SAVONIA

THESIS – BACHELOR'S DEGREE PROGRAMME

TECHNOLOGY, COMMUNICATION AND TRANSPORT

PERFORMANCE REPORTING TOOLS, INTEGRABILITY AND INFORMATION FLOW

AUTHOR/S: Panu Jääskeläinen

SAVONIA UNIVERSITY OF APPLIED SCIENCES THESIS

Abstract

Field of Study Technology, Communication and Transport	
Degree Programme Degree Programme in Mechanical Engineering	
Author(s) Panu Jääskeläinen	
Title of Thesis Performance Reporting Tools, Integrability and Information Flow	
Date 23 May 2023	Pages/Appendices 32 pages
Client Organisation /Partners Iisalmen Teollisuuskylä Oy	

Abstract

Performance reporting tools are important tools to gather data. Companies need data to function in an ever-evolving field of data driven business management. The reporting software that companies use in the effort to gather data, can be a crucial and helpful tool, providing companies with the necessary data to create functional solutions. This thesis was a part of the TeknoHub-project, where the aim is to aid companies connected to the project in implementing or researching a business management related performance reporting tool. The eventual goal was to study and research about the performance reporting tools and how they are used or incorporated within a company. The data gathered for this thesis was gathered from background research and interviews conducted in the companies related to the TeknoHub-project. The thesis was commissioned by Iisalmen Teollisuuskylä Oy.

There is a wide range of performance reporting tools in the market, such as SkyPlanner, Power BI, Tableu, Qlik sense, Looker, and DOMO. Of these performance reporting tools, Business Intelligence tool, Power BI is used or researched in every company related with the TeknoHub-project. There had been some problems with the use of Power BI in one of the companies involved. The research came from the TeknoHub-project's main goals for the study were to research, learn and help the company in figuring out effective solutions to their data related issues from the management side off the company, with the aid of performance reporting tools. In the study it was mainly focused on working with one company related to the TeknoHub-project looking how to incorporate Power BI to their management team and aid in building a pilot version of the program they could use and build in the future.

Performance reporting tools are useful tools and in particular Power BI, can provide companies with the ability to take hold of the data that their company produces, using it to create intelligent decisions. The flexibility of Business Intelligence tools gives them a wide range of possibilities and can be a valuable tool for any company.

Keywords

Reporting tools, Business Intelligence, KPI, Power BI, Tableu, Qlik Sense, Looker, DOMO

CONTENTS

1 Introduction 5
1.1 Goals Of Thesis 8
1.2 Technical Information 8
1.3 Choosing Process 10
2 Business Intelligence Tools 11
2.1 Choosing The Right Business Intelligence Tool 11
2.2 Power Bi By Microsoft Inc. 12
2.3 Tableu Salesforce 14
2.4 Qlik Sense 15
2.5 Looker By Google 16
2.6 Domo 17
3 Teknohub - Project 19
3.1 General Information 19
3.2 Student Project 19
3.2.1 Company A 19
3.2.2 Company B 28
3.2.3 Company C 28
3.2.4 Company D 29
4 Conclusion 29
5 References 31

LIST OF FIGURES

Figure 1. Gartner Magic Quadrant for Analytics and Business Intelligence Platforms 7

Figure 2. Power BI's dashboard example. 13

Figure 3. Tableu's dashboard example. 14

Figure 4. Qlik Sense's dashboard example. 15

Figure 5. Looker's dashboard example 17

Figure 6. DOMO dashboard example 18

Figure 7. Page 1: Reported time Power BI dashboard. 20

Figure 9. Visualization tools and how data can be inserted. 21

Figure 10. Page 2: Reported time matrix. 22

Figure 11. Page 3: Planned and Reported Time. 23

Figure 12. Grouping values. 24

Figure 13. Page 4: Reported time weekly visualized. 25

Figure 14. Highlighted data point. 25

Figure 15. Filtered data point. 26

Figure 16. Relationship modelling in Power BI between the two data sources. 27

Figure 17. Relationship issue between two data sources. 27

1 Introduction

Performance reporting tools is the main topic of this thesis, with a vast number of various kinds of tools available in the market with vastly different kinds of tools and abilities to them. Basic tools like Excel, is the most used tool in the market, Excel is sold by Microsoft corporation and can easily fabricate sensible reports in its cellular format. Performance reporting tools may be used to follow a particular key performance indicator (KPI), such as Overall Equipment Efficiency (OEE), Value Added per Person (VAP), On Time Delivery (OTD), Parts Per Million (PPM). These few of many key performance indicators, are measured commonly within the companies related to the TeknoHub-project, for which this thesis was done. Key performance indicators can be used with different kinds of performance reporting tools, in general using data gathered from various equipment's production data or company's reporting data. Specialized performance reporting tools such as SkyPlanner are focused programs, whereas Business Intelligence tools can be used to monitor different aspects of the company. Business Intelligence tools may be used to follow the finances, the work floor, the machinery, or the personnel of a company.

The specialized performance reporting tools can be tailor-made for each company. Key performance indicator specific tools can be used for financial, machinery or management purposes. More commonly in company's managerial department Business Intelligence tools are used.[1] Key Performance Indicator specific tools, such as SkyPlanner made by Skycode Oy were performance reporting tools other than Business Intelligence tools, used by the companies related to the project. Key performance indicators are used to track and follow different aspects of the company's work, depending on what the company wants to gather data on. Depending on the needs of the company key performance indicators may be used to follow quality, customer service, shipping, or managerial data, that all can be summarized into key performance indicators. Performance reporting tools are not the end goal of business management, there must be a harmony found in the usage of all information gathering tools and other tools that are used by the companies. These tools should be communicating with each other and provide effective and important data gathering that can be utilized by the company.

Business Intelligence is an analysis and data driven choice making process, where data is taken into Business Intelligence programs where it can be visualized and managed.[2] Business intelligence tools take these different reports or data for example from Excel sheets or Enterprise Resource Planning (ERP) software and simplify the data in a quickly digestible format that can be used to monitor the

[1] Tavera Romero, Carlos Andrés, Jesús Hamilton Ortiz, Osamah Ibrahim Khalaf, Andrea Ríos Prado 2021. Business Intelligence: Business Evolution After Industry 4.0. Sustainability 2021, 13(18), 10026. https://doi.org/10.3390/su131810026 read 16.1.2023.

[2]Patrick LeBlanc, Jessica M. Moss, Dejan Sarka, Dustin Ryan, Dustin Ryan 2015. "Applied Microsoft Business Intelligence." John Wiley & Sons, Incorporated. Hoboken: New Jersey, USA

health of these key performance indicators'.[3] These Business Intelligence tools are working in a database format build up from Search Query Language (SQL) coding language. Search Query Language is the primary source code for Business Intelligence tools, its relational databases are used to create data relationships that are used for with most Business Intelligence tool data visualization dashboards[4]

TeknoHub-project had four companies primarily to work with, all with different situations regarding their business management processes. Three of the four companies had implemented Power BI in the past and have been using the tool to varying degrees of success and the goal for the student project was to help them develop the usage of this tool. The fourth company was considering Business Intelligence tools as a potential solution for their business management practices. The project with preliminary research and focus on thesis topic and aim. Company meetings was the primary goal for the research and providing help for the companies for developing or researching reporting tools this case. Following the company meetings one company had a problem, related to reporting tools and was looking to fix this issue with the aid of Power BI. Utilizing Power BI as a managerial tool was the main work done for this company.

Business Intelligence tool's is a growing market with different companies providing their own version of Business Intelligence tool that companies can usually buy with an implementation fee and a monthly subscription to their service. The monthly fee depends on the number of accounts the company pays for that have the control of the Business Intelligence tool. Data driven business management is a modern way of working and with it the number of tools available has risen too. The most popular tools in the market right now are Power BI by Microsoft, Tableu, Qlik Sense, Looker by Google. and Domo. The number of tools in the market is impossible to calculate, since it is an ever evolving field and new tailor-made tools are developed every year. The five mentioned earlier can be considered the leading brands in the field, with Power BI being the vast majority shareholder in the market. Gartner Inc. has been following the Business Intelligence field with a yearly review, with Power BI being the clear market leading tool since the 2000's. Gartner's 2022 report shows the most popular tools in use in the business management market.[5]

---

[3] https://www.domo.com/learn/article/how-data-connectors-modernize-business-intelligence © 2023 Domo, Inc. read 10.3.2023.

[4] Virve Prami, SQL and Relational Databases – CampusOnline Course, Metropolia UAS.

[5] https://www.cxtoday.com/data-analytics/gartner-magic-quadrant-for-analytics-and-business-intelligence-platforms-2022/, © Today Digital 2023 read 12.1.2023.

Figure 1. Gartner Magic Quadrant for Analytics and Business Intelligence Platforms[6]

The most basic of any performance reporting tool is the use of Microsoft Excel. The program is widely used, and its potential has rarely reached its peak in a company. Excel is a great way to spreadsheet company data, but the depth of Excel is far beyond that, such as macroing and data analysis. Macroing refers to the ability to create quick shortcuts to streamline a calculation process and can be fairly automized within the program. Excel has some visualization abilities, but these are nowhere near the visualizations Business Intelligence tools allow the user to create.

Business Intelligence market has been followed by a yearly review from the Gartner company's Magic Quadrant market research report. The report analyses the most used Business Intelligence tools and some of the newcomers on the scene. With many different tools and tool providers in the market, companies have wide array of alternatives to choose the best overall tool for their current management needs and requirements.

[6] 2022 Gartner Magic Quadrant for Analytics and Business Intelligence Platforms, https://info.microsoft.com/ww-landing-2022-gartner-mq-report-on-bi-and-analytics-platforms.html?LCID=EN-US read 16.1.2023.

1.1 Goals of Thesis

Researching performance reporting tools, it was learned about the vast selection of tools widely available in the market. Some companies do specialize on providing effective performance reporting tools to solve more focused problems. Whereas the more flexible tools like Business Intelligence tools are advertised by companies as a flexible solution that can envelope multitude of branches of a company. Business Intelligence and other performance reporting tools were at some cases already implemented in the companies visited during the TeknoHub-project. Performance reporting tools like SkyPlanner, were used by the companies to calculate and review one or two different key performance indicators within the companies work floor. Focusing on equipment overall efficiency or OEE, SkyPlanner for example keeps a log on the machinery in use on the work floor.[7] The program logs how long are the machinery idle, working or shut off. This data can provide a great understanding of the machines scheduled usage and how working practices could be improved on the work floor.

Performance reporting tools and Business Intelligence tools could be a key solution to some of the companies, such as Power BI. With the end goal to develop or aid in implementation of the tool to the companies in an effective and informative way. Background research into the various performance reporting tools, was done hopefully to provide a catalogue for the companies that they could utilize to choose the right tool for their problem. However, each of the companies had already researched Business Intelligence tools as a solution beforehand and were in various steps in using or implementing the tool.

The TeknoHub-project had a choice of three topics, this one interested me most, since of learning about Business Intelligence tools before as a method of utilizing data in a format previously foreign to me. TeknoHub-project aims to answer questions on performance reporting tools as follows:

What kinds of tools are there in the market and how are these performance reporting tools chosen as a solution to a problem company is facing?

How is information gained from performance reporting tools shared within a company?

How performance reporting tools get the data and how is it updated?

1.2 Technical Information

Business Intelligence tools are a visualization tool utilized in companies that need a way to analyse their data in a more succinct manner. Business Intelligence tools are built from using relation database models and usually use the ability to use search query language to help in updating and building relationships from the data.[8]

---

[7] https://skyplanner.ai/ai-features/ © Skycode Oy read 6.3.2023.

[8] https://www.stitchdata.com/resources/business-intelligence-tools/ © 2023 Talend, Inc. read. 18.1.2023

Relational Database is database model, where all the data is categorized and relationships between these categories can be created to form the basis of the relational database. Relational databases utilize search query language to utilize the relationships between the data. Relations between the attributer or "columns" of data are utilized by the usage of "keys", primary keys are the line of code that is referred to when the attribute is to be utilized. Foreign keys are "keys" in other attributes that refer to data in another attribute's primary key. From the relationship between primary and foreign key's Search query language coding language creates or manages the data.[9]

Search Query language or SQL is the coding that utilizes these relationships and creates queries or searches between the attributes to manage or create calculations from within the data and its relationships. This is the basis of relational database and the Search Query Language, that is utilized in Business Intelligence tools, the two can function from apart from each other, many Business Intelligence tools automate visualization with drag and drop features and thus will not require the need of learning basic Search Query Language knowledge. The two can function better when the user can create intelligent queries to the Business Intelligence tool and then the information provided is more precise and does not trust on the AI features in many of the Business Intelligence tools to create the necessary right relationships the user is looking for from the data.

Connectors refers to the possible sources from which a Business Intelligence tool can extract the data from. Most common connectors are Microsoft Excel and ERP systems used for reporting within companies. Connectors do not necessarily need to be from the same source, since within the system the Business Intelligence tool usually can create relationship from two different connectors such as from ERP data and Excel data. Logical relationships are created in the Business Intelligence tool that are then available to the users to use and create visualizations from the relationships between the data sources to provide the necessary outcome in form of measures or calculations. Business Intelligence tools can update the information given from each automatically or manually, the process of which varies a little bit depending on the different Business Intelligence tools that can be in use.[10]

Data Lake means the pool of raw data used by Business Intelligence tools, forming from both good and bad data within it.

Data warehouses are all the categorized or warehoused data provided to the Business Intelligence tool, compromised from mainly the good data gathered from data lakes.

Data Silos are groups of data with functioning relationships in between themselves, many data silos create the data warehouse.

---

[9] Virve Prami, SQL and Relational Databases – CampusOnline Course, Metropolia UAS.

[10] https://www.domo.com/learn/article/data-integration-in-business-intelligence © 2023 Domo, Inc. read 10.3.2023.

Data structure is the form of the data is, the format of the data can be later in within Business Intelligence tools.

1.3 Choosing Process

How are the right performance reporting tools chosen? The first step is always to identify the problem and start to think about what the solutions to the problem are. One such problem was faced in one company related with TeknoHub-project in the work floor. Problem was to find the key bottlenecks and work practices that affect quality and OTD (On Time Delivery). The solution was found from a performance reporting software called SkyPlanner, tracking the machinery usage and creating a trackable metric. The company was able to find solutions from work floor practices that greatly improved the efficiency of the workers by tuning their working habits.

Identifying the problems is always the first step in creating a solution, thinking about how and why a tool could be utilized in a purposefully manner. Creating a positive feedback loop that improves the company's health is always the goal, but there must be strategies and thought put ahead of time when finding solutions to a problem. Business Intelligence tools can be an effective way to visualize and analyse the data from a company and should be considered as a solution if the problem is data based. Performance reporting tools that include Business Intelligence tools are mostly used in data related issues, where the simple act of visualization of data can create insightful reasonings what the next steps could be to solve a problem.[11]

Business Intelligence tools creates what are called dashboards, visualization pages that can be modified to the required parameters and include all the necessary information required. There is no limit on how many of these dashboards can be made but they should be categorized to follow at most a few key performance indicators or aspects of the company each to keep the dashboard clean and easy to digest the information within it. Modern Business Intelligence tools function with Artificial Intelligence, to automate dashboarding and report sharing to each branch of the company, depending on the Business Intelligence tool provider and the user's requirements. Report creation and sharing can be automated and timed as needed, so that the needed reports are shared on time via e-mail or other processes depending on the users' requirements.

Data evaluation and performance reporting tool such as Business Intelligence tool research are a key aspect when choosing the right tool for the right data pool. Cloud based data storage is an effective manner to create a data warehouse, that Business Intelligence tools can effectively utilize but generally have some implementation hurdles when paired with cloud-based servers to function effectively. Less modernized versions of data storage such as on or off-site servers are still widely used. Physical servers still are a good solution to some companies be it from a lack of need for refreshing speed of cloud-based data storage or monetary benefit ratios being more in line with

[11] https://www.tableau.com/learn/articles/business-intelligence/choosing-bi-platforms read 18.2.2023.

server-based data warehousing.[12] Companies such as these still running the server-based data warehousing can still effectively utilize Business Intelligence tools and such Qlik Sense and Power BI for data visualization and data analytics.[13]

2 Business Intelligence Tools

2.1 Choosing the Right Business Intelligence Tool

With the large number of different Business Intelligence tool providers in the market it can be hard to choose the right tool. Business Intelligence tools have many similar qualities but vary in the tools that they provide. Connectors or the data that the company would provide to the tool being one of the more important factors. Many of the tools provide a vast quantity of available connectors to the customer, but there is in general an obvious bias with tools that provide their own versions of data collection systems, such as Microsoft's Excel and Azure functions with Power BI.[14] Company should always think what their data lake is like, how their data warehousing practices are in line with the Business Intelligence tool they are researching, how would they utilize the data visualization and data analysis of the Business Intelligence tool of which all should be considered before incorporating any Business Intelligence tool.[15]

Pricing models vary from each tool provider and depending on the package size the company requires and usually the number of users or accounts for the Business Intelligence tool. Pricing and monetary benefit calculations should be done beforehand for the best contenders when choosing the right Business Intelligence tool, as pricing models vary. Aside from the monthly pricing models, Business Intelligence tools bring implementation costs that always vary depending on the company's data practices.[16] These implementation costs can be much lower, if a company has data practices with the same provider as with Business Intelligence tools, when the company utilizes the same provider for example cloud services with Microsoft's Azure and Power BI or Salesforce and Tableu. Implementation however is never a quick process; it can take month's to properly incorporate each

---

[12] https://quickbi.io/miksi-erp-tai-crm-jarjestelman-integroiminen-suoraan-bi-tyokaluun-on-huono-idea/ © 2023 QuickBI read 18.1.2023.

[13] https://www.analytics8.com/blog/how-do-i-pick-the-right-business-intelligence-tool-for-my-business/ read 18.1.2023.

[14] https://powerbi.microsoft.com/en-gb/power-bi-and-azure/ © 2023 Microsoft read 21.2.2023.

[15] https://www.gartner.com/reviews/market/analytics-business-intelligence-platforms, © 2023 Gartner, Inc., read 12.1.2023.

[16] https://www.airops.com/blog/best-bi-tools-for-startups-how-to-choose-a-bi-tool © 2022 AirOps read 27.2.2023.

necessary data source and create a functioning database.[17] The costs varies with depending on the companies size, amount of data that is to be connected to the Business Intelligence tool and the programs that the company uses, for larger enterprises the costs can be as high as millions of euros, before a functioning platform is operational.

Business Intelligence tools are not the simplest software to use, it does not matter which provider a company chooses there will always be a learning curve for the workers to start using the tool effectively. The right training and commitment on learning any Business Intelligence tool will be needed for the ability to use the tool correctly. It may take around two weeks two or more fully understand the basics and some of the more advanced features of Power BI. Understanding that the tools utilized during the TeknoHub-project are mostly rudimentary and there is still need for more research and training to fully be able to utilize more advanced features of the tool. Measure or function building in Power BI is extremely in-depth tool that can be used to develop very personalized or specialized metrics. The learning period for Business Intelligence tools must be taken into consideration when choosing the Business Intelligence tool to use. Training courses are available for most companies to learn the basics of tools such as Power BI. Business Intelligence tools have active communities participating in teaching new users and developing insightful videos online usually free of charge, but it may be in the interest of companies to provide possibilities on online courses on Business Intelligence tools, for more professional training.

2.2 Power BI by Microsoft Inc.

Power BI can be considered the market leading software for many years now; it is the most widely used available tool in the market with good backing and availability. Another of Microsoft's popular tools Excel is the most used data gathering software. Power BI does not have an exclusive access to Excel however and all other Business Intelligence tools have available connectors to the excel sheet formats. Power BI's supporting software from Microsoft line of products is a good way to incorporate the product into the business management practices the company wants to modernize. Microsoft line products such as the Microsoft 365-line, such as Excel, Teams, Outlook, and PowerPoint. Microsoft 365-line can be used as a data tool, sharing or as a publishing tool with Teams, Outlook, and SharePoint.[18] Power BI can also quickly be used to create presentations with the aid of PowerPoint. Azure Microsoft's cloud service all are easily incorporated into Power BI to visualize and analyse data. Excel spreadsheets can easily be included into the Azure ERP system, where the data provided can then be automatically updated and processed.

[17] https://www.scnsoft.com/analytics/business-intelligence/implementation © 2023 ScienceSoft USA Corporation read 27.2.2023.

[18] https://powerbi.microsoft.com/en-gb/power-bi-and-microsoft/ © 2023 Microsoft read 21.2.2023.

Figure 2. Power BI's dashboard example.[19]

The primary advantage of Power BI is the backing behind it, large team in Microsoft and an active community solving each other's problems and discussions of the program. Power BI has a bit of a learning curve but can be quite intuitive to learn and it is a good program for people that are accustomed to spreadsheeting from programs such as Excel. Power BI also has the best pricing currently within the market leaders. The Power BI basic Pro monthly package starts at 10€ per users and 20€ per user for Power BI Premium.[20] Power BI Premium also offers the ability to access advanced AI for the use of the Premium users. The pricing being low is an asset to the software, though all Business Intelligence tools have implementation costs and require training to be used, the lower price from Microsoft's Power BI, is an attractive offer to any business that wants to implement data driven business management practices. Power BI also offers a full organization license with unlimited number of users for larger capacity needed by big companies. This bulk package is priced at 4995€ per month so it is only realistic to enterprises or concerns that have subsidiaries that can also utilize the tool for their inhouse business management.

Power BI has some disadvantages one of the more common problems is when working with large data pools, Power BI Pro package is known slowdown from the large amount of data.[21] Power BI is

[19] https://powerbi.microsoft.com/en-gb/what-is-power-bi/ © Microsoft 2023 read. 21.2.2023

[20] https://powerbi.microsoft.com/en-us/pricing/ © 2023 Microsoft read 21.2.2023.

[21] W. Stewart Thomas 2020, "Power BI: An Analytical view, Association of International Certified Professional Accountants", https://www.journalofaccountancy.com/issues/2020/mar/microsoft-power-bi-data-excel.html. read 19.1.2023.

best utilized with Excel, so companies using other spreadsheet programs may find some more hurdles using the program. Search Query Language-language knowledge is needed to fully utilize the program when creating personalized equations solving more in-depth data problems.

2.3 Tableu Salesforce

Tableu is American based company providing business management solutions, with their Tableu product line, from data management, analytics, and interactive data visualization.[22] Tableu primary focus is to provide smart Business Intelligence, data driven solutions to companies. Tableu is widely used in the United States as one of the primary markets leading Business Intelligence tools and has accrued over one million users with over 500 companies worldwide using the tool daily. In 2019 Salersforce Incorporated acquired Tableu. Salesforce providing cloud-based Customer Relationship Management or CRM, makes Tableu excellent choice to manage the data from companies using Salesforce CRM software.

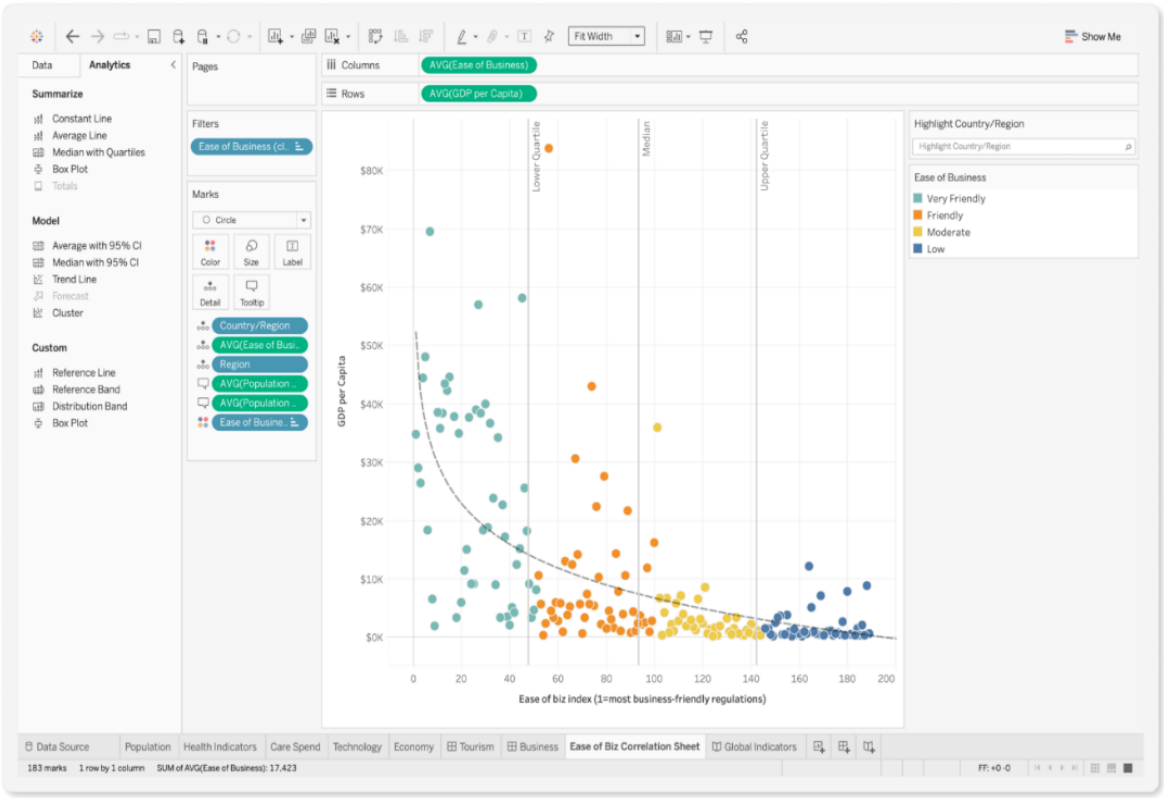


Figure 3. Tableu's dashboard example.[23]

With a comprehensive drag-and-drop features, Tableu has been noted as quick to learn by customers and as an effective tool in data analytics.

---

[22] https://www.tableau.com/why-tableau/what-is-tableau © 2003-2023 TABLEAU SOFTWARE read 18.1.2023.

[23] https://www.tableau.com/products/desktop © 2003-2023 TABLEAU SOFTWARE read 18.1.2023.

With a more expensive pricing ranging from 35€ to 70€ per user monthly, depending on the packet size, Tableu can be more expensive option, with however good benefits. The program does utilize a very well formed and operational mobile program. Tableu can be used with low Search Query Language coding experience, only with the more expensive package sizes require Search Query Language knowledge to fully utilize. The basic package is more than a friendly choice for beginners wishing to learn the of use Business Intelligence tools.

2.4 Qlik Sense

Qlik Sense is a Sweden based company started in 1993. They provide data problem solutions one of these forms is the Business Intelligence tool Qlik Sense.[24]

Qlik Sense is a sensible system that is scalable with other systems and flexible to work with an array of connectors. The system does not require Search Query Language coding knowledge to be utilized effectively. The program uses artificial intelligence to help the user build up clean and functioning visualizations.

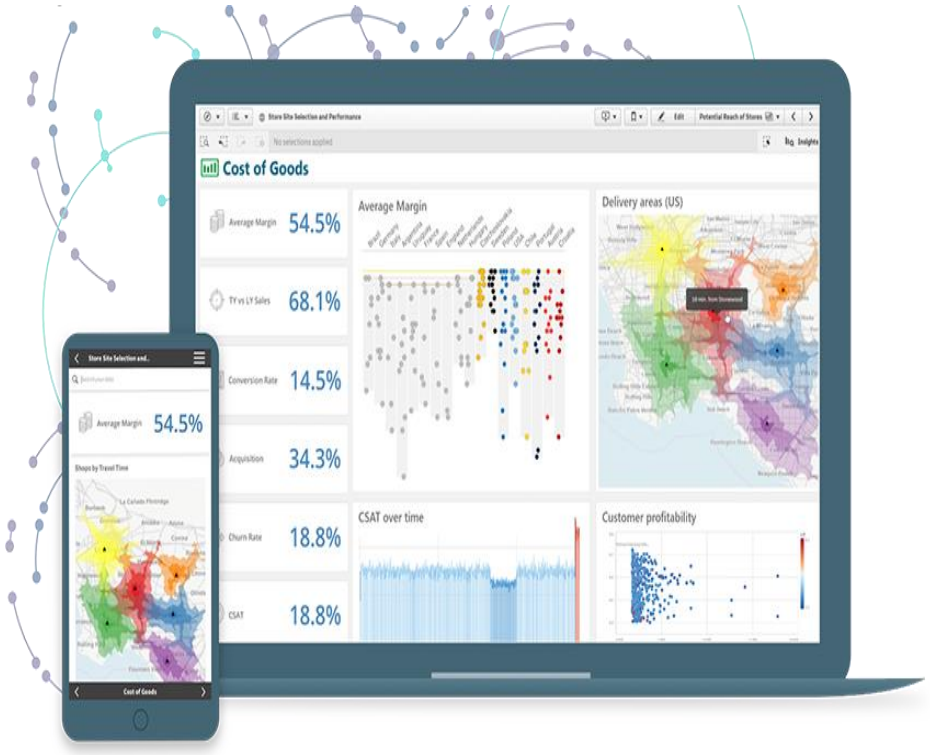


Figure 4. Qlik Sense's dashboard example.

Qlik Sense has mobile capabilities, and the program has AI function in aid of creating and learning form visualisations even in the basic price model.

[24] https://www.qlik.com/us/products/qlik-sense read © 1993–2023 QlikTech International AB read 24.2.2023.

Qlik Sense currently advertises two price models for the use of their program, 30€ per month or an enterprise-wide service that uses more tailored pricing.[25] Depending on the needs and requirements of the company Qlik Sense Enterprise SaaS, includes more functions compared to the basic model. More automation and machine learning are utilized compared to the basic model, to help larger enterprises manage their company in a sleeker manner, whereas the basic model has some Artificial Intelligence used in it, but it lacks the learning capabilities that can generate automated packets that the Enterprise model utilizes.

2.5 Looker by Google

Google LLC developed Looker is a favourite Business Intelligence tool used by individuals outside of work. It has a comprehensive program within its free plan, though the paid software gives access to more functions. The program is easily and well-integrated to other Google products and such has powerful information functions behind it.[26]
Looker utilizes its own brand of Search Query Language coding called LookerML.[27] Looker does require some understanding of Search Query Language to fully utilize, so that you can create comprehensive queries to the program, that create the correct data the user was looking for.
Pricing is tied to the company implementing the program, but the price is generally expected to be higher that of Power BI and around the same area that of Tableu and Qlik Sense. Companies using Google Cloud Platform, are generally pushed towards using Looker. BigQuery data warehousing software provided functions effectively with Looker. Good integration between other Google products is a sure way to quickly access and get hands on to the raw data provided from the company. Looker has exceptionally clean visualization models and

[25] https://www.qlik.com/us/pricing © 1993–2023 QlikTech International AB read 24.2.2023.

[26] https://cloud.google.com/looker © Google LLC. read 8.3.2023.

[27] https://cloud.google.com/looker#section-2 © Google LLC. read 8.3.2023.

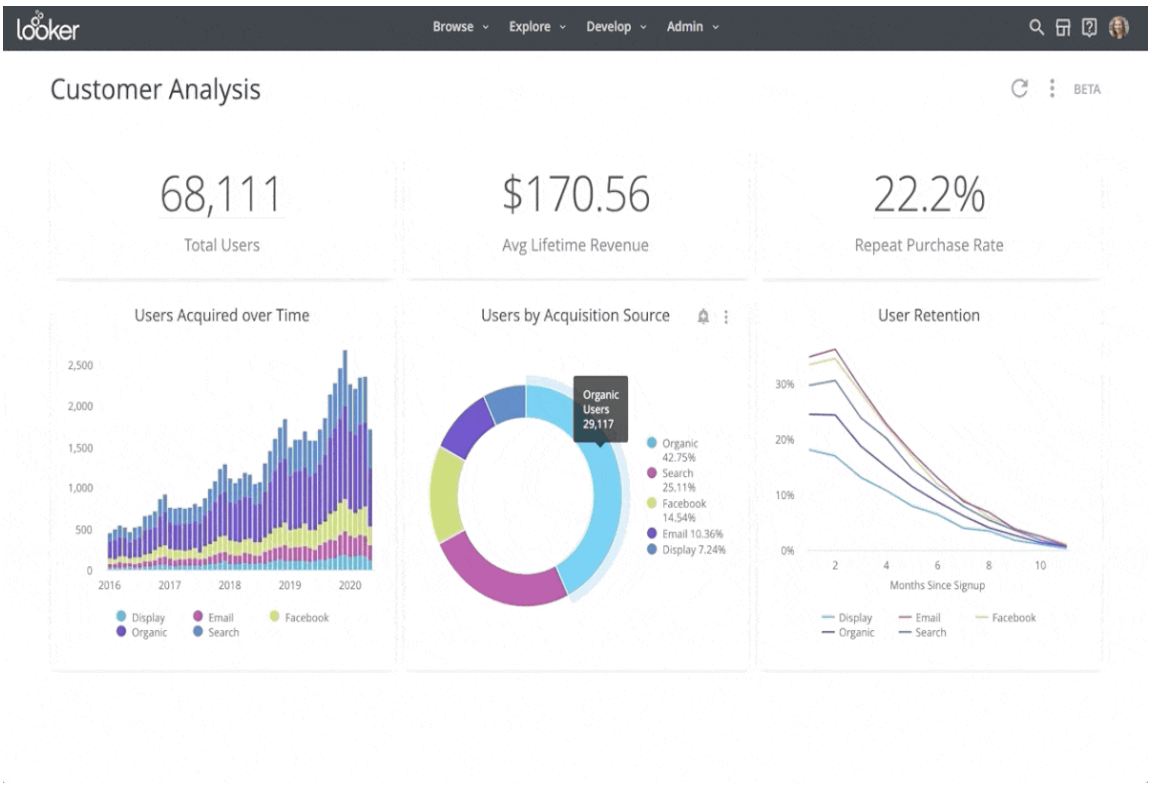


Figure 5. Looker's dashboard example[28]

2.6 DOMO

Founded in 2010 the SaaS company DOMO, provides a Business Intelligence solution. The American based company has its tools utilized by the likes of the National basketball Association (NBA) and the UNILEVER companies.[29]

DOMO aims with its program to provide a functional and easy to learn solution to companies and enterprises with data related issues. DOMO's Business Intelligence tool also has developed a mobile function to its catalogue.

[28] https://www.looker.com/product/visualizations/ © Google LLC 2023 read 8.3.2023.

[29] https://www.domo.com/company © 2023 Domo, Inc. read 10.3.2023.

Figure 6. DOMO dashboard example[30]

The dashboard of the program takes a more simplified version of Business Intelligence tools. Pricing generally ranges from company or enterprise size but generally $83 per month is the low end of the tool price. DOMO is more aimed towards companies and enterprises, but the tool has a free version, that can be utilized by individuals, though with less functionalities.

DOMO's Business Intelligence tool has connectors over thousand different pre-built in it. Real time metrics and self-aid in managing the system within a company.[31] Machine learning in the paid plan is utilized to help larger enterprises manage their systems. Embedded analytics within the tool gives the users abilities to share real-time data created reports with other users and customers.

[30] https://www.domo.com/business-intelligence/visualizations-and-dashboards © 2023 Domo, Inc. read 10.3.2023.

[31] https://www.domo.com/product-walkthrough/connecting-data © 2023 Domo, Inc. read 15.3.2023.

3 Teknohub - Project

3.1 General Information

TeknoHub Project partnered with Savonia and Iisalmen Teollisuuskylä Oy, aimed to provide student help in different aspects of business management practices. Three topics were chosen for three students, one of them was reporting tools and Business Intelligence. The aim was to provide information and aid to companies about the Business Intelligence tooling they could utilize in the future.

Four companies, two of which use Power BI and two are researching the topic as a possible answer for different problems faced with reporting. Business intelligence tools were underutilized in some of the companies, and some were researching of the possibilities of Business Intelligence tools. Each of the company cases differed with the aid that the students were able to provide and the different situations that the companies were in. Business Intelligence tools are not a quick fit all fix to all problems, they require training and comprehensive thought to be used effectively.

3.2 Student Project

3.2.1 Company A

The company thinks to use Power BI as a potential solution for nowadays' fragmented data management. In the present thesis an example dashboard was provided for the company as a baseline that the company may be able to use. Regarding data with vast amount of information that is quite hard to read on its own, Power BI may provide a solution from gathering and compiling relevant data from the Excel sheets.

The work started by learning how to use and create effective visualizations within Power BI. Then the company shared with falsified data from the company for the thesis work. Microsoft provides a good comprehensive guide for their tool at their website, that was the first steppingstone in learning how to use the tool.[32]

The Power BI usage within the company was still in early stages, but in the future the company is hopeful to implement it. Specialized key performance indicators or measures within Power BI were built to visualize analytical data from two sheets of Excel. The measures were visualized so that the data extracted was useful and helpful to the company. Data was visualized in different ways and with the input of the company, the best solution to their requirements was created.

The company wanted to have answers to a few questions with parameters to answer to from the data that could be utilized to manage the company with. Building the dashboard started with figuring out the best possible visualization tools that could be used. Power BI offers various tools for this

[32] https://learn.microsoft.com/en-us/training/powerplatform/power-bi?WT.mc_id=powerbi_landingpage-marketing-page © 2023 Microsoft read 24.2.2023.

ranging from simple bar charts to creating interactive metrics and reports. The goal was to create quick to read visuals from the large pool of data that was given. The company was used to using Excel as their main source of spreadsheeting information from the day-to-day basis operations.

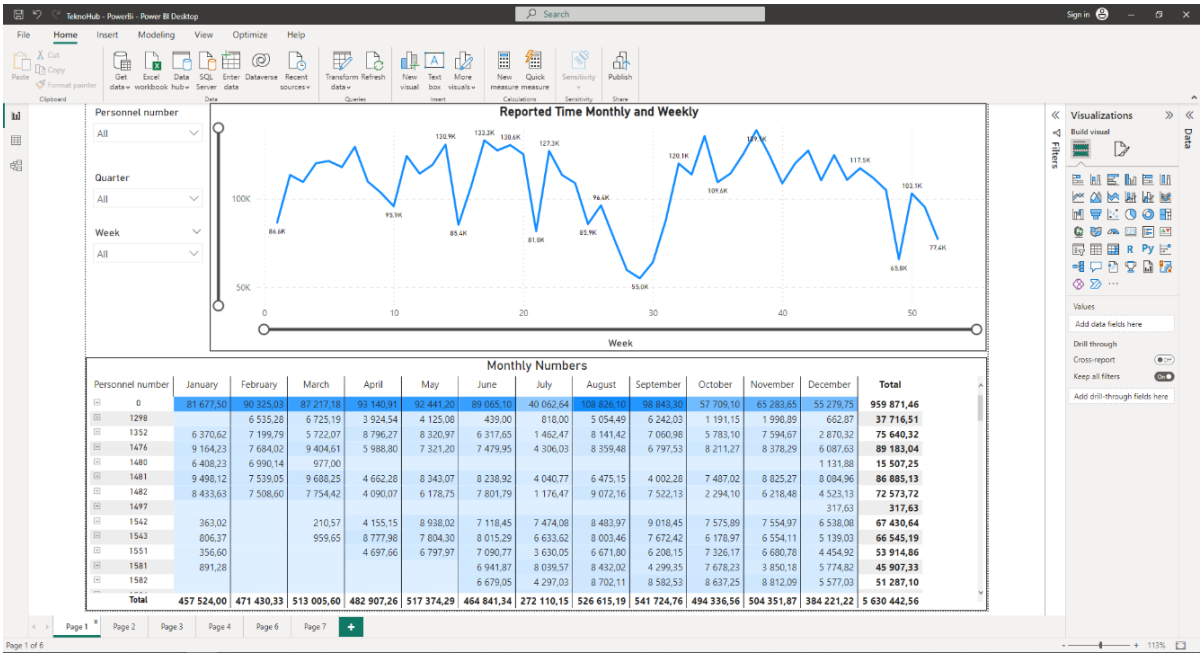


Figure 7. Page 1: Reported time Power BI dashboard.

As pictured in Figure 7, the aim of the first dashboard was to simply visualize the reported time data used within the company. The matrix visualization tool in the bottom was used to give more accurate numbers. Graphs as pictured above are a more digestible format so they were added to see the overall accrued time, this can be however changed depending on the filtering. Filtering is not necessary for all visualizations, since graphs for example use drill down and up feature, that does not require filters set up if the desired times are added from the data's date hierarchy. Filters were added to the top left corner which can be used to display more accurate information, the choices being by personnel number, quarterly reported time, or weekly reported time.

Power BI does not offer the option to straight filter the information given by the week, rather than daily, monthly, quarterly, and yearly basis. The idea was that weekly may be a good information to add. Weekly time is less information than daily so over cluttering the dashboard could be avoided. Weekly reported time is also more informative than monthly quarterly or yearly basis, while avoiding excessive information and too large pool of data. Since Power BI does not offer the option automatically, research was to be done of a way to add this. Research is essential in Power BI if the user wants to create accurate and informative visualizations to the user's liking, thankfully Power BI has

an active and large community of users, [33] so solution was found. The data is gathered from Microsoft's Excel program, and there creating a calculation that gives the data weekly dates is possible. Using the ISOWEEKNUM function in Excel and adding a new column in the Excel sheet calculated the week number for each data point was created. Same calculation can be done inside Power BI as well, by creating a new measure and using the WEEKNUM function within the program. Utilizing SQL coding to an effective manner has a learning curve and having a functional solution in the Excel file there was no reason to change Excel function to Power BI measure.

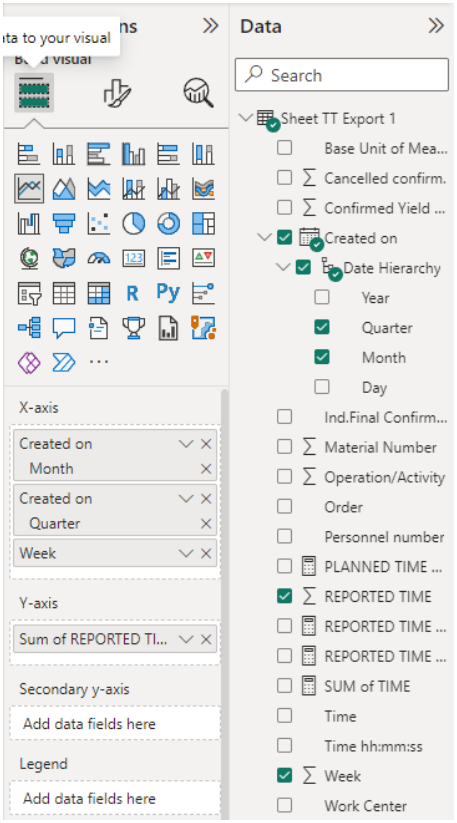
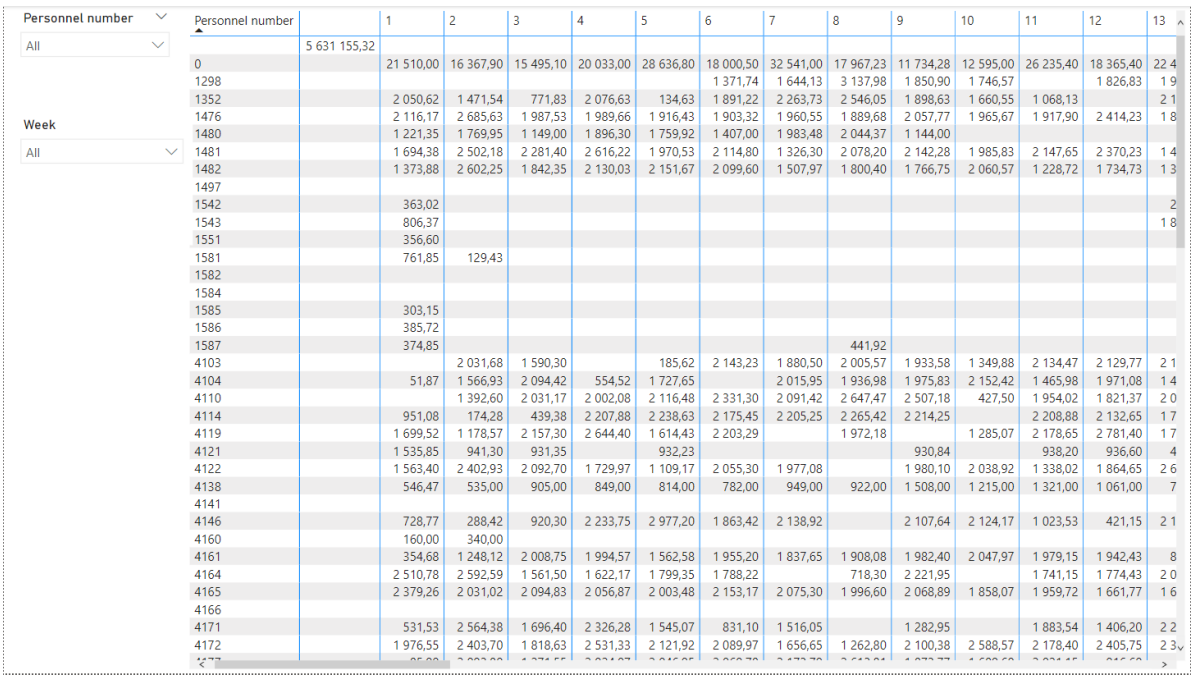


Figure 8. Visualization tools and how data can be inserted.

As pictured in Figure 8, Power BI provides multiple different tools, but the interface can get cluttered as more data sets are sourced.

Creating the visual is simple after choosing the visualization tools to be used. Drag and drop features in Power BI makes it easy for the user to fill out the dashboard with the necessary information, but when unhappy with the results playing around with the different options given in the program to create the desired visualization. Since tools within a dashboard are linked in Power BI all the filtering applies to both visualizations, this helpful feature eases the digesting of information quickly, rather than painstakingly filtering each visualization one by one.

[33] https://community.powerbi.com © 2023 Microsoft read 29.3.2023.



Personnel number		1	2	3	4	5	6	7	8	9	10	11	12	13
	5 631 155,32													
0		21 510,00	16 367,90	15 495,10	20 033,00	28 636,80	18 000,50	32 541,00	17 967,23	11 734,28	12 595,00	26 235,40	18 365,40	22 4
1298							1 371,74	1 644,13	3 137,98	1 850,90	1 746,57		1 826,83	1 9
1352		2 050,62	1 471,54	771,83	2 076,63	134,63	1 891,22	2 263,73	2 546,05	1 898,63	1 660,55	1 068,13		2 1
1476		2 116,17	2 685,63	1 987,53	1 989,66	1 916,43	1 903,32	1 960,55	1 889,68	2 057,77	1 965,67	1 917,90	2 414,23	1 8
1480		1 221,35	1 769,95	1 149,00	1 896,30	1 759,92	1 407,00	1 983,48	2 044,37	1 144,00				
1481		1 694,38	2 502,18	2 281,40	2 616,22	1 970,53	2 114,80	1 326,30	2 078,20	2 142,28	1 985,83	2 147,65	2 370,23	1 4
1482		1 373,88	2 602,25	1 842,35	2 130,03	2 151,67	2 099,60	1 507,97	1 800,40	1 766,75	2 060,57	1 228,72	1 734,73	1 3
1497														
1542		363,02												2
1543		806,37												1 8
1551		356,60												
1581		761,85	129,43											
1582														
1584														
1585		303,15												
1586		385,72												
1587		374,85							441,92					
4103			2 031,68	1 590,30		185,62	2 143,23	1 880,50	2 005,57	1 933,58	1 349,88	2 134,47	2 129,77	2 1
4104		51,87	1 566,93	2 094,42	554,52	1 727,65		2 015,95	1 936,98	1 975,83	2 152,42	1 465,98	1 971,08	1 4
4110			1 392,60	2 031,17	2 002,08	2 116,48	2 331,30	2 091,42	2 647,47	2 507,18	427,50	1 954,02	1 821,37	2 0
4114		951,08	174,28	439,38	2 207,88	2 238,63	2 175,45	2 205,25	2 265,42	2 214,25		2 208,88	2 132,65	1 7
4119		1 699,52	1 178,57	2 157,30	2 644,40	1 614,43	2 203,29		1 972,18		1 285,07	2 178,65	2 781,40	1 7
4121		1 535,85	941,30	931,35		932,23				930,84		938,20	936,60	4
4122		1 563,40	2 402,93	2 092,70	1 729,97	1 109,17	2 055,30	1 977,08		1 980,10	2 038,92	1 338,02	1 864,65	2 6
4138		546,47	535,00	905,00	849,00	814,00	782,00	949,00	922,00	1 508,00	1 215,00	1 321,00	1 061,00	7
4141														
4146		728,77	288,42	920,30	2 233,75	2 977,20	1 863,42	2 138,92		2 107,64	2 124,17	1 023,53	421,15	2 1
4160		160,00	340,00											
4161		354,68	1 248,12	2 008,75	1 994,57	1 562,58	1 955,20	1 837,65	1 908,08	1 982,40	2 047,97	1 979,15	1 942,43	8
4164		2 510,78	2 592,59	1 561,50	1 622,17	1 799,35	1 788,22		718,30	2 221,95		1 741,15	1 774,43	2 0
4165		2 379,26	2 031,02	2 094,83	2 056,87	2 003,48	2 153,17	2 075,30	1 996,60	2 068,89	1 858,07	1 959,72	1 661,77	1 6
4166														
4171		531,53	2 564,38	1 696,40	2 326,28	1 545,07	831,10	1 516,05		1 282,95		1 883,54	1 406,20	2 2
4172		1 976,55	2 403,70	1 818,63	2 531,33	2 121,92	2 089,97	1 656,65	1 262,80	2 100,38	2 588,57	2 178,40	2 405,75	2 3

Figure 9. Page 2: Reported time matrix.

As pictured in Figure 9, the second dashboard's goal was to include more accurate filtering, if the company desired more in-depth information for each personnel number. The visualization aspect of the second dashboard is not succinct to look at, but it being necessary in the end for the company to have the ability to access accurate information on a particular personnel number level.

The third dashboard had different parameters to use, switching from personnel to work center related time. Comparing the reported to the planned time for each order, the visualization's aim was to measure the performance of each workstation compared to the planned time. Feature added next was the ability to filter the information also by the work done by one personnel for each workstation.

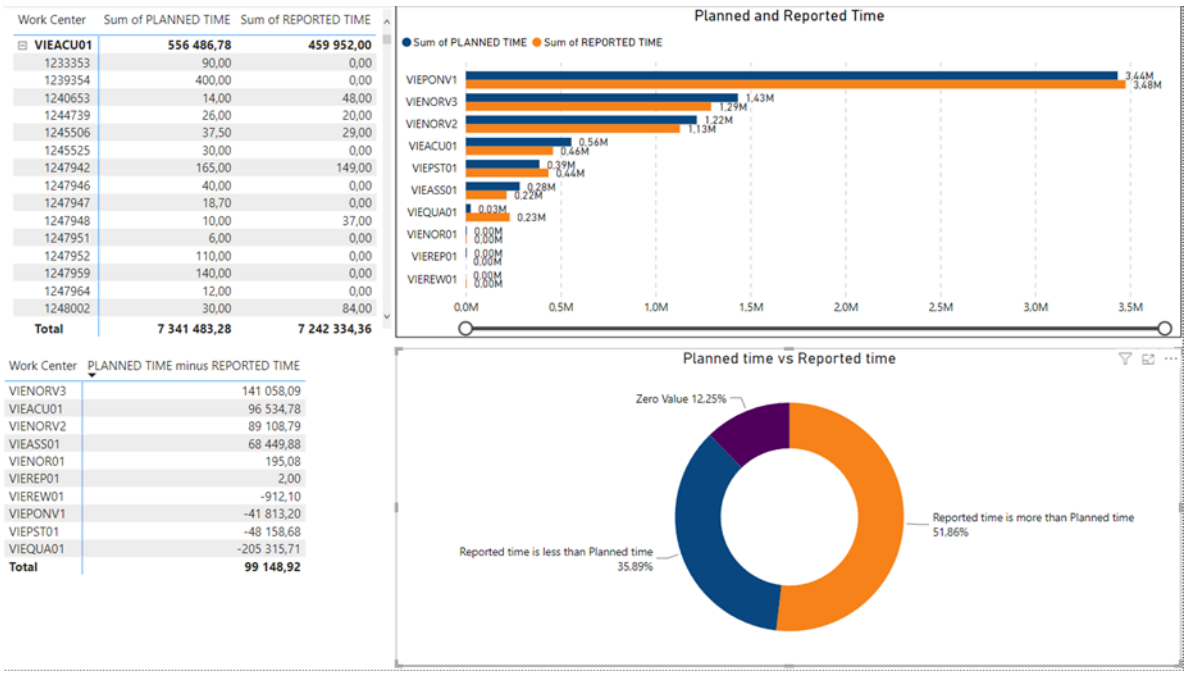


Figure 10. Page 3: Planned and Reported Time.

Bar charts as shown in Figure 10, were used to visualize the gap between the reported and planned time and adding a zoom slider on the bottom so the smaller work centers' reports could also be featured by zooming into their range or using the filter feature on the graph itself.

Donut chart pictured in Figure 10 on the bottom, was added to visualize the percentages in between each work centers' reports. Creating a new problem, since zero value or work not done yet, was included in the falsified data, the chart would portray bad data. Wanting to portray accurate information, but since the data included errors, goal was to learn on how to create accurate percentages of the reported, planned times and zero values from the data.

Power BI does not automatically calculate the data for the user, therefore best course of action was to group the information reported in the data. Grouping the information gives you the ability to simply create as many groups as needed for the user, in this case three was enough. Three groups one composing from the positive values, negative values and null or zero values. Choosing to do this in Excel format again, not necessarily needing to research about necessary coding needed to create the required measure within Power BI.

Understanding how the data was formed and how it could be utilized required reading and studying the raw data pool, from which starting to format the necessary steps needed to visualize the data in an informative manner. Creating a simple subtraction to a new column was a solution to the problem. This new column would create a new data point in Power BI that could be used utilize to group and sort the data in the desired manner. Positive data being reported time being under the planned time and negative being the opposite.

The data now was composed of three different values: positive, negative and zero values. Creating three groups for each of the values and including each single point of value that was positive to the positive, negative to negative and zero to zero group. Grouped data can be used to create the percentages of each group compared to the full data set. This grouping was used to create the donut

chart to visualize the overall health of the working practices. Since the data is not real and has issues, the data is not truly accurate, as such some errors can be found in the data itself which reflects on graphs such as this. The overall goal of the work was to portray the data in a meaningful way, so no steps were taken to start modifying or fixing the data points themselves in any way to create more artificially comprehensive results for the company.

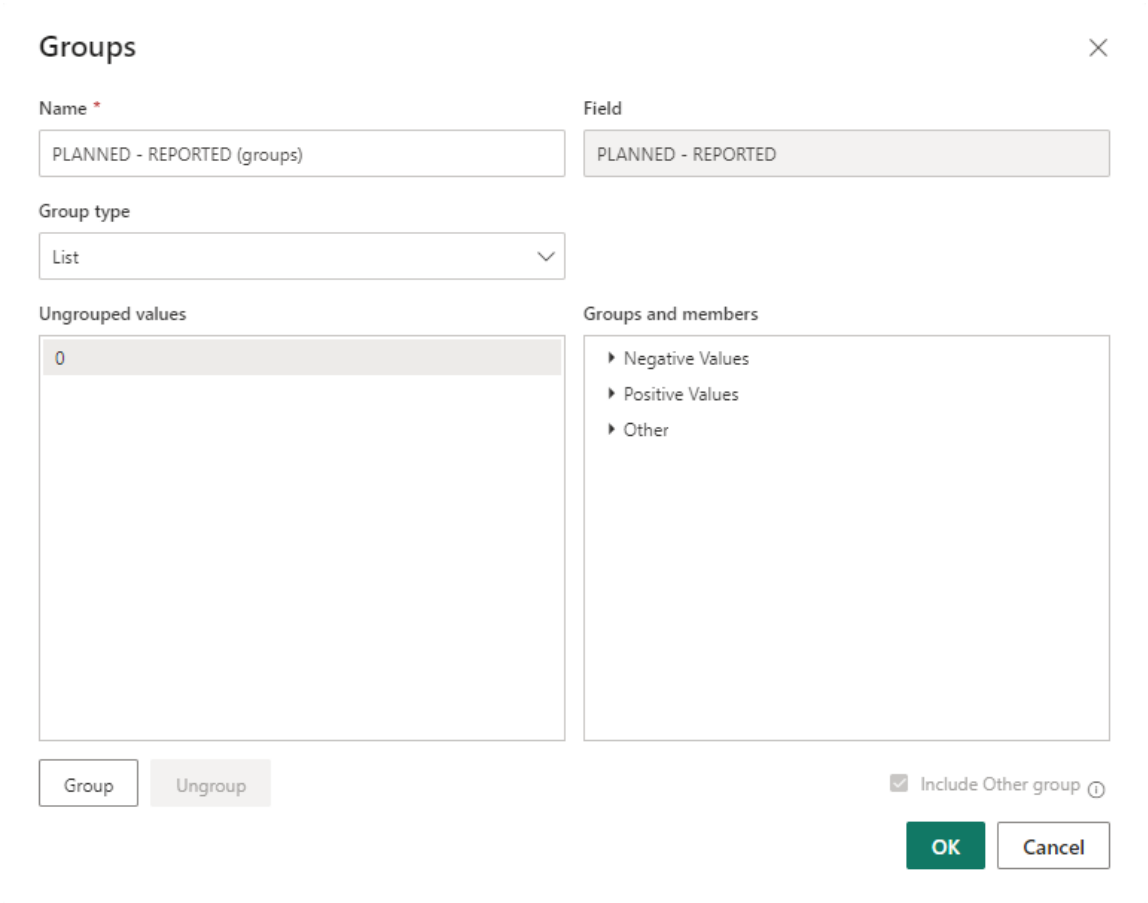


Figure 11. Grouping values.

As pictured in Figure 11, the groups are formed from each negative value and positive value, not yet having grouped the zero value. Grouping data set can be arduous when working with thousands of data points, but shift clicking from the lowest value to the highest value was the fastest way to group the values as needed. The grouped values disappear from the ungrouped values, making grouping easier as you continue creating more groups.

The fourth page was used to visualize reported time of each personnel number on a weekly basis and the reported time each personnel number had done to each of the work centers.

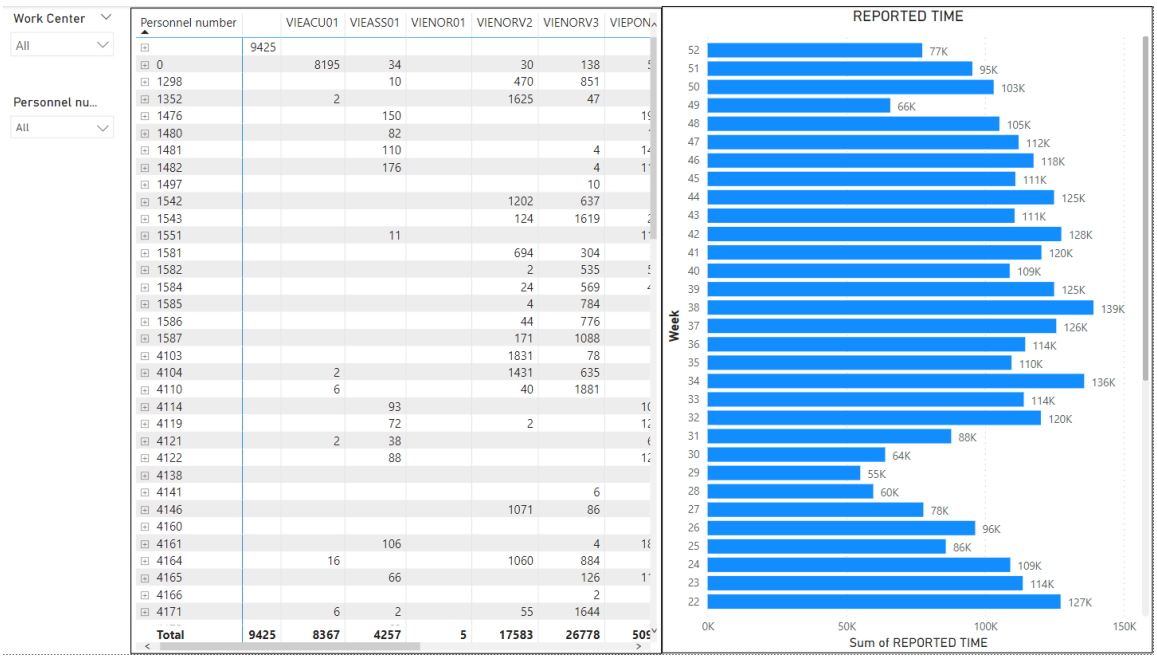


Figure 12. Page 4: Reported time weekly visualized.

As pictured in Figure 12, this was to show how each personnel number divides their time with each of the work centers and the weekly reported time, with an added filter by the order. Depending on how the data is filtered the graph functions in different ways, whether you are simply highlighting a data point as pictured in Figure 13 or filtering out other data.

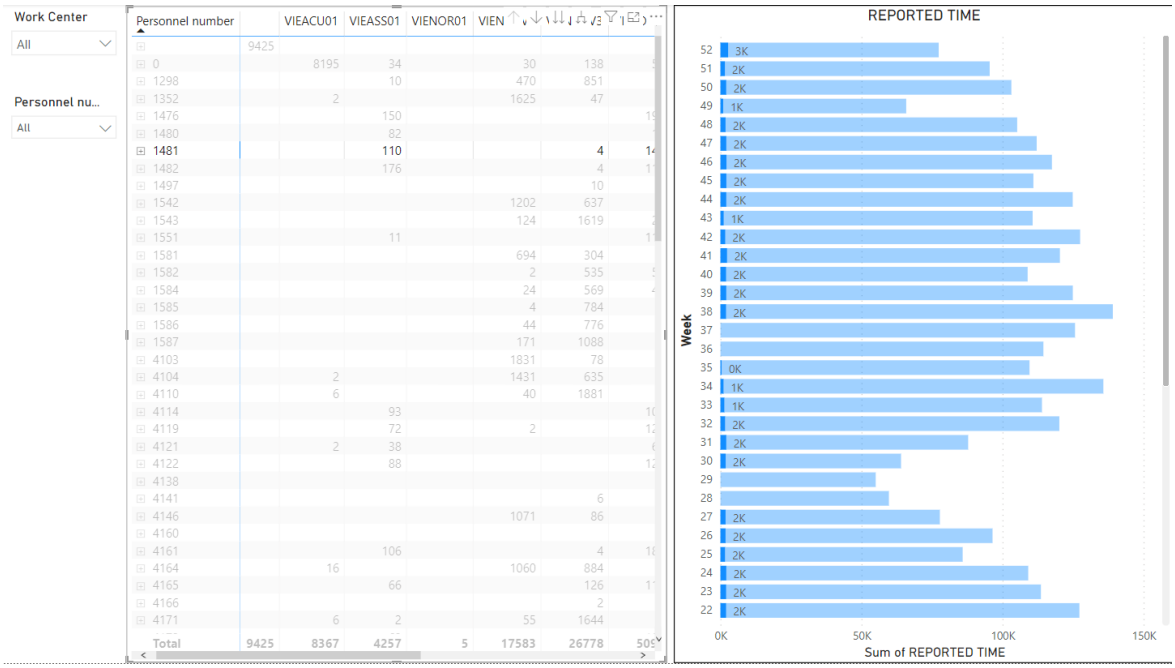


Figure 13. Highlighted data point.

Figure 14. Filtered data point.

As pictured in Figure 14, filtered data as pictured above point gives much more in-depth information of the chosen data set and changes the bar chart to solely portray the information of the filtered data. Simple highlighting can give you an overall performance information compared to the whole data set. Filtering tool can be used for as many data points as the user deems necessary, but it is always a good choice to keep dashboards less cluttered as possible. In a case such as this adding more filters for each order and week was an option but choosing not to since these filters would list every single row of data from the Excel spreadsheets. This would make a filter menu featuring thousands of choices in the filter for orders and 52 for the weeks. Adding the necessary filters was always the last step that was added to finish a dashboard.

The last two were used for problem solving, so being unintuitive and used to solely highlight the issues that had come across with the relationships between the two data sources. Visualizing data from the two sources there was problem that information was not shared accurately between the work center and the personnel number data sets. Trying to create a dashboard applying the planned minus reported measure from page three for each personnel using the relationships between the two data sources.

This created a table that featured each personnel number, "work center" and the "planned", "reported" and "planned – reported data". This was the key to figuring out one the problem with the relational database models, inflexibility of the data model. The basic idea of a relational database model creates a static structure for the data, which can create issues with the relationships between data.

The main issue with this company's case is, that creating a more functional database with the two data sources, the data would require the modification of the data sources. The main goal being fixing the data problem within Power BI. The data source issue being that in the relationship between the two data sources share one column type "Work Centre", this creating a primary and foreign key between the two sources. Both sources have unique data within themselves, and the database

model could not create the necessary relationships in the data. Therefore, Power BI takes the data it knows and gives the work centre related data to each personal number, since it cannot create the relationship between "planned time", "reported time", "work centre" from Excel source two and "personnel number" from Excel source one.

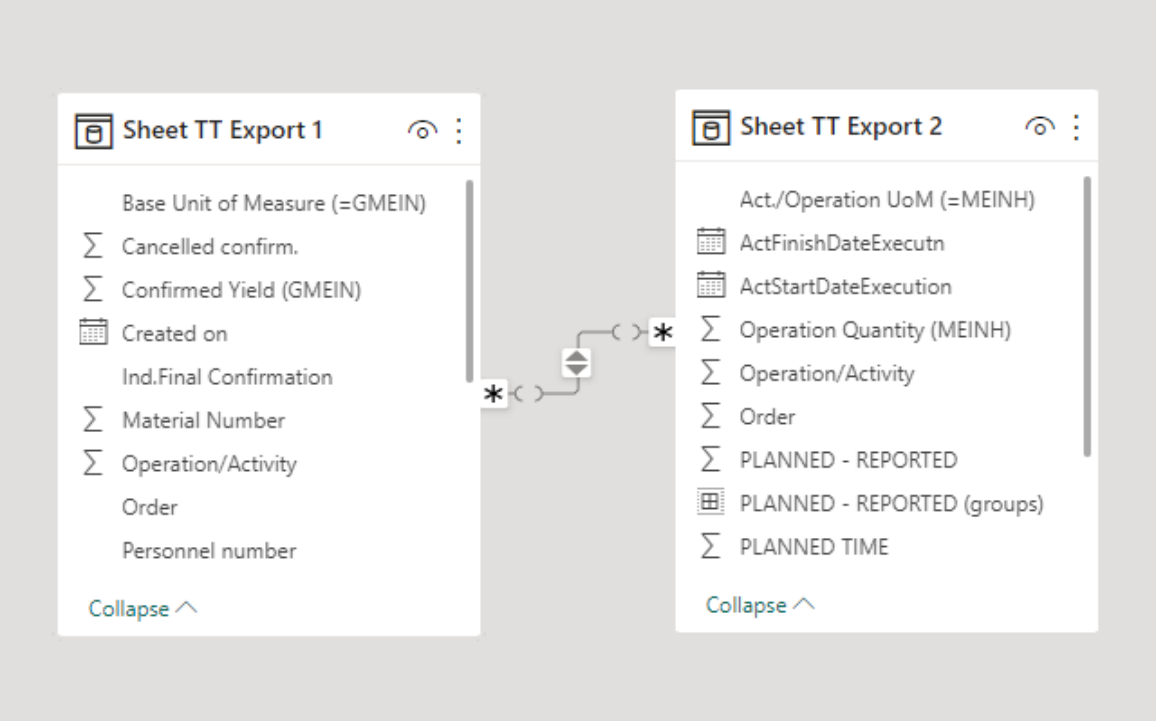
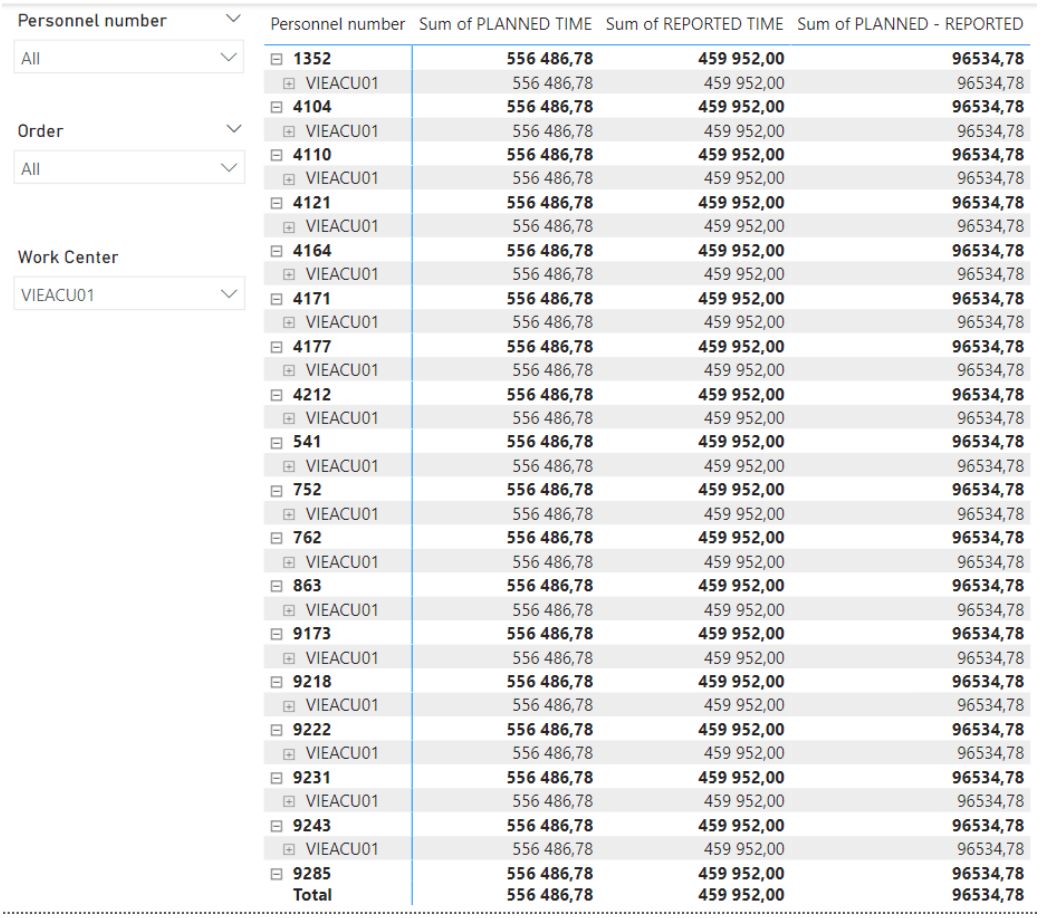


Figure 15. Relationship modelling in Power BI between the two data sources.



Personnel number	Sum of PLANNED TIME	Sum of REPORTED TIME	Sum of PLANNED - REPORTED
1352	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4104	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4110	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4121	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4164	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4171	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4177	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
4212	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
541	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
752	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
762	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
863	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
9173	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
9218	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
9222	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
9231	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
9243	**556 486,78**	**459 952,00**	**96534,78**
VIEACU01	556 486,78	459 952,00	96534,78
9285	**556 486,78**	**459 952,00**	**96534,78**
Total	**556 486,78**	**459 952,00**	**96534,78**

Figure 16. Relationship issue between two data sources.

As shown in Figure 15, the relationship type within these two sources was Many-to-Many, meaning that there should be many realised relationships created from the data sources between the two Excel files. Research and testing yielded no solutions to the problem, because of the underlying issues. The solution suggested to the company was to remodel the layout of the two data sources themselves to better suit the relational database model that Power BI utilizes. Stemming more from the lack of knowledge about the relational databases, taking part of a learning course on relational databases and Search Query Language was required to shed light on the situation between data problems.

Conveying the problems and solutions to the company, feedback was positive. The company was happy with the dashboards and visualization choices, with the understanding that some issues with fragmented data sources from Excel was not solved with the aid of Power BI. Conveying the idea that data source remodelling or modifications were needed to solve their problems at the base level, on which to build from a functional and effective relational database, would be a solution to their problems before implementing Power BI.

3.2.2 Company B

The company has Power BI in use and hoping to expand its current usage with a new project. The project regards to creating a visual dashboard for six teams in the work floor. The six teams operate machinery in different aspects of the production. One team focusing on grinding, four different teams working with different lathing processes and a logistics team. These six teams would have access reading key performance indicators' regarding their team (PPM, OEE, OTD, VAP, efficiency). One account in Power BI with six different dashboards creating one each for each the teams to follow and track the team's performance on the work floor.

The management team's idea was to create an active team utilizing data driven decisions on the work floor, from which the teams would have more control over their daily actions. The goal of having more informative, responsible workers and lessen the burden of information sharing within the chain of command, for more streamlined production floor practices. The project within the company was in the very early stages and as such, aid provided was very minimal with basic research points given to the company.

3.2.3 Company C

The company is researching Power BI as a potential solution for management team. Not sure if Business Intelligence tools can provide enough solutions to cover its costs. The company utilized a specialized OEE software SkyPlanner, that tracks the machine usage percentages. The management team is quite comfortable with their Excel sheet formatting and SkyPlanner setup, that they deemed easy to use. Adding brand new performance reporting tools, such as Power BI was seen to be just an added cost for them without providing any sufficient help for the company. The data form in the

company was seen to be in a digestible format, which did not require tuning, though basic information about performance reporting tools was given to the company, but they were content on their current system of data management and informational reporting.

3.2.4 Company D

The company used a five-member management team using Power BI for business management, some potential changes with current Power BI usage. The information used in Power BI by the company was sourced from multiple Excel spreadsheets. In the company meetings discussions of combining the data sources create a more functional database model was discussed.

4 Conclusion

The project offered a good chance to work in the field as a business management side of mechanical engineering, though with some time constraints that became a problem early on. The vast array of reporting tools available to the public and private users is impressive. Tailor made tools that track one key performance indicator such as OEE with SkyPlanner, can be as or more important to companies than the larger manufacturing management tools such as Power BI and other Business Intelligence tools. The companies had procured or installed one form or another of performance reporting tools already and were looking for a more management-based solutions to their problems. Power BI was their primary source of solution to each of the company's problems and suggestions of looking into the other Business Intelligence tools available were mostly not investigated, as Power BI is the current market leader and it most available tool to incorporate to a business. Other Business Intelligence tools could function as a better fit for some of these companies, but the benefits of Power BI can be seen to outweigh the negatives of implementing a Business Intelligence tool the company may have never heard of beforehand. Microsoft's provided BI solution is widely available and utilizes same functionality as other programs in its repertoire. Microsoft has the largest customer support chain, being widely available all over the world and as such has the best support compared to the other Business Intelligence tools available.

The usage of Business Intelligence tools is never a solution in its own, there is training to do and there must be an understanding behind what the company requires from the tool results wise. The company must have a clear distinction of what information the Business Intelligence tool is gathering, where it comes from and how it is presented via the tool to the end user. The information source is key in providing good data, as bad data exists, there is no use to process and visualize data, which's source is a bad one and you end up with useless visualization. On the other hand, if there is a lack of refinement with the data that is used, the visualization may lack the key factors that the user was looking for. Badly refined, but beautifully visualized data can be taken as it is, where the information it provides is not accurate enough to provide useful insights and rather functions as a useless but pretty to look at measure.

Other than Business Intelligence tools, the many specialized programs and Artificial Intelligence tools used in production, management, or sales side of a business to track company health such as SkyPlanner, used to follow OEE, are very narrow fielded, but effective in solving the specialized

problem. These tools can be an expensive solution to a problem but given time the best solution. Business Intelligence tools can be used to support performance reporting tools, but it is never a given that the tailor-made programs can communicate or function with other programs, such as Business Intelligence tools effortlessly. Communication and compatibility with different programs must be considered when introducing new programs within any aspect of the company.

Properly functioning software can be incredible in boosting the productivity of individuals or the company but only when they are properly utilized and implemented. Tools such as these can aid management team create data driven choices managing the workforce, visualizing financials or find faults in the production line or team. Data driven management choices can be very intelligent and a very effective tool in today's working life, that should not be ignored for the hardships that the implementation and the learning process may have. Operational Business Intelligence tool dashboards require practice and fine tuning, but with enough effort and understanding of the data that is sourced, the help they provide can be essential to a business.

5 References

Tavera Romero, Carlos Andrés, Jesús Hamilton Ortiz, Osamah Ibrahim Khalaf, Andrea Ríos Prado 2021. Business Intelligence: Business Evolution After Industry 4.0. Sustainability 2021, 13(18), 10026. https://doi.org/10.3390/su131810026 read 16.1.2023.

Patrick LeBlanc, Jessica M. Moss, Dejan Sarka, Dustin Ryan, Dustin Ryan 2015. "Applied Microsoft Busi-ness Intelligence." John Wiley & Sons, Incorporated. Hoboken: New Jersey, USA read 16.1.2023.

https://www.domo.com/learn/article/how-data-connectors-modernize-business-intelligence © 2023 Domo, Inc. read 10.3.2023.

Virve Prami, SQL and Relational Databases – CampusOnline Course, Metropolia UAS.

https://www.cxtoday.com/data-analytics/gartner-magic-quadrant-for-analytics-and-business-intelligence-platforms-2022/, © Today Digital 2023 read 12.1.2023.

2022 Gartner Magic Quadrant for Analytics and Business Intelligence Platforms, https://info.microsoft.com/ww-landing-2022-gartner-mq-report-on-bi-and-analytics-platforms.html?LCID=EN-US © Microsoft 2023 read 20.1.2023.

https://skyplanner.ai/ai-features/ © Skycode Oy read 6.3.2023.

https://www.stitchdata.com/resources/business-intelligence-tools/ © 2023 Talend, Inc. read. 18.1.2023

https://www.domo.com/learn/article/data-integration-in-business-intelligence © 2023 Domo, Inc. read 10.3.2023.

https://www.tableau.com/learn/articles/business-intelligence/choosing-bi-platforms read 18.2.2023.

https://quickbi.io/miksi-erp-tai-crm-jarjestelman-integroiminen-suoraan-bi-tyokaluun-on-huono-idea/ © 2023 QuickBI read 18.1.2023.

https://www.analytics8.com/blog/how-do-i-pick-the-right-business-intelligence-tool-for-my-business/ read 18.1.2023.

https://powerbi.microsoft.com/en-gb/power-bi-and-azure/ © 2023 Microsoft read 21.2.2023.

https://www.gartner.com/reviews/market/analytics-business-intelligence-platforms, © 2023 Gartner, Inc., read 12.1.2023.

https://www.airops.com/blog/best-bi-tools-for-startups-how-to-choose-a-bi-tool © 2022 AirOps read 27.2.2023.

https://www.scnsoft.com/analytics/business-intelligence/implementation © 2023 ScienceSoft USA Corporation read 27.2.2023.

https://powerbi.microsoft.com/en-gb/power-bi-and-microsoft/ © 2023 Microsoft read 21.2.2023.

https://powerbi.microsoft.com/en-gb/what-is-power-bi/ © Microsoft 2023 read. 21.2.2023

https://powerbi.microsoft.com/en-us/pricing/ © 2023 Microsoft read 21.2.2023.

W. Stewart Thomas 2020, "Power BI: An Analytical view, Association of International Certified Professional Accountants", https://www.journalofaccountancy.com/issues/2020/mar/microsoft-power-bi-data-excel.html. read 19.1.2023.

https://www.tableau.com/why-tableau/what-is-tableau © 2003-2023 TABLEAU SOFTWARE read 18.1.2023.

https://www.tableau.com/products/desktop © 2003-2023 TABLEAU SOFTWARE read 18.1.2023.

https://www.qlik.com/us/products/qlik-sense © 1993–2023 QlikTech International AB read 24.2.2023.

https://www.qlik.com/us/pricing © 1993–2023 QlikTech International AB read 24.2.2023.

https://cloud.google.com/looker © Google LLC. read 8.3.2023.

https://cloud.google.com/looker#section-2 © Google LLC. read 8.3.2023.

https://www.looker.com/product/visualizations/ © Google LLC 2023 read 8.3.2023.

https://www.domo.com/company © 2023 Domo, Inc. read 10.3.2023.

https://www.domo.com/business-intelligence/visualizations-and-dashboards © 2023 Domo, Inc. read 10.3.2023.

https://www.domo.com/product-walkthrough/connecting-data © 2023 Domo, Inc. read 15.3.2023.

https://learn.microsoft.com/en-us/training/powerplatform/power-bi?WT.mc_id=powerbi_landingpage-marketing-page © 2023 Microsoft read 24.2.2023.

https://community.powerbi.com © 2023 Microsoft read 29.3.2023.