuva-analyysi ja mittareiden rakentaminen olisi suoraviivaista. Suorituskykymittareiden laskentatapoja on esitetty siten, että niitä voidaan soveltaa myös muissa yrityksissä.

Lopuksi on esitelty Power BI raportti Dooap Oy:n sisäiseen käyttöön, joka sisältää valittujen suorituskykymittareiden ja taloudellisten mittareiden esikuva-analyysin. Raportin avulla voidaan löytää näkemyksiä ostoreskontran prosessien kehittämiseen. Kuitenkaan raportti ei sovellu kaikkiin käyttötarkoituksiin. Näin ollen raportin kehitysmahdollisuuksia on tarkasteltu niin KPI mittareiden kuin myös raportin teknisen toteutuksen osalta.

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I am grateful of the people who have supported me in my studies. A special thanks to my friends and family who have been there to discuss even the most trivial topics. A big thank you also to Dooap Inc. for providing the thesis topic and creating an environment that allowed me to pursue my research with flexibility and without undue performance pressure.

Nokia, June 2023

Sakari Miettinen

Abbreviations

AI	Artificial Intelligence
AP	Accounts Payable
BI	Business Intelligence
DAX	Data Analysis Expression
IDP	Intelligent Document Process
KPI	Key Performance Indicator
ML	Machine Learning
PO	Purchase Order
P2P	Purchase-to-pay
RPA	Robotic Process Automation
SaaS	Software as a Service

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1 Introduction

This Master’s thesis studies Key Performance Indicators (KPIs) for the Accounts Payable process. In an optimal scenario, KPIs are used to build an internal report which follows a Software as a Service (SaaS) product’s invoice processing performance that includes each customer of the SaaS company. This following section of the thesis focuses on background, research methodology and structure of the thesis. Then the theoretical part of this thesis focuses on KPI research and benchmarking methodology. Lastly, the empirical part of this thesis concentrates on building a KPI benchmarking report.

1.1 Background

In today's dynamic business world, companies need to be flexible, creative, adaptable, and open-minded in order succeed and gain an edge over their competitors. In addition to that, technology is now also a crucial factor in driving productivity and competitiveness across all industries, including finance. Therefore, technology plays a vital role in organizational performance. As a result, financial operations have come under pressure to reduce transaction costs while improving the quality, reliability, and responsiveness of company-specific information systems. The focus of many companies is therefore shifting towards optimizing business processes to free up resources.

Information is essential for companies to operate and build strategy. With for example product usage information, a company can allocate their recourses based on real usage or by the importance of the product’s functions. Software as a Service (SaaS) products are transforming the software industry (Fox et al. 2014, pp. 17) as SaaS companies gather and processes data on behalf of their customers. Therefore, these companies can for example gain insight into their customer’s behavior and optimize their products and services. Generally speaking, the single most important thing that data analytics brings to these companies is a way to improve overall performance.

Dooap is a SaaS product by the company Dooap Inc. that provides Accounts Payable (AP) automation solutions to simplify and streamline the AP process. In addition to automation solutions, Dooap Inc. provides reporting and analytics for its customers. This Master’s thesis focuses on developing an internal report in order to evaluate the performance of the Dooap SaaS product with certain selected KPIs.

1.2 Aim of the thesis

This thesis aims to find Key Performance Indicators that are important in Accounts Payable in general as well as those that could be utilized at Dooap Inc. The research of KPIs focuses on measuring AP process efficiency and financial indicators in AP. KPIs are benchmarked against relevant reference points, for example Dooap Average or Dooap Best Performer. Therefore, this thesis also focuses on developing a benchmarking system including the KPIs.

The research questions for this thesis are:

- Which Key Performance Indicators are important for Accounts Payable?
    - Which Key Performance Indicators measure Accounts Payable process performance?
    - Which Key Performance Indicators measure financial stability?
- How to benchmark Accounts Payable Key Performance Indicators?

The aim of the thesis is to present a Power BI report including summarized data as KPIs, and relevant benchmarks for each KPI.

1.3 Research methods

The research of KPIs and benchmarking methods are done by theoretical research. Empirical research is done with qualitative and quantitative analysis of Dooap's data. The desired outcome, which is an internal benchmarking report made with Power BI, follows design science principles. Design science is a popular research method in i.e., engineering (Geerts 2011, pp. 142). It focuses on creation of things to reach goals or to change situations to be better (Geerts 2011, pp. 142). In this thesis design science principles are applied to build a Power BI report.

1.4 The structure of the thesis

This thesis consists of six chapters including an introduction. It is divided into two entities: the theoretical and the empirical sections. Theoretical section includes chapters 2 and 3. The empirical section includes chapters 3, 4, 5 and 6. Chapter 1 introduces the thesis' research problem and background. The second chapter focuses on Accounts Payable in general and the process of how Accounts Payable should be measured and managed. The third chapter includes benchmarking methodology, researched KPIs and reporting tools. Chapter four focuses on the case company, problem statement and available data. The fifth chapter includes implementation of the Power BI report for benchmarking several KPIs. In addition to this, the fifth chapter includes possible recommendations of improvements for the future. Finally, the last chapter summarizes the major findings and derives conclusions from them. The thesis structure is illustrated in figure 1.

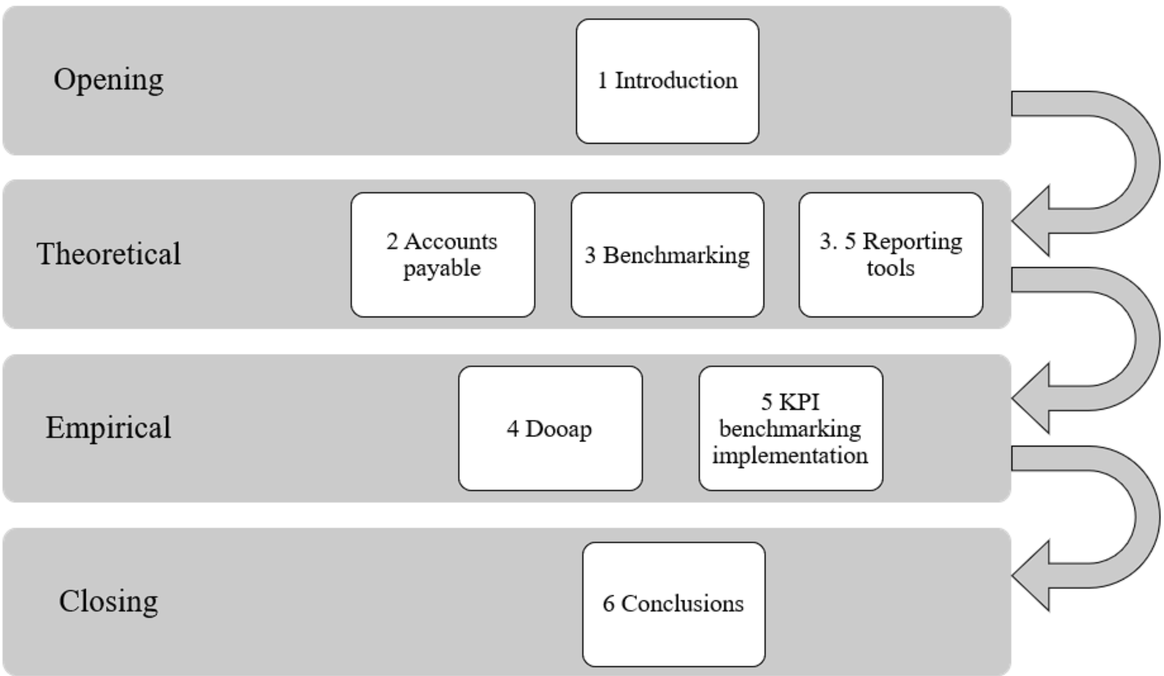

Figure 1. Thesis structure.

2 Accounts Payable

Accounts Payable represents a company’s unpaid bills. The bills include the money that the company owns to its vendors and other creditors. Accountants classify the money that company owes into two categories: *current liabilities* and *long-term liabilities*. This classification allows them to distinguish between debts that must be paid off within a short period of time, usually within a year, and debts that can be paid off over a longer period, typically more than a year. Generally, Accounts Payable falls under the *current liabilities* or *short-term liabilities* category. (Schaeffer 2002, pp. 2-3)

This chapter discusses which steps are included in invoice processing and how to measure Accounts Payable operational process and efficiency. This chapter also considers Artificial Intelligence (AI) and Machine Learning (ML) solutions for processing invoices. Lastly, relation to working capital management is briefly sidelined.

2.1 Accounts Payable Process

To make a payment in a company, three documents are usually needed:

- Purchase order (PO)
- Invoice
- Receiving documents

A purchase order includes details related to the purchase such as quantity, price, and special terms that the buyer might have negotiated. However, in many companies the purchase orders are not filled correctly, and Accounts Payable department is not able to then verify the purchase. An invoice includes information about what was purchased. In addition to the purchase information, the invoice ideally contains a due date, payment terms, payment address and possible special instructions. Most companies prefer to verify the delivery of goods before making a payment for the invoice of those goods. The receiving documents are used for that purpose. Before Accounts Payable associate pays the invoice, they should know the quantity received. (Schaeffer 2002, pp. 11-13)

The traditional method for invoice processing is called “Three-Way Match” (Schaeffer 2002, pp. 14). It includes comparing invoice price to PO price, invoice quantity to the quantity ordered, and finally invoice quantity to the quantity received (Pachpute 2017). Three-Way Match and other match types’ comparison logic can be seen in table 1.

Table 1. PO-match approval level options. (Pachpute 2017)

Matching type	**Invoice attribute**		**Purchase order**
Two-Way	Invoice price	< or =	PO price
	Invoice quantity	< or =	Quantity ordered
Three-Way	Invoice price	< or =	PO price
	Invoice quantity	< or =	Quantity ordered
			Quantity received
Four-Way	Invoice price	< or =	PO price
	Invoice quantity	< or =	Quantity ordered
			Quantity received
			Quantity accepted

In Three-Way Match, the Accounts Payable associate will cross-check the three primary documents - the invoice, the purchase order, and the receiving documents - to ensure that price and quantity match. In reality, only half of incoming invoices match the purchase order and receiving documents. The biggest problem with matching is in invoices. To pay an invoice on time, it should be arrived at Accounts Payable department in reasonable time frame. That might be difficult if invoices are sent all around the company. If Accounts Payable has the purchase order for the invoice or knows who placed the purchase order, the company can direct all incoming invoices directly to the Accounts Payable. (Schaeffer 2002, pp. 14)

If all of the three primary documents are filled correctly and they all match, the Accounts Payable team should have the authority to pay the invoice without requiring involvement from any other department. However, some companies have policies that require the original purchaser to approve the invoice even if all documents are filled correctly and match. Getting approvals for invoices prior to payment can result in various problems, such as:

- The invoice approval is not directed to a specific person and the invoice circulates around the company until it reaches the appropriate individual.
- The approval takes so long that the vendor sends a second invoice addressed to the Accounts Payable manager. The manager sends the invoice to the relevant individual or department for approval and fast payment. Eventually, the original invoice shows up and the invoice might also get approved and paid. (Schaeffer 2002, pp. 14-15)

Workflow technology enables Accounts Payable departments to get approvals a lot easier than without invoices being computer-readable attachments. (Schaeffer 2002, pp. 15) Therefore, problems related to invoice approvals aren't as big as before workflow technology. In figure 2 there is an illustration of traditional invoice processing workflow. Sometimes invoice review are done by an approver.

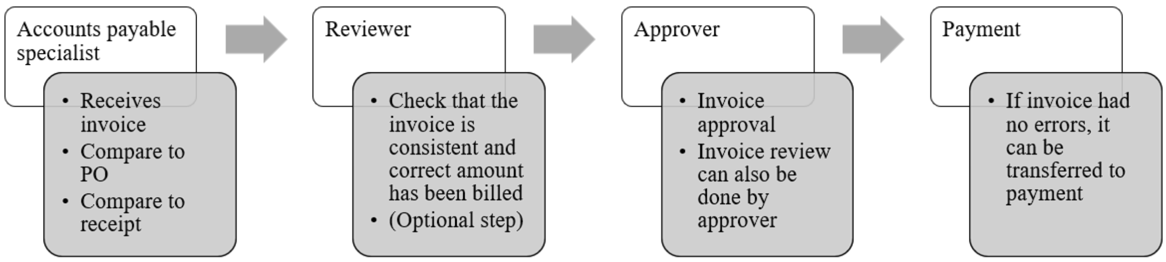

Figure 2. Account Payable workflow.

2.2 Guidelines for Accounts Payable

Operationally, Accounts Payable is the place where cash flow is regulated, and financial commitments are made. It is necessary for companies to gather information from Accounts Payable to manage cash flow and spending successfully. The information from Accounts Payable should include visibility into the status of the invoices, including their location within the processing workflow, the number of invoices being handled, and the total amount of financial obligations they represent. Companies must have a way to set proper level of approval for each person in Accounts Payable, maintain a record of every invoice received, to track the status and location of each invoice in real-time, to identify the individuals who have interacted with each invoice, and to keep track of all the actions that have been performed on each invoice. Some large companies are having a hard time controlling this process, because there might be invoices sitting on someone's desk without anyone noticing.

As a result, it becomes almost impossible for the head office to know the exact amount of money it should allocate for payments. Large companies might also miss out on the ability to negotiate early-payment discounts as well as prevent incurring penalties due to late payments. (Kaskinen 2007, pp. 48)

Technology has enabled companies to inspect invoice processing data in multiple ways, such as viewing cost codes, measuring time from processing to payment, and detecting the people that have processed those invoices. With Accounts Payable shared service center, companies can streamline costs and implement best Accounts Payable practices across the entire enterprise. Accounts Payable audits that used to take several weeks to complete can now be accomplished within a few days. Some advanced companies have created shared service centers for handling administrative, financial, and other services throughout the organization. The use of technology has increased the efficiency of conducting Accounts Payable audits. This is because the information required for the audit is now available instantaneously, without the need for manual searching through files to find a specific invoice. (Kaskinen 2007, pp. 49)

With technology solutions, companies can have additional benefits by optimizing the AP process. According to Kaskinen (2007, pp. 49) companies should consider these areas regarding the AP process:

- **Capture**: Companies should find out how information is being inputted into the system, find ways to reduce manual data entry, and extract necessary data for invoice processing from ERP system.
- **Processing:** It is important to determine the following topics: the number of people needed to review an invoice, the way invoices are coded, and invoice routing with only necessary approvers. Finally, companies should ensure that invoices are processed and approved in a timely manner.
- **Reporting:** Companies should determine reporting needs, a way to build them and a way to make it easy and fast.

Automated invoice processing systems can help Accounts Payable departments shift their focus from transactional tasks to strategic activities, thus adding more business value. Such systems can streamline processes and create efficiencies to achieve this objective. Before implementing automation, it is crucial to evaluate the current methods and identify areas that require improvement to enforce policies more efficiently. It is essential to consider streamlining these processes to save time and reduce costs while achieving better results. Once the necessary changes are made, automation can be considered. (Kaskinen 2007, pp. 50-51)

2.3 Automation in Accounts Payable

Organizations are looking for ways to save time and money, to improve their profit from operations. Manual invoice processing is a time consuming and costly process. (Kaskinen 2007, pp. 49-50) According to Kaskinen (2007, pp. 49-50) tasks that are included in manual invoice processing are: “Checking invoices against the purchase orders; making sure that the price, quantity, and goods match the PO and that all the information on the invoice is correct; determining the proper approver and routing the invoice to that person; tracking the invoice to ensure that it comes back in a timely manner; inputting, coding, and reviewing the invoice when entering it into the accounting system; and coding it again to the right cost center, etc.”

Process automation significantly reduces the invoice processing times; the reduction is usually from a few days to even many weeks. After an invoice is made available electronically by receiving it electronically or scanning it in, the system can then automatically compare it to the purchase order and route it for payment. Alternatively, the invoice can be sent to the relevant person and then forward it to the AP department. Technology can also automate the handling of periodic or contract-based purchase invoices, as the approval workflow and posting data for these types of invoices are usually the same, making automation efficient. The system matches the invoice to the contract and automatically transfers matching invoices to Accounts Payable. In case the invoice does not match, the system transfers it to a designated individual for approval. (Kaskinen 2007, pp. 49-50)

Most invoices do not require human intervention once technology is properly integrated, and the system operates in accordance with established business rules. As the system automates the workflow, and processes most of the invoices by itself, what is left for the Accounts Payable department is to handle only the exceptional cases, which then allows them to utilize their time more strategically. Furthermore, implementing an automated invoice processing provides companies with increased oversight and transparency of their invoice management, which in turn can lead to cost savings through vendor discounts and the avoidance of late-payment penalties. Additionally, by gaining control over their spending, companies may improve their relationships with suppliers and potentially negotiate better terms in future agreements. An automated system might also help to prevent fraud and provide control for financial accuracy: the system could uncover inconsistencies between an invoice and a purchase order or identify duplicate payments. (Kaskinen 2007, pp. 49-50)

2.4 Measurement in Accounts Payable

Regulations require companies to show continual improvement. To effectively identify and implement improvements, it is crucial to establish a framework for measurement beforehand. One way to create a framework is to determine Key Performance Indicators for the purchase-to-pay (P2P) process. The KPIs should be selected based on business goals by the AP department. For example, a company could be interested in measuring the costs associated with invoice processing or the interval between receiving an invoice and completing the processing of it. After the framework is implemented, the company should follow the historical progress of KPIs and benchmark those against industry averages. This practice allows the company to regularly observe and compare the benefits of process improvements against the effort required to implement the improvements. (Kaskinen 2007, pp. 50)

2.5 Artificial Intelligence in Accounts Payable

Robotic Process Automation (RPA) means automating repetitive and manual tasks by creating a bot or a robot that can perform them. This approach saves time from personnel who previously handled these tasks and enables them to concentrate on more critical matters, rather than just performing routine and repetitive actions. Furthermore, automating processes might lower the potential for human error and expensive rework while also improving working spirit by allowing employees to work on tasks that need intelligence. (Fantina et al. 2022, pp. 2) Artificial Intelligence represents a machine or a program that tries to imitate human intelligence and Machine Learning is one of the central areas of AI (Tekoäly, n.d.).

Machine Learning is a computational technique that improves the efficiency of the system by learning through practical encounters. Practical encounters, in this case, exist in the form of data, and the main goal of machine learning is to develop a algorithms that construct models based on the available data. When we input the experience data into the learning algorithm, it produces a model capable of making predictions on new observations. (Zhou 2021, pp. 2)

Robotic Process Automation can enable companies to automate their AP process with multiple checks and validations related to invoices. Some of these are:

- Validating whether all required fields/information are available on the invoice
- Checking whether an invoice is PO-based or non-PO based
- Validating if the PO number mentioned in the invoice is present in the PO data
- Validating whether the invoice is billed to the receiving company and the billing address matches
- Vendor matching by matching the vendor name, address, and banking details from the invoice to the vendor data
- Data entry of all the details into the system
- Matching the invoice line items to PO line items and goods receipt for PO invoices
- Assigning accounting codes to process the invoice in the system and determining the tax code for non-PO invoices (Tater et al. 2022, pp. 12406)

One of the main problems with RPA, is the need to process a large volume of documents, and to have all the documents in the same format. At first, the processing of these documents was partly carried out using Optical Character Recognition (OCR). However, OCR had various drawbacks such as difficulty in understanding natural language, inability to detect blurred text, and it became evident that without sufficient intelligence or guidance, the results were not accurate. Consequently, the integration of AI and RPA became a practicable solution resulting in the development of Intelligent Document Processing (IDP) which utilizes Machine Learning to classify and extract data from the documents into structured format. As a result, combination of RPA and AI is one of the most potential areas in RPA. (Desai et al. 2021)

2.6 Relation to working capital management

Most companies require a certain amount of current assets to sustain their daily operations. This typically involves holding a cash reserve to facilitate ongoing activities, such as receiving money from customers and making payments to suppliers and employees. As inflows and outflows of cash may not always align perfectly, a company must maintain a sufficient cash balance in its bank account. The same applies to inventories. These short-term assets that are used in operating activities are called *operating current assets*. On the other side of the table, there are short term liabilities called *operating current liabilities*. Accounts Payable falls under the latter category. Net operating working capital is defined as: (Brigham & Ehrhardt 2018, pp. 60-61)

$$Net\ operating\ working\ capital = Operating\ current\ assets - Operating\ current\ liabilities$$

Net operating working capital measures the amount of cash a company has tied up in its current operating assets and liabilities. (Brigham & Ehrhardt 2018, pp. 60-61)

Every company operates according to a "working capital cycle," in which they buy or make inventory, keep it for a period, and subsequently sell it to receive cash. This process is Cash Conversion Cycle (CCC). (Brigham & Ehrhardt 2018, pp. 648) CCC is calculated as (Sagner 2011, pp. 26):

$$CCC = Inventory\ conversion\ period + Receivables\ conversion\ perioid \\ - Payables\ conversion\ perioid$$

The first component of CCC is inventory conversion period, which is also called as Days Inventory Held (DIH), is calculated as:

$$DIH = \frac{Inventories}{Cost\ of\ Goods\ Sold} * 365$$

The second component, receivables conversion period which also has an alternative expression which is Days Sales Outstanding (DSO). DSO is calculated as:

$$DSO = \frac{Accounts\ Receivable}{Net\ Sales} * 365$$

The final component of CCC is payable conversion period, which is also called as Days Payable Outstanding (DPO), is calculated as:

$$DPO = \frac{Accounts\ payable}{Cost\ of\ Goods\ Sold} * 365$$

The three components presented above form the Cash Conversion Cycle. CCC is a metric that represents the average amount of time needed to transform one dollar invested in resources into one dollar of revenue generated from a customer. In other words, it measures the duration of the working capital cycle, from the moment a company pays for its raw materials to the point when it collects payment from the client for the finished goods. Cash Conversion Cycle is calculated as:

$$CCC = DIH + DSO - DPO$$

If a company can increase its value by generating more revenue, reducing costs, or freeing up capital that was previously tied up, it will have a higher likelihood of obtaining external financing and strengthening its internal financial power. However, many companies still neglect to actively manage their working capital through proper management techniques. (Hofman et al. 2011, pp. 8-16) Elements of Cash Conversion Cycle are presented in figure below. However, DPO is the only element of CCC that is directly related to Accounts Payable.

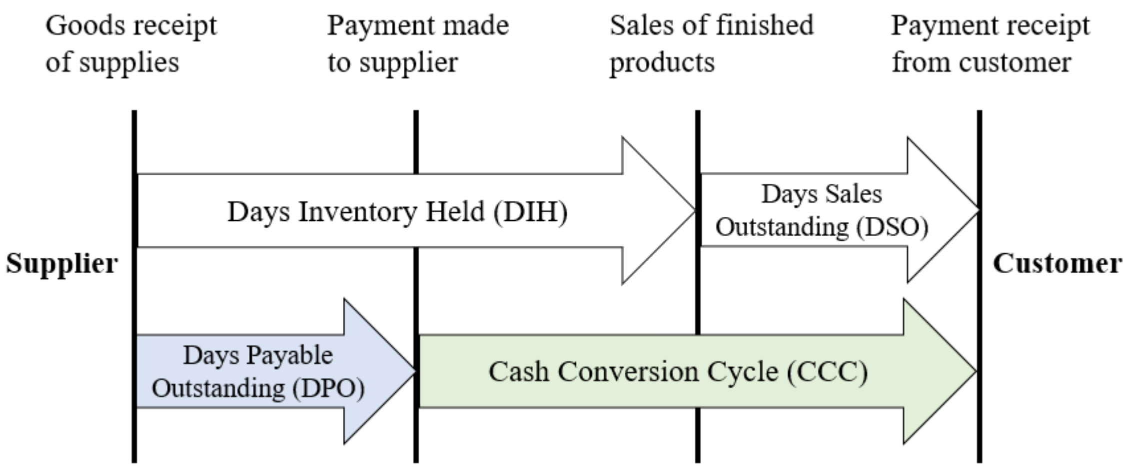

Figure 3. Elements of Cash Conversion Cycle. (Hofman et al. 2011, pp. 8-16)

Purchase-to-pay (P2P) process includes all the steps involved in managing creditors. The process includes purchasing goods or services from a supplier and making payments to them.

(Hofman et al. 2011, pp. 19) According to Hofman et al. (2011, pp. 19) Cash Conversion Cycle can be optimized in P2P process with:

- “Optimization or standardization of payment processes: Avoiding payments made either too early or too late.” (Hofman et al. 2011, pp. 19)
- “Optimization of payment terms: Renegotiation of payment terms and Incoterms with existing suppliers and preparation of guidelines for new suppliers as well as preventing down payments.” (Hofman et al. 2011, pp. 19)

3 Benchmarking

Benchmarking is a process in which a business compares its own processes and performance metrics to those of industry leaders or companies from different industries. The idea behind benchmarking implies that successful enterprises in each industry have business processes valuable to analyse and possibly replicating the process in order to enhance competitiveness, gain market share, and improve profitability in another enterprise. (Sagner 2011, pp. 27)

There is potential to learn and enhance performance by examining and contrasting the operations of other organizations with those of your own operations. Benchmarking involves more than just comparing KPIs, although KPIs are utilized in benchmarking to compare operations. KPIs have a broader application as a management tool. However, numerous organizations consider KPIs and benchmarking as interchangeable. The central focus of the benchmarking process should be on enhancing operations, with the use of KPIs to facilitate the process. Drawing conclusions and developing improvement strategies based solely on quantitative comparisons can be perilous without understanding the underlying processes and definitions behind these performance comparisons. (Hanman 1997, pp. 1)

The following chapters explain benchmarking in a more detailed level and introduce KPIs that could be used for benchmarking purposes. In addition to this, data architecture is clarified to the extent that data gathering for KPIs can be implemented further in this thesis. Furthermore, top reporting tools for KPI benchmarking and information security are introduced.

3.1 Benchmarking methodology

Benchmarking can be used to improve any operational procedure within a business. The first thing that should be done is to select the problem that needs to be measured. (Sagner 2011, pp. 27) According to Sagner (2011, pp. 27) the methods for finding the problem are: “Informal conversations with customers, employees, or suppliers; exploratory research techniques such as focus groups, in-depth marketing research, quantitative research, surveys, questionnaires, reengineering analysis, process mapping, quality control variance reports, or financial ratio analysis; or the review of cycle times or other performance indicators". After the problem is defined, the following actions should be executed:

- Recognizing companies and sectors that share comparable processes
- Identification of companies that are acknowledged as industry leaders
- Conducting surveys and site visits to organizations to gather metrics and observe their practices
- Implementation the best practices (Sagner 2011, pp. 27)

3.2 KPIs in Accounts Payable

Benchmarking could be done by inspecting the business process and then implementing a benchmarking system to measure the process. However, this thesis focuses on inspecting general Accounts Payable KPIs and benchmarking possibilities for them. The KPIs examined in this thesis should not be limited to the applicability for a single business process, but rather be pertinent to all Accounts Payable departments.

KPIs are important predefined metrics that describe target performance and furnish individuals to evaluate previous actions. KPIs can be built with a drill down function to investigate the data on a deeper level. This allows you to acquire increased awareness and understanding. For example, if a KPI measures a company's earnings, it could be drilled down to operational costs and even further to labor costs and interest expense. Most organizations face challenges in understanding that having a business intelligence solution does not necessarily mean that individuals are utilizing it in a meaningful way or comprehending how to integrate it into their daily routine. Companies might even have overwhelming amounts of reports and information to effectively use it. One way to improve people's understanding of the data is to create visual dashboards that include KPIs that measure the objective or summarize data. (Wu 2007, pp. 44) This could for example be executed by using Power BI.

By monitoring KPIs related to Accounts Payable, it is possible to pinpoint areas of weakness and inefficiency in the department's processes. These metrics help to identify specific tasks and technologies that are preventing optimization and provide insight into where improvements are needed. When utilized effectively, KPIs also offer solutions to these pain points. AP department should select and prioritize actionable and useful KPIs to track their progress as they develop processes. Improved efficiency resulting from these efforts can lead to cost savings for the company. (Brooker 2023)

In the next five subchapters there will be introduced five KPIs that could be measured from Accounts Payable in general. These five KPIs have been chosen for discussion in this thesis for their relevancy of the matter at hand.

3.2.1 Days Payable Outstanding

Days Payable Outstanding (DPO) is a KPI that represents the typical duration taken by a company to settle its outstanding payments to vendors. It is important to maintain a balance in this number, so that the suppliers are satisfied while there is still sufficient cash flow in the business. This ratio describes how effectively the business is managing its cash flow. (Beaver 2020)

Having a high DPO is generally seen as a positive thing, but it is important to consider the context in which this metric is being used. A high DPO could indicate that a company has negotiated favorable payment terms with its suppliers. By extending payment terms, the company gains greater flexibility for repayment and may even be able to use loans to fuel growth. (Russell 2023) Conversely, a low ratio indicates that the business is not making use of the credit terms offered by the vendors (Beaver 2020). However, a high DPO could also suggest that a company is taking too long to pay its creditors. This could lead to service suspensions, as well as limits and fees being placed on the company's accounts. (Russell 2023)

3.2.2 Invoice processing time

When a company takes a long time to process invoices, expenses grow. Companies that perform poorly in invoice processing time metric are much more likely to have inefficiencies in their Accounts Payable processes, in for example:

- Complex workflows

- Inefficient invoice coding
- Delayed invoice approving
- Congested invoice closing and posting (Brooker 2023)

According to Brooker (2023), time per invoice processed consists of “hours spent keying, hours spent rekeying, hours spent reviewing materials, hours spent identifying route checkpoints, hours spent on approvals, hours on remitting and hours on reconciling”.

In order to reduce invoice processing time, a company could utilize Accounts Payable automation which then could include automatic data inputting and lowering error rate on manual tasks. (Brooker 2023)

3.2.3 Percentage of e-invoices

E-invoicing is a digital solution designed to simplify invoicing procedures and enhance the efficiency of businesses, financial institutions, and society as a whole. By automating the invoicing process, it helps companies save time and increase productivity. Moreover, it brings added value to customers by improving the handling and payment of invoices. (Korkman et al. 2010, pp. 240)

Once e-invoicing is integrated with a company’s ERP system, all billing-related data can be processed electronically. This results in improved cash management and creates the opportunity for supply chain financing to become an additional indirect benefit of e-invoicing. (Caluwaerts 2010, pp. 234) The percentage of e-invoices from all incoming invoices is relevant KPI for determining Accounts Payable automation capabilities.

3.2.4 One-to-one correspondence

According to an Accounts Payable specialist of Dooap Inc., invoices that have one purchase order and one reception of goods are the easiest to process automatically. The whole P2P process could then be automated, when the details are straightforward. Therefore, requesting separate invoices for each purchase order from vendors is important.

By automating the process, organizations can further streamline their operations and foster better vendor relationships by ensuring accurate payment processing. For example, Dooap's database has data regarding purchase orders and receptions of goods. Therefore, it is possible to inspect if the invoices could have been processed automatically with a predefined processing logic. Hence, it is important to determine the ratio between invoices that have one-to-one correspondence and more complicated invoices, and perhaps benchmark the ratio with Dooap Average and Dooap Best Performer.

3.2.5 Average cost per invoice

To determine the invoice processing costs per invoice, the total expenses associated with running the AP department should be divided by the number of invoices processed within a specific time frame. It is important to consider various expenses involved in invoice processing, including salaries of the staff and software fees, to accurately calculate the total costs. By obtaining the average cost of processing an invoice, businesses can work towards reducing this cost, which will lead to an increase in the profitability of the AP department. (Taulia 2021) Average cost per invoice can also be benchmarked with other companies. According to American Productivity & Quality Center, the bottom performers spend over 10$ per invoice and top performers spend 2.07$. (Beaver 2020)

3.3 Working capital benchmarking

To measure working capital efficiency, processes are benchmarked more often by consulting companies and association sponsorships rather than through public sources. Leading companies are: AnalyticResults, Hacket Group, Citibank Treasury Diagnostics, Deutsche Bank and CEB. The following associations provide sponsoring for benchmarking research: the Association for Financial Professionals, the Benchmarking Network, and the Knowledge Management Benchmarking Association. These associations have been supplying data for comparison and enhancement. Recently data connections for ERP systems have been built to retrieve data on costs, error rates, cycle times and cash conversion cycles. (Sagner 2011, pp. 28)

Applications that benchmark working capital usually concentrate on comparing metrics that produces logical comparisons to identify opportunities for cost reduction and efficiency improvements. These metrics commonly include:

- **Full-time-equivalent staff levels per dollar of sales**
- **Overall cost per dollar of sales**
- **Throughput measured as units processed per FTE.** For example, payment transactions.
- **Cycle times measured in days.** Calculating number of days to complete any activity such ad reconciling bank account discrepancies.
- **Policies and procedures evaluation**

The main objective of benchmarking working capital is to achieve greater efficiency and cost savings. (Sagner 2011, pp. 28)

3.4 Data architecture and data logging

A tenant is a cluster of users who access the same view of an application they use. Data, configuration of application, user management, certain functionalities and other properties are included in the same view. The concept of multi-tenancy involves sharing an application instance with several tenants by allocating a corresponding share of the instance to each tenant. The share is isolated from others concerning data confidentiality and system performance. (Krebs et al. 2012, pp. 427)

In cloud-based service infrastructure, logs are extremely valuable as an analytical data source. Logs can be used for multiple purposes: debugging and forensics, fault monitoring, troubleshooting, feature usage, performance monitoring, security and incident detection, regulatory and standards compliance. A commonly accepted principle suggests that log entries should be written in a way that can be understood by humans and processed by machines with ease. This implies that each log entry should ideally include information such as what occurred, when it occurred, who caused the event, and why it occurred. To ensure that every log record contains the necessary information, the following fields should be included: timestamp, application, user, session identifier, severity, reason, and categorization. Logs could be structured using Common Event Expression which is a standard that assigns each record as key-value pairs. (Marty 2011, pp. 178-181)

3.5 Reporting tools

Reporting is important for companies to have transparency on operations and to monitor processes. Tools used for reporting can be utilized to track KPIs and benchmark them.

Microsoft has been acknowledged by Gartner as a leader in analytics and business intelligence platforms in Gartner’s Magic Quadrant report. This is the fourth consecutive year that Microsoft has achieved this recognition, being placed at the top for their ability to execute and completeness of vision. (Microsoft n.d.-b) Gartner’s Magic Quadrant can be seen in figure 4.

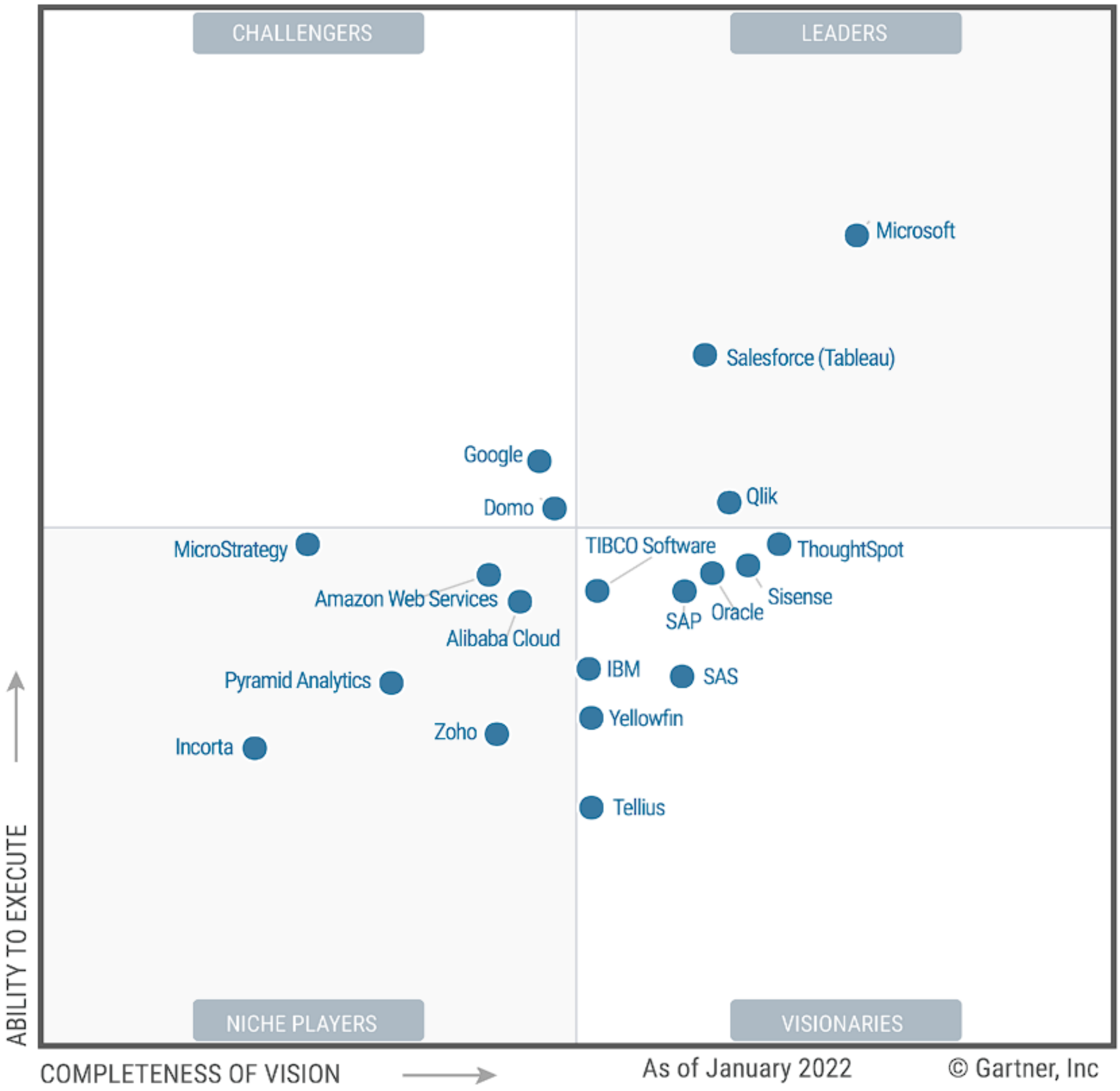

Figure 4. Gartner's BI product rating in 2022. (Microsoft n.d.-b)

The following paragraphs compare the top three reporting tools based on the Gartner's product rating above. These tools are Power BI by Microsoft, Tableau by Salesforce and QlikView by Qlik.

3.5.1 Power BI

Power BI was created by Microsoft by combining multiple "Power" add-ons for Excel that were first introduced in the 2013 version. The base layer of Power BI is a software tool named Power Query, which has been integrated into Excel as "Get and Transform" since

2016. Power Query offers capabilities to access tabular data in various formats, including for example databases and simple text files. The data from these tables can be reformatted and merged before being loaded as part of a data model. This model can be managed with pivot tables and graphing tools to analyse the data effectively. (Becker & Gould 2019)

Power BI is comprised of two different options. The first option is a Windows application called Power BI desktop, which combines the visualization and analysis layer with Power Query. This option is available for free. The second option is the Power BI cloud service, which can be used for basic analysis and visualization without the desktop software. However, to perform customized calculations that go beyond standard descriptive statistics, the desktop version is necessary. Reports built with Power BI desktop can be published to the Power BI service for sharing. Visualizations can be shared in internet, allowing them to be embedded on a public web page. (Becker & Gould 2019) In figure 5 there is a visualization created with Power BI desktop (Microsoft n.d.-a).

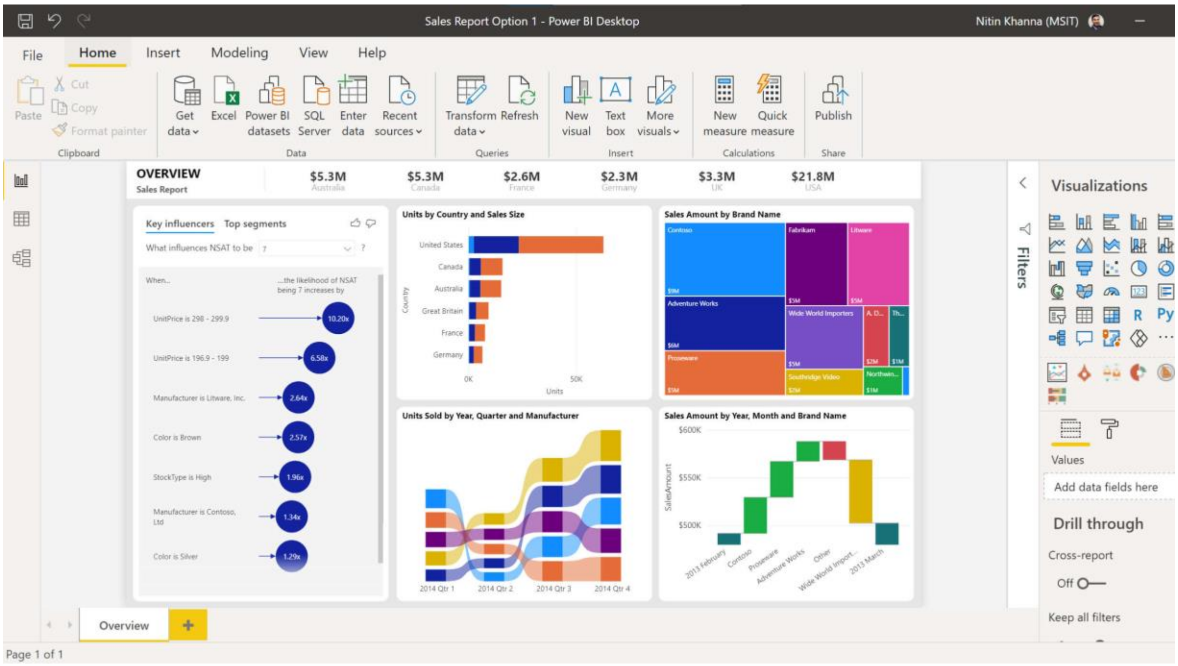

Figure 5. Example of Power BI desktop view. (Microsoft n.d.-a)

A Power Query M formula language query is made up of a series of steps that use formula expressions to create a mashup query. Each formula expression can be computed to produce a value. The "let" expression allows you to group a set of values together, give them names, and then use them in a later expression using the "in" statement. (Microsoft 2022) In figure

6 there is a simple example of Power Query M-code. The code pulls a whole table from SQL database.

```
let
    Source = Sql.Database("Server", "Database"),
    dbo_Table = Source{[Schema="dbo",Item="Table"]}[Data]
in
    dbo_Table
```

Figure 6. Example of Power Query code in advanced editor.

The code introduced above transferred into SQL query would be a simple statement:

$$SELECT\ *$$

$$FROM\ dbo.Table$$

All queries, whether they are generated by Power Query, written manually by the user in the advanced editor, or entered using a blank document, are composed of functions and syntax from the Power Query M formula language. The Power Query engine interprets and executes these queries to produce the desired results. The M script is like a set of instructions that tells the engine how to evaluate the query. (Microsoft 2023b)

While refreshing the data, M script is submitted to the Power Query engine through the advanced editor, along with other crucial information like credentials and data source privacy levels. Power Query then analyzes this script to determine what data needs to be extracted from the source, and it submits a request to the data source. Once the data source responds, Power Query receives the data and performs necessary transformations using its engine. Finally, the transformed data is loaded into a specified destination, such as a data model in Power BI. (Microsoft 2023b) Figure 7 represents this process.

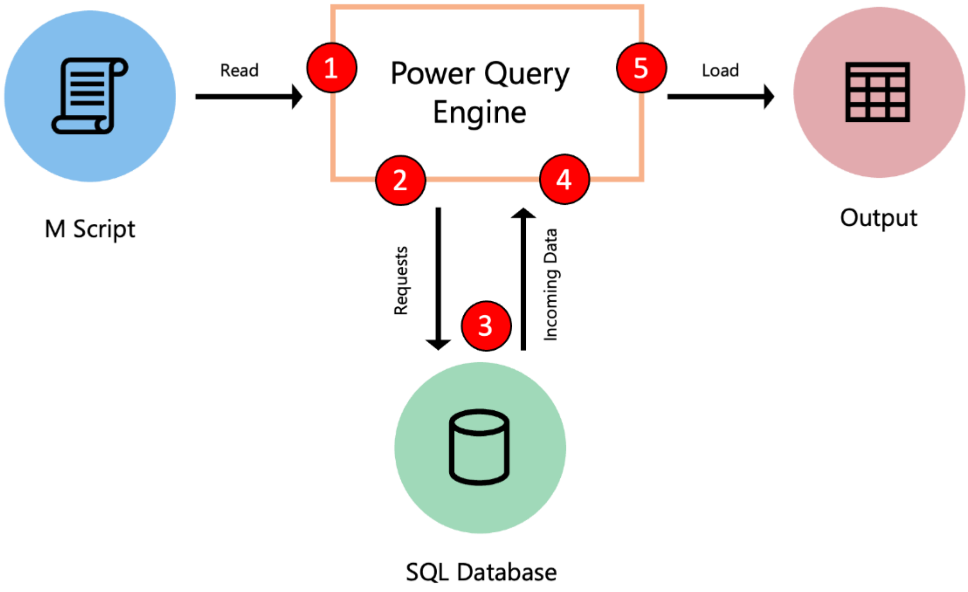

Figure 7. Query evaluation process. (Microsoft 2023b)

3.5.2 Tableau

Tableau is a software tool that enables users to analyse customer data sets visually and interactively in a flexible and exploratory manner. It was originally developed as a research project called Polaris and has since evolved into a commercial product that is widely used as a key component of the Business Intelligence (BI) stack in many organizations. Tableau allows information workers to create dynamic and engaging visual representations of data using a desktop application. This application has the ability to connect to an online data source or work offline with its own copy of the data. It can easily switch between these two modes without any disruption. The online data source option ensures consistency among all users who are connected to it, but it requires a powerful database server to handle the analytical workload. In some cases, the server may have other operational responsibilities that interfere with its ability to handle such a workload, or it may not be suitable for this purpose due to its limitations. (Wesley et al. 2011, pp. 1185) A picture of Tableau's interface can be seen in figure 8.

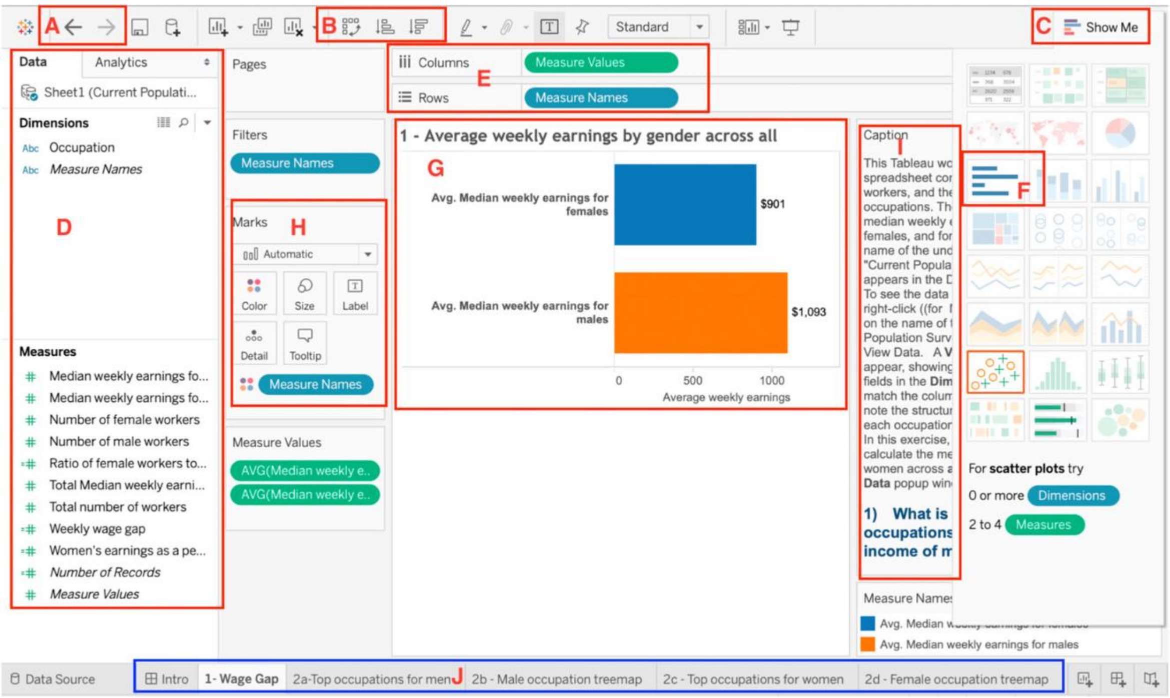

Figure 8. Example of a Tableau worksheet. (Batt et al. 2020, pp. 321)

In the picture above, the following commands have been highlighted:

- A: Undo and redo
- B: Sort data
- C: Show me pallet
- D: The data pane with categorial variables as "Dimensions" and quantitative variables as "Measures"
- E: Columns and Rows
- F: Bar chart
- G: Visualized bar chart
- H: Format chart
- I: Caption of visualization
- J: Worksheet navigation. (Batt et al. 2020, pp. 320-321)

3.5.3 QlikView

QlikView was founded in Lund, Sweden in 1993 under the name "QuickView". However, due to copyright issues, the company was forced to change its name and as a result, "QlikView" became the new name for the product. This change occurred early in the company's history, which spans nearly three decades. (Garcia et al. 2018, pp. 1) QlikView is a software tool that enables users to extract, transform, model, and visualize data all in one place. Its built-in visualization capabilities allow users to detect data anomalies early in the extract, transform and load process, making it easier to share findings with business users and receive feedback before investing too much time in analytical applications that may not be useful. (Garcia et al. 2018, pp. 467) An example of a dashboard created with QlikView can be seen in figure 9. While QlikView is classified as a BI software, its exceptional ability to explore, visualize, and discover data distinguishes it from other BI tools. (Garcia et al. 2018, pp. 467)

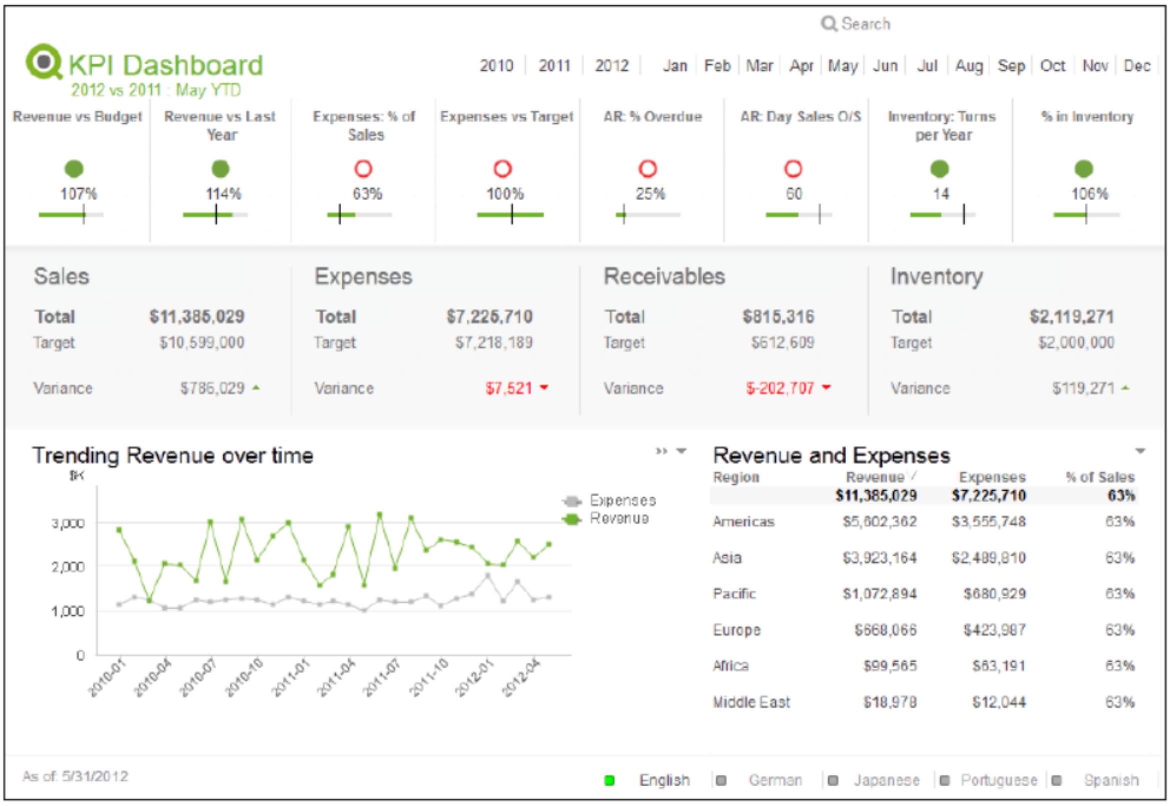

Figure 9. Example of a dashboard created with QlikView. (Garcia et al. 2018, pp. 334)

A traditional BI tool's initial emphasis is on arranging data into data warehouses and cubes, based on the business requirements established at the beginning of the project. After the data is organized and the first reports have been built based on business requirements, the data is explored using visualization. However, when business users first see their new reports, the primary realization they have is that significant time and resources have been invested in developing reports that do not satisfy their actual business requirements. (Garcia et al. 2018, pp. 467) Figure 10 summarizes the key points of QlikView differences compared to traditional BI tools.

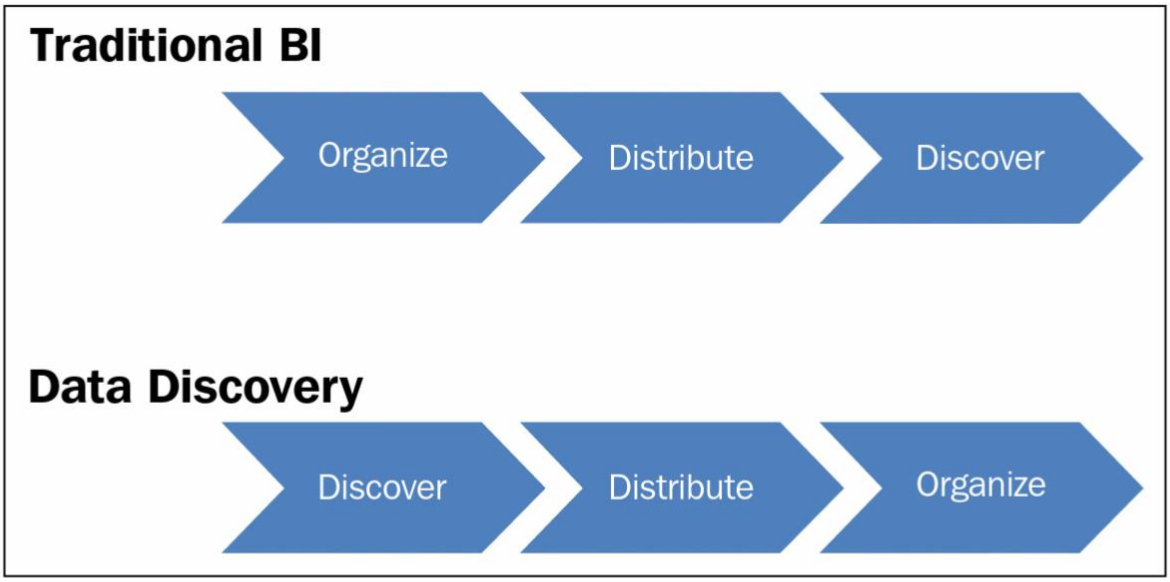

Figure 10. Differences in traditional BI software and QlikView's Data Discovery method. (Garcia et al. 2018, pp. 467)

3.5.4 Comparison of reporting tools

If Power BI reports require to be distributed within an organization to enable collaboration, both the creator and collaborators must be "Pro" users, which costs $9.99 per month or $3 per month for nonprofits. This is a more affordable option than Tableau's current pricing of $70 per user per month for individuals who design reports and $12 to $15 per user per month for users who view non-public content. (Becker & Gould 2019)

Gartner rates BI tool features based on user reviews. This rating can be seen in table 2. Features have been selected based on the needs of benchmarking report intended to be built in this thesis. Gartner has set a maximum of 5 points for each feature. Based on the feature scoring table, Power BI has the highest overall rating based on the user reviews. However, Power BI is not the best option in all use cases and therefore some other BI tool might be more suitable in some cases.

Table 2. BI tool features and scores. (Gartner n.d.)

Feature	**Power BI**	**QlikView**	**Tableau**
Collaboration & Social	4.4	3.8	4.0
Interactive visual exploration	4.5	4.3	4.6
ETL & Data storage	4.0	4.2	3.6
Ease of use to deploy and administer	4.2	4.2	4.3
Ease of use for content consumers	4.3	4.2	4.4
Cloud	4.3	3.8	4.1
BI Platform Administration	4.2	4.1	4.2
Pricing Flexibility	4.2	3.7	3.7
Score	**4.26/5**	**4.04/5**	**4,11/5**

3.6 Information security

The General Data Protection Regulation (GDPR) is widely considered to be the most stringent in the world when it comes to privacy and security laws, which applies to organizations worldwide that collect or process data about individuals living in the European Union. It was enacted on May 25, 2018. According to GDPR, there are going to be severe consequences on any organization found guilty of violating its privacy and security regulations. (Wolford n.d.)

GDPR only applies to personal data. Personal data includes for example: name, address, passport number, income, cultural profile, IP address and health information. If personal data is processed, individuals should be informed about who is processing the data and why the processing is being done. Also, the legal basis and receiving party of the processing should be informed. (Your Europe 2022)

A company can process personal data if one of the following conditions is fulfilled:

- The company has been given the consent of the individual concerned
- The company needs the personal data to fulfil a contractual obligation with the individual
- The company needs the personal data to satisfy a legal obligation
- The company needs the personal data to protect the vital interests of the individual
- The company processes personal data to carry out the task in the interest of the public
- The processing is done according to company's legitimate interests. Fundamental rights and freedoms of the individual whose data are processed are not seriously impacted (Your Europe 2022)

However, if the processed data does not include personal data about individuals, GDPR's data protection rules do not apply. Data protection rules do not govern data about any legal entity or company. (European Commission n.d.) The GDPR recognizes pseudonymous data as personal data that has been stripped of its direct identifiers, making it impossible to link it to an individual without using additional information that is stored separately. This is distinct from anonymized data, where the connection to personal data is completely eliminated. Anonymized data cannot be linked back to the data subject and therefore falls outside the scope of the GDPR. However, if a company uses pseudonymization techniques to handle personal data, the company may be able to take advantage of the relaxation of some provisions of the GDPR, including the obligation to notify in case of personal data breaches. The GDPR also promotes pseudonymization as a privacy-enhancing and security measure, aligning with the principle of privacy by design. (Microsoft 2018, pp. 8)

4 Dooap

Dooap Inc. is a company that provides Accounts Payable automation software for Microsoft Dynamics 365 ERP system. The company's innovative solution aims to simplify the Accounts Payable process by automating manual tasks, reducing errors, and providing real-time visibility into financial data. Dooap's software includes a range of advanced features, such as approval workflows, automatic invoice matching, and analytics for AP data. By integrating seamlessly with existing Dynamics 365, Dooap helps businesses streamline their financial processes and improve efficiency. This thesis explores the impact of Dooap's software on the Accounts Payable process in the context of KPI benchmarking. In the following paragraphs, “Dooap” refers to the Dooap software and “Dooap Inc.” refers to the company. Also, tenant and customer are used as synonyms in technical context.

The following paragraphs define the elements needed to implement the benchmarking report. Data generation, data logging and KPI measurement have been described, but not yet implemented in this section.

4.1 Current status of Dooap’s benchmarking

Dooap Inc. currently lacks benchmarking options between tenants. This limits the ability to provide valuable insights and recommendations to optimize AP processes. Without benchmarking options, it is difficult to showcase the value of Dooap by for example not being able to compare customer performance with each other. Total invoice volume is the only metric that is currently being gathered, ranked, and estimated. The objective of this thesis is to build a report that provides an overall picture of efficiency with benchmarking possibilities. Figure 11 represents the general level architecture for the creation of this report.

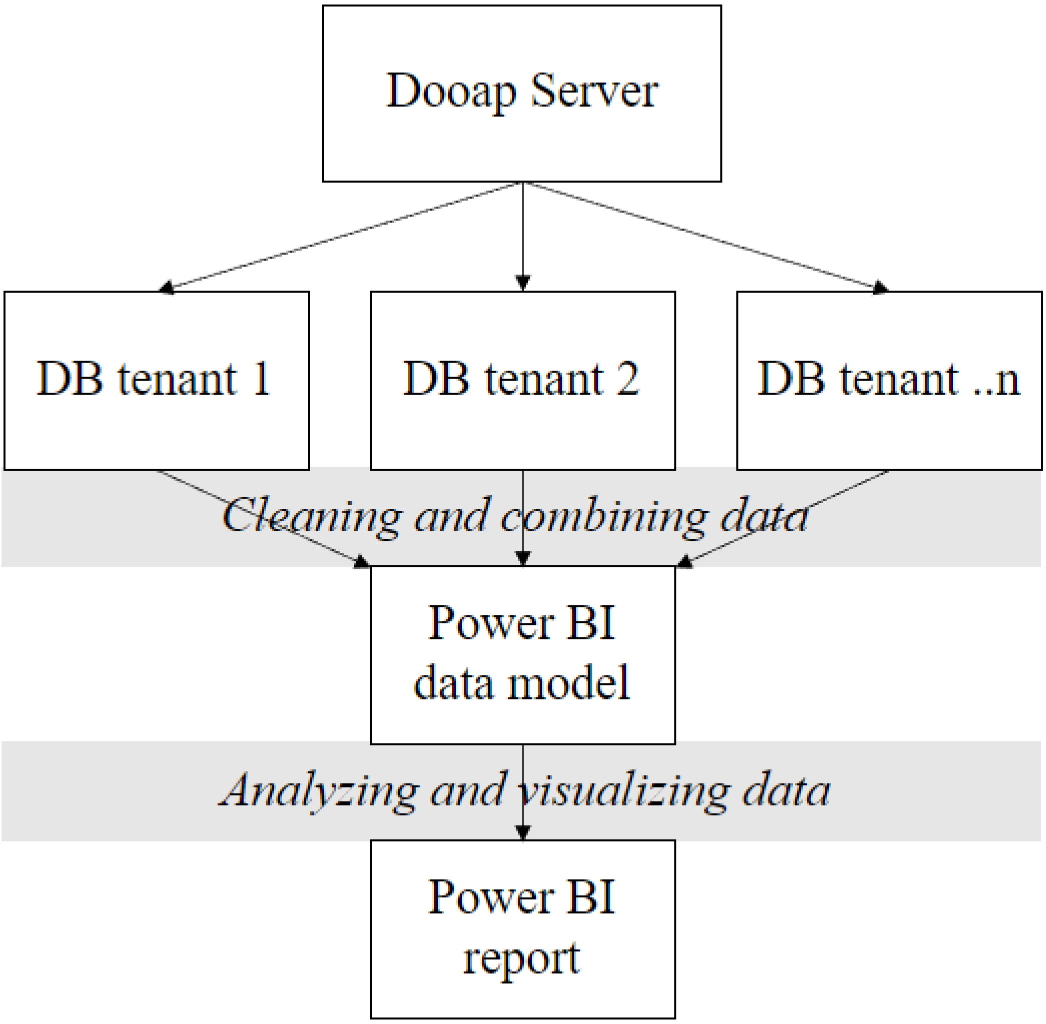

Figure 11. Reporting pipeline.

4.2 Data generation and accessibility

Dooap includes options to enable multiple features by users. The features include, for example, automation based on a desired set of invoice processing policies. Each customer's settings have been saved in the database of Dooap. The table also includes a boolean value for each feature. The table includes all tenants that are registered in Dooap.

Dooap logs data from multiple invoice processing activities. Each log includes a timestamp that enables time related analysing as well. KPIs can be calculated from these log events by summarizing events and timestamps. The data is then stored in corresponding SQL database for each tenant.

4.3 Database

Each Dooap Inc.'s customer has a separate database hosted by Dooap. Invoice data is being inserted to the database when new invoices are imported into the software. This invoice data includes for example invoice amount, vendor and method of payment. Also, date and time related data is available, for example cash discount date, invoice date, invoice created timestamp, posting date and invoice due date.

Dooap logs data about different activities from the software into the database. These activities are for example invoice imported, invoice sent to workflow, invoice approved, and invoice transferred to payment. Each activity has a timestamp which describes when the activity has occurred. By utilizing invoice related attributes and action timestamps, a Power BI report can be built.

4.4 Measurement of selected KPIs

To create a well-functioning Power BI report, it is necessary to contemplate data and the possible outcome in advance. Section 3.2 included various KPIs and their significance. This section analyzes those KPIs on a more detailed level and focuses on calculations needed to compute.

4.4.1 Days Payable Outstanding in Dooap

Data for invoice date, due date and payment date are available in the database. A Power BI DAX expression can be created to calculate the difference between those dates. This allows the calculation of DPO. Figure 12 includes a representation of a DAX measure of an average time between invoice date and payment date. The outcome of this measure is a number of days from invoice date to payment date for each invoice. The "SWITCH" expression has been inserted into the function to outline incorrect user inputs where invoice date is smaller than the payment date or where the payment date is further than 300 days of invoice date. "AVERAGEX" function does not consider blank values, and therefore the average is calculated only on the invoices that do not fulfil the conditions described in the figure below.

```
AVERAGEX(InvoicesTable,
          SWITCH(TRUE(),
               DATEDIFF(InvoicesTable[InvoiceDate], InvoicesTable[InvoicePaymentDate], DAY) < 0, BLANK(),
               DATEDIFF(InvoicesTable[InvoiceDate], InvoicesTable[InvoicePaymentDate], DAY) > 300, BLANK(),
               DATEDIFF(InvoicesTable[InvoiceDate], InvoicesTable[InvoicePaymentDate], DAY)
          )
)
```

Figure 12. DAX expression example of DPO.

To give more insight into a DPO metric, an average payment term is calculated. It is calculated the same way as the DPO, but the invoice payment date is replaced by a due date. An average payment term can be compared against the DPO. Table 3 has been populated with arbitrary numbers to shows possible insights of the DPO relation to an average payment term.

Table 3. An example of a DPO and an average payment term relationship.

DPO		Average payment term	Insights
10	=	10	Invoices are being paid on time. Short DPO indicates weak liquidity. Payment terms are not negotiated to be long.
40	>	30	High DPO indicates high liquidity, but invoices are being paid 10 days late. The company might have a liquidity problem.
30	<	40	Above average payment terms have been negotiated. In terms of working capital, money could have been tied elsewhere for a longer period. Invoices are being paid too early.
30	=	30	30 is considered as an average DPO and payment term.

By utilizing DPO and average payment term metrics, customers could become aware of how well they are performing compared to other companies. DPO is also one part of a Cash Conversion Cycle which describes the efficiency of working capital in a company.

4.4.2 Invoice processing time in Dooap

In section 3.2.2 where invoice processing time is introduced, total time for invoice processing is divided into multiple tasks that are a part of the invoice processing. In Dooap, user activities are not tracked at the same level of precision. Invoice processing time is split into few categories based on the workflow steps. Those categories are:

- AP Time
- Approval time
- Transfer to payment time

All AP processes do not include invoice reviewing. Therefore, in the above grouping, the review category is left out. If a customer has an invoice review in their process, the review time is added to “Approval time” category.

Dooap logs invoice related activities. AP time includes time between invoice creation and invoice transferred to workflow. Approval time includes time between invoice transferred to workflow and invoice approved. Transferred to payment time is calculated as time between last approval and invoice transfer. These metrics are calculated with DAX but simplified in table 4 below.

Table 4. Calculations of invoice processing time metrics.

Metric	**Calculation**
AP time	[Invoice transferred to workflow timestamp] – [Creation date]
Approval time	[Invoice approved timestamp] – [Invoice transferred to workflow timestamp]
Transfer to payment time	[Invoice transferred to payment timestamp] – [Invoice approved timestamp]

4.4.3 Percentage of e-invoices in Dooap

In Dooap's database there is data to express file format for each invoice. Therefore, it is possible to calculate the percentage of e-invoices based on file formats that are considered as e-invoices. It can be done by selecting all invoices that can be considered as an e-invoice and dividing the count by the count of all invoices.

The count of the e-invoices is relevant especially in the Dooap because the e-invoices facilitate customers' AP process automation. Customer satisfaction increases when invoices have less errors due to the e-format. Also, Dooap as a SaaS product needs less computational power to process these e-invoices due to less invoice data editing and additional workflow steps.

4.4.4 One-to-one correspondence in Dooap

One-to-one correspondence can be calculated from Dooap's database. Each row of a specific table represents each line of an invoice. The table gathers data only if a PO number and a reception exists.

The first step to calculate the metric is to remove invoices from the table that have multiple lines. If multiple lines exist, the invoice does not have one-to-one correspondence. The line removal cannot be done with Power Query's built-in "Remove Duplicates" function since it only removes the other if two instances exist and the desired outcome is to remove both. To resolve the problem, the table is grouped by each invoice and the count of lines is calculated into a custom column. This is done by Power Query's *Table.Group* function. The function and its components are wrapped inside *Table.SelectRows* function which lets the user to filter the table based on conditions. In this case, the condition is that the table only includes invoices that can be found from the table once. Therefore, the count is set as one.

The second step is to insert corresponding PO line numbers into the table after filtering the count. Only invoices with one lined purchase orders should be inspected. Hence, every invoice that has a corresponding PO line number other than one, is filtered out. As a result, the table includes all invoices that would have been easy to process. The row count of the table can be divided with a row count of a table that includes all invoices, and the outcome is a ratio that describes a percentage of invoices that are easy to automate. After loading the data from Power Query into the data model, the percentage can be filtered with more meaningful filters, for example to include only PO invoices. Figure 13 presents a pseudonymized version of Power Query M-code to determine the count of invoices that have one-to-one correspondence and then filter the table to include only rows where the count is one.

```
Aggregated = Table.SelectRows(
Table.Group(#"Data from previous step", {"Invoice instance"}, {
    {"InvoiceRowCount", Table.RowCount},
    {"OtherColumns", each _, type table [Column1=number, Column2=text]}}
), each [InvoiceRowCount] = 1),
#"Expanded Other columns" = Table.ExpandTableColumn(Aggregated, "OtherColumns", {"Column1", "Column2"}, {"Column1", "Column2"})
in
#"Expanded Other columns"
```

Figure 13. Pseudonymized Power Query M-code to have only one instance.

5 KPI benchmarking report implementation for Dooap

This chapter focuses on the report building process. Data modeling and the creation of the report are the core parts of implementing a KPI benchmarking report. In addition to this, other aspects that are omitted from the report are introduced in this section. Power BI was selected as a tool for the report because of its usability and compatibility with other Microsoft products.

5.1 Data modeling

To begin the data modeling, an access to each database is needed. After the access, a table including features with boolean values is pulled to Power BI through Power Query. The table is called “Tenants” and it includes each tenant representing customers. The table includes necessary information for benchmarking purposes such as a tenant id, a customer name, a database name and each Dooap’s feature and corresponding value whether the feature is disabled or enabled. The following chapters elucidate how “Tenants” table can be utilized in the data model.

5.1.1 Query generation

A custom column is created that takes a database name as an input of “Tenants” table and then builds a new query for a desired table from each customer’s database. This desired table can be any table with any data manipulation functions. As an example, the desired table could be called “Table 1” and it could be taken from the database as is. Then the data is not modified in any way. The example of querying “Table 1” as a custom column on the side of “Tenants” table is pseudonymized and summarized in figure 14.

Tenant Id	Customer name	Database name	Custom column
Id 1	Customer 1	Database 1	Table 1
Id 2	Customer 2	Database 2	Table 1
Id 3	Customer 3	Database 3	Table 1

Figure 14**.** A snapshot of pseudonymized “Tenants” table.

The “Tenants” table’s custom column cells include another table that has been queried. Each cell of the custom column contains the same schema for the table, but the data is different since each table has been queried from a different database. To simplify, the figure above includes “Table 1” for each row in “Custom column” representing the identical table filled with respective customer’s data. Below on figure 15 is a piece of a pseudonymized Power Query function which represents the generation of “Custom column”.

```
TableQueries = Table.AddColumn(Tenants, "Custom column",
    each (
        Source = Sql.Database(DooapServer, [Database name]),
        dbo_Table_1 = Source{[Schema="dbo", Item="Table 1"]}[Data]
        )
    )
```

Table 1

Figure 15**.** Pseudonymized Power Query function.

As the figure above represents, the “Table 1” has the same name for each row since it is the name of the table. The database name is inside square brackets meaning that the database to be connected to with *Sql.Database* function is taken as a reference from the “Database name” column. “DooapServer” represents a variable of Dooap’s server name.

The data from “Table 1” can be expanded as columns into the original “Tenants” table. Below in figure 16 is a representation of how the table would look after expanding the data. Rows from the original table will duplicate for each customer until the “Table 1” is expanded completely for the corresponding customer. In figure 16, after rows from Customer 1’s table has reached the end of the data, the Customer 2’s first row of “Table 1” will appear. This is the final form of the data before loading it to the Power BI data model.

Tenant Id	Customer name	Database name	Table 1 Id	Data A	Data B	Data C
Id 1	Customer 1	Database 1	Unique Id 1	…	…	…
Id 1	Customer 1	Database 1	Unique Id 2	…	…	…
Id 1	Customer 1	Database 1	Unique Id ..n	…	…	…
Id 2	Customer 2	Database 2	Unique Id 1	…	…	…

Figure 16. Tenants table after expanding the "Table 1".

Data expanding logic is applied to each table required to implement the benchmarking report. Moreover, "Tenants" table is divided into two separate tables for each query. When queries are completed, the tables are combined to include all tenants. The reason for the division is to maximize the number of parallel queries that local CPU can process. Power BI allows users to control the number of parallel queries in Power Query (Microsoft 2023c). By default, the maximum number of queries performed simultaneously is determined by the number of cores in the computer's processor. The lowest possible value is 1, and the highest possible value matches the number of cores in the computer's processor (Microsoft 2023c). The queries for each table are divided into two tables based on customer location. After the queries are finished, the tables are combined. Each row of each table in the model has a table identifier and a customer identifier which will enable customer level KPI calculation.

5.1.2 DAX computing logic

After database queries have been implemented, it is turn for the implementation of KPIs presented in chapter 4.4. That chapter also included explanations of computations of each KPI.

DAX has a possibility to create calculated columns and measures (Russo 2020). Each DAX formula is processed by two engines: DAX formula engine and DAX storage engine (Russo 2020). The DAX formula engine takes a DAX query and transforms it into a query plan that outlines the individual actions required to execute the query (Russo 2020). Each action in the plan represents a particular operation carried out by the formula engine (Russo 2020). The storage engine's objective on the other hand, is to examine the database and generate data caches that the formula engine requires (Russo 2020). The data model is implemented to include calculated columns where local CPU for measure computation is sufficient for large tables. Visualizing calculated columns utilize the data caches generated by storage engine. This makes visualization faster if there is a lot of data. However, each calculated column makes the data model size larger, which is why in this report calculated columns are only used where it is necessary.

5.1.3 Data model static benchmarks

Benchmarking is done by calculating Dooap Average and Dooap Best Performer measures for each KPI. Power BI DAX measures detects row level filters while visualizing the data. Therefore, it is crucial to exclude row level filters from average benchmarks. Calculating Best Performer is a bit challenging. The KPIs are first calculated with Power BI DAX measures, then KPIs need to be calculated for every tenant and only after that, the Best Performer is found. Best Performer implementation needs a virtual table inside the Best Performer DAX measure. The virtual table has the KPI values for each tenant. However, a static benchmarking table has been created that has each tenant and corresponding KPI values. Therefore, there is a possibility to use DAX's "MAX" function to create measures for Best Performers. A static table that includes each KPI provides for report user an option to compare KPI levels with filtered data against static unfiltered data.

5.2 Report building

In the previous chapter, data modeling was implemented to the point where building the report can be started. This chapter introduces the report design. The report is built with Power BI although Tableau, and QlikView are also popular visualization software options for benchmarking Accounts Payable performance. Dooap's existing reports have been built with Power BI and users have become accustomed to using them. The report implementation is divided into automation related KPIs and financial KPIs. The report includes all customers, even the most recent ones. By pressing the "Refresh" button on Power BI desktop, Power Query retrieves all existing tenants from the database.

5.2.1 Automation metrics

Invoices that have been processed automatically in their corresponding step have been gathered as a percentage of total invoices processed. Those steps are Auto AP, Auto Approved and Auto Transferred To Payment. For each step, an Average Performer and the Best Performer measures have been calculated. Figure 17 represents general level benchmarking, where the actual data has been hidden.

	dooap	Average performer	Best performer
Auto AP	- %	- %	- %
Auto Approved	- %	- %	- %
Auto TTP	- %	- %	- %

Figure 17. General benchmarking of Dooap's built in features.

An improved version of the figure above includes KPIs of invoice features which streamlines the automation. These features are an invoice being an e-invoice or it has one-to-one correspondence. If the invoice has one-to-one correspondence meaning that the invoice has only one line, one purchase order and one reception, it's easy to automate. Also, if an invoice is an e-invoice, it is straightforward to automate. These KPIs measure the count of invoices that belong to each category and then show a percentage of its fulfilment. The improved version also has an option to select a customer and compare the customer specific levels to average customer and the best performing customer of each metric. This improved version of the figure above can be seen in figure 18.

All

	Selected customer	Average performer	Best performer
Auto AP	-%	-%	-%
Auto Approved	-%	-%	-%
Auto TTP	-%	-%	-%
One-to-one	-%	-%	-%
E-invoices	-%	-%	-%

Figure 18. Benchmarking of invoice formats and Dooap automation features.

Customers' AP processes might include a custom RPA that is setup as regular user and therefore invoice processing actions of the RPA are not logged the same way as Dooap's built-in automated processing. In those cases, the percentage of automation seems to be low even if it might be on a high level. Therefore, invoice processing times can be more relevant for AP departments rather than automation percentages. Below in figure 19 is introduced a comparison tool of an Average and Best Performer of invoice processing time including different stages in invoice processing. Breakdown of Dooap's prediction features is also included.

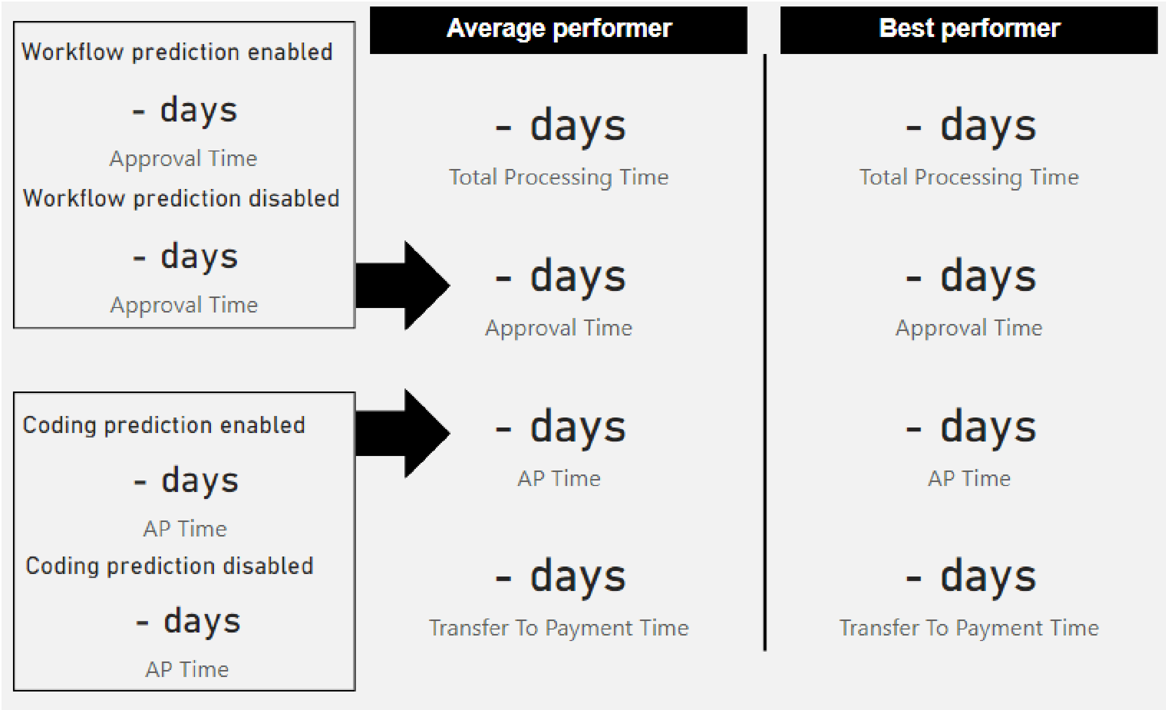

Figure 19. Invoice Processing Time with prediction feature breakdown.

The final form of the automation KPI benchmarking is a table that includes the following columns:

- Customer name
- %- of one-to-one correspondence
- %- of e-invoices
- %- of Auto AP
- %- of Auto Approved
- %- of Auto Transferred To Payment
- AP time in days
- Approval time in days
- Transfer time in days
- Total processing time in days

This table can be filtered in an arbitrary manner. The table can be used for example in comparing each KPI with PO and Non-PO invoices or to filter the data to only include invoices created last month. Power BI’s dynamic data filtering is utilized to connect fact tables in a way that any filtering combination on invoices, customers or Dooap’s functions, will generate a re-calculation of each KPI and provide new, filtered metrics. Furthermore, these filtered metrics can be compared against static KPIs for benchmarking purposes.

By using the report, insights can be gained on whether invoice processing is more efficient in different time series or with certain business logic. For example, if a tenant’s invoice processing time is slow for PO invoices, automation metrics and processing times can be compared against better performing tenants. If a tenant’s processing time is high even with high automation levels, and Average and Best Performer benchmarking levels’ processing time decreases with automation increase, one can conclude that automation does not bring processing time efficiency for the corresponding tenant. In this case AP specialists might have to execute unnecessary tasks on invoices which slows the process even if automation is applied.

5.2.2 Financial metrics

Days Payable Outstanding became the most significant metric from the financial side of benchmarking. DPO can be compared to payment terms and late payment prevalence. If invoices are being paid on time and DPO is high, it benefits any business. Below in table 5 is a benchmarking table of financial metrics. If inventory data and sales data would be available, the whole Cash Conversion Cycle could be benchmarked, and more meaningful insights could be gained through that metric.

Table 5. Financial metric benchmarking table.

Customer name	**Average payment term**	**DPO**	**Paid late -%**	**Paid late (days)**
Customer 1	-	-	-	-
Customer 2	-	-	-	-
Customer.. n	-	-	-	-
Dooap Average	-	-	-	-

5.3 Dooap feature usage analysis

Dooap has built in machine learning features, for example workflow prediction and coding prediction. Each KPI and benchmark can be aggregated for tenants that have whether enabled or disabled machine learning possibilities. Therefore, ML feature efficiency can be inspected with multiple KPIs and promoted to tenants that have not adopted those features in case these ML solutions would provide increasing efficiency for the corresponding customer.

The usage of automated invoice processing has been studied in this thesis. An Auto AP feature has been calculated per tenant including all processed invoices. Figure 20 below represents a trend line of all tenants and their levels of invoice processing time and Auto AP usage on invoices. Individual data points have been hidden.

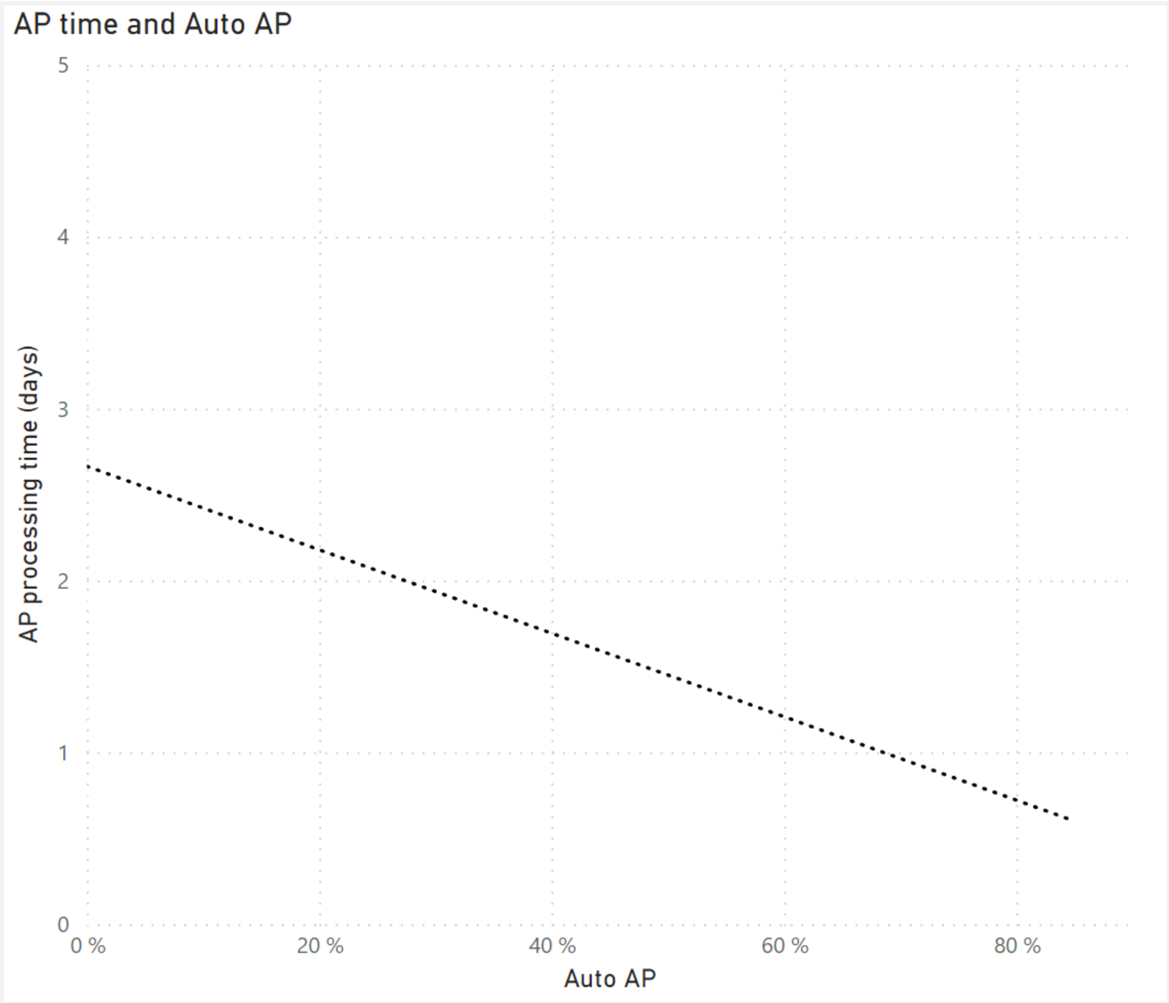

Figure 20. Auto AP feature usage relation to AP time.

An Auto Approved feature has more effect on approval time than Auto AP on AP processing time. Figure 21 shows approval time relation to whether invoices have been auto approved as a percentage aggregated to tenant level. Data points have been hidden again. If all invoices are automatically approved, the approval time will be 0 days. However, the slope of the trendline in the figure below is remarkably steep downward. Approval time seems to go to 0, even if there are manually approved invoices. The reason for the unconvincing trendline steepness lies in the number of customers that do not use the Auto Approved feature on their invoices and simultaneously have high invoice approval time. When some customers use the feature, it has an extremely steepening effect on the trendline, which makes it unconvincing on higher automation levels.

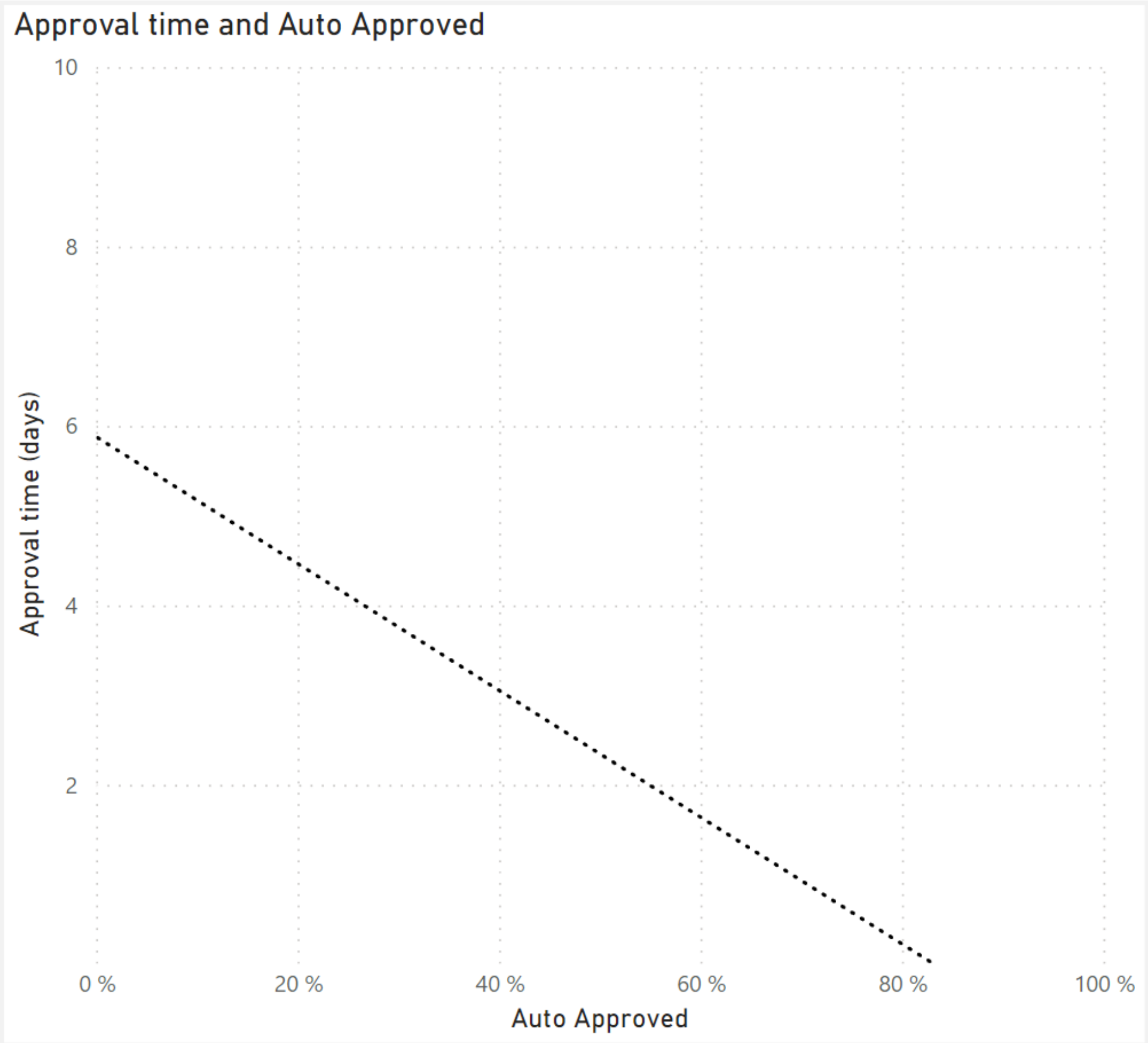

Figure 21. Approval time relation to Auto Approved feature.

5.4 Advantages and disadvantages of the report

In today's world, businesses make more rational purchasing decisions. Companies operating with a SaaS business model need to provide rational reasons for potential customers for the usage of their SaaS product. Therefore, a report including data from the whole product is beneficial in cases where the data or a KPI answers problems affecting a potential customer's purchase decision. In addition, if some KPI is used for marketing purposes by AP automation solution companies in general, such KPI can relatively easily be created in the Power BI model implemented in this thesis. For example, in Dooap Inc. automation efficiency due to Dooap features could be marketed with plausible data from the system.

More practical use cases for the report would concern helping customers to optimize their AP process. Consultants configuring a new customer's features could inspect their invoice processing model and suggest a combination of features that would provide the best performance for their needs. For existing customers, new features could be promoted to them by having data from the feature's effect on increasing efficiency.

The report in its current form, however, is not helpful for clients just by its existence. Contact with the customer about the matter of process efficiency is needed since the visibility of the report is limited for the internal use of Dooap Inc. Therefore, Average and Best Performer levels are not visible for customers. Also, the process of contacting customers and providing suggestions to increase their processing efficiency might be time-consuming. Every KPI the report has might not be helpful for every client. Thus, AP processes should be tailored based on business goals. Without recognizing the goals there is no certainty that the KPIs in the report are relevant.

5.5 Future development of the report

The implemented report is made for the internal usage of Dooap Inc. KPIs of the report can be inspected to perceive Dooap overall performance and compare customer level KPIs.

However, improvements can be made to increase relevance of KPIs and to improve the technical implementation.

5.5.1 KPI development opportunities

Days Payable Outstanding by itself does not provide an objective or goal for each company because it is a sector specific KPI. Dooap Inc. would need to create customer sector classification and corresponding DPO benchmarks for them. Furthermore, if inventory levels and customers' sales data would be available, the whole Cash Conversion Cycle could be calculated. CCC would also be more meaningful if industry benchmarks are included.

Interest rates have been rising since 2022. The increase in interest rates, along with a sustained labour shortage, difficulties in supply chains, and significant inflation, have raised the cost of doing business. (Segebarth 2023) If a company has debt, the cost of debt is higher than before, making working capital optimization more important. If working capital allocation is becoming more efficient, companies can pay off their debts more quickly or invest the excess capital to interest yielding asset. If companies would know their working capital efficiency compared to other companies, they could negotiate their credit terms to be as long as possible. Also, working capital benchmarking options could be a significant factor for making the purchasing decision of AP automation software.

Average Cost Per Invoice was introduced in section 3.2.5. but not implemented in the report. This KPI combines the mechanical and the financial side of invoice processing. Invoice total processing time is a similar KPI to the Average Cost Per Invoice since invoice costs consist of salaries and software fees. Dooap logs invoice processing steps as timestamps and not as time spent actively processing invoices. Therefore, invoice processing time also includes the time that the invoice sits without anyone handling it in the workflow. Also, customers' AP department number of personnel and their expenses are not relevant information in terms of the functionality of the software. Thus, the needed information is not collected. Costs for Dooap usage is available, but it is not useful for understanding the overall picture of costs. From the benchmarking point of view, Dooap usage costs are equivalent with customers.

To develop any cost analysis related to invoice processing, Dooap would need to somehow have the cost related data. As an alternative, cost parameters could be inserted into Power

BI report as parameters, where one parameter could be the average user activity per processed invoice as percentage and the other could be a cost for user activity. Then average user activity and the corresponding cost could be projected to all invoices based on processing time. Defining user activity is more problematic since users might use time for invoice processing in other systems where activity might be intricate to track.

The cost analysis of invoice processing might also be beneficial for marketing purposes. If potential customers know their AP department costs as well as automation levels, providing a cost savings by automation report as a marketing material with realistic automation levels, they might be more trusting of Dooap’s benefits. A scenario of increasing automation levels as a possible benefit of Dooap could be generated from overall data of Dooap, based on multiple customers’ data that have similar invoice management structure as the potential customer. Then the existing customers’ automation levels could be projected to the potential customer’s levels.

Invoice processing log analytics could also be used to suggest automation solutions to already existing customers. Benchmarking helps to recognize what could be the most efficient way to process the invoices. The report could be drilled down to benchmark the exact steps of invoice processing and possibly provide automation suggestions on steps that bottleneck the process.

5.5.2 Technical improvement possibilities

Power BI service does not refresh datasets that include dynamic data sources. Power Query function that generates recurringly changing data source from a list of data sources is counted as a dynamic source. Therefore, the dataset and the report are only refreshable on a Power BI desktop version. One option is to transfer the report to a virtual machine where the report could be inspected and updated through the virtual machine. Another option is to build a query with another Extract, Transform and Load (ETL) tool other than Power Query, for example Python. Python connection to Power BI dataset would require Python installed to a local computer, which brings us to the same issue: Power BI report is not refreshable in Power BI Service without a connection to local computer.

Power BI can be connected to multiple Azure data services with a virtual network data gateway. A virtual network data gateway connects a Power BI dataset and a SQL server through Azure cloud and therefore connection to a local computer is not needed. However, a virtual network data gateway is a Power BI Premium feature. (Microsoft 2023a) In the future, ETL tools with connectivity through virtual network data gateway could be investigated to have an automatically up-to-date report.

Furthermore, if Average and Best Performer benchmark levels are shown to clients in Power BI service, the levels must be inserted into each tenant's database. That could be implemented for example with a combination of Power BI and Power Automate. Power Automate supports SQL database connection, and Power BI has an option to create a button that triggers Power Automate function. Building a Power Automate function that inserts the data points into each database would let the customers compare their own data against Average and Best Performer levels.

6 Conclusions

AP processes in organizations might be old fashioned and therefore benchmarking AP process metrics with other companies might be beneficial for improving processing standards. Accounts Payable automation is increasing through ML and RPA options. Automation solutions could provide process efficiency, cost reduction and business scalability.

This thesis researched Accounts Payable KPIs that could be measured in an Accounts Payable SaaS product – Dooap. Accounts Payable KPIs significance was inspected in terms of process efficiency and financial stability. The thesis focused on four KPIs: Days Payable Outstanding, invoice processing time, percentage of e-invoices and one-to-one correspondence. The KPIs were chosen based on expertise and practicality. The thesis also contained a contemplation of query execution and KPI calculation. Finally, KPIs were implemented into a Power BI report designed for benchmarking purposes for Dooap Inc.

The report was built in such a way that when new customers are acquired or old customers are given up, the report generates a list of currently active customers. This facilitates report maintenance and traceability. The report also includes an option to inspect KPIs in different time series which enables trend tracking. M-Queries and DAX calculations are universal and could possibly be built in other contexts with Power BI.

Each AP process should follow KPIs that serve the AP department’s objectives. KPIs researched in this thesis are universal and do not necessarily suit every invoice processing software, or every company’s or department’s objectives. KPIs implemented in this thesis’ benchmarking report are calculated from Dooap’s data and therefore the KPIs might be complicated to implement in other contexts. However, SaaS businesses in general measuring their customers’ processes and providing benchmarking options could improve customer satisfaction.

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