BACHELOR THESIS

BUILDING A BUSINESS INTELLIGENCE SYSTEM FOR THE UNIONSHOP TO SUPPORT MANAGERIAL DECISIONS

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February 2022

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Preface

Dear reader,

You are about to read my thesis "Building a Business Intelligence System for the UnionShop to support managerial decisions". This research has been conducted at the UnionShop commissioned by the Student Union as an assignment for my bachelor Industrial Engineering and Management at the University of Twente.

I would like to thank Matthieu van der Heijden, my supervisor from the University, for his time and effort to supervise my research. I learned a lot from the last few months and am thankful for all the feedback. It was difficult to guide this research in the right direction but with the help of Matthieu we found a way.

Also, I would like to thank Sandra Nienhuis, my main supervisor from the organization, for providing me with this opportunity to conduct this research. Her passion to keep the UnionShop running has motivated me to deliver a solution for their problem. She was always available for asking feedback or providing me with more data. Besides Sandra, I would also like to thank Giel van Weezel for making this research possible from scratch and Coen van Orlé for providing his feedback on this research.

Enjoy reading!

Kind regards,

Pieter Voogt

Enschede, February 2022

Management Summary

The UnionShop is a shop that is located at the University of Twente. The shop sells various products that a student might need while studying such as notebooks, readers, or University of Twente merchandise. The UnionShop has student employees and is managed by an organization called the Student Union. While the UnionShop is *the* shop to visit when you are in the need of an item that is study-related, it has operated at quite a big loss for the last couple of years. The reason for this research is the fact that the Student Union has to compensate for the loss that the UnionShop is making and the organization would rather use the money elsewhere.

To find out how the UnionShop could decrease this loss, the current situation was analyzed. The shop was not selling enough products to compensate for their fixed costs. Before the issue can be addressed the financial performance of the UnionShop has to be tested with the use of Key Performance Indicators (KPIs) over different areas. However, there was no structure in their data handling to test this financial performance. The data was stored in different places and making simple calculations was not possible. This is why the following main research question was created:

How can an information system be created for the UnionShop that displays its performance?

To answer this question, there will be needed to find literature on what information system will suit the UnionShop the best. A Business Intelligence system will help the UnionShop with their data handling, performance management, structure into their strategy, and give an overview of their total performance. A centralized database was created to collect all their data into one central place which was easily accessible. The database was created in Excel and with the use of Power Query the data was imported. This made it possible to show inventory levels and historic data of their sales. Performance measurement became more accessible and gave the first in-depth insights into the performance. The performance was displayed on a clear dashboard so that the manager of the UnionShop could find the information that was needed within a few clicks. A strategy map and corresponding balanced scorecard were made to help the shop with monitoring and achieving its goals. The strategy along with its goals was created together with the manager of the UnionShop to outline what should change to obtain a certain amount of revenue while reducing the costs.

Another purpose of the system was to make managerial decisions better substantiated and not what sounds good to the ear. These decisions mostly include the determination of selling prices, determination of order sizes, and the introduction of new products. After some tests was found that the manager would make different decisions when the new information from the system was available. For instance, the system shows that often inventory is purchased while there was still enough inventory left. The manager would not have ordered these products if she had insight into the data that the system displays.

To make the system ready for implementation in the daily use of the UnionShop, the product list containing the product names, product IDs, and product categories were updated. This will prevent any data inconsistencies in the future and will make the data complete.

It can be concluded that the UnionShop is in the need of an information system to make better managerial decisions and to gain more insight into their performance. The system will help the shop with spotting new trends and room for improvement which would lead to a decrease in their loss. The strategy map and balanced scorecard will support the UnionShop with achieving its goals for the future.

An important recommendation for the UnionShop is to store all data into the information system to get the most out of the system. All the revenue and expenses in the system should match the actual

revenue and expenses so that nothing is left out. The managers should actively monitor their overall performance and their performance when changes are made. Another recommendation would be to invest in a new checkout system that can show even more data that is related to customer behavior such as the busiest visiting times or learn about combinations that are often bought.

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1. Introduction

In this chapter will be explained why this research is performed and for who. Firstly, the company will be introduced. After that, the motivation for the research will be mentioned and the objective will become clear. The core problem will be addressed and there will be described how this problem is going to be solved.

1.1 Company Description

The Student Union (SU) is an organization for and directed by students with the following mission: "*Everything we do is done for our fellow students – to empower them to achieve more than a degree*". The SU is founded in 1999 and even since it is a well-known organization among the students of the University of Twente. The organization is the voice of the students in policy matters. They also provide numerous services, own several "UnionLocations" and organize events all year long. One of these UnionLocations is *the* shop for the students of the University of Twente, the so-called UnionShop. The UnionShop provides almost all the products that a student would need at a University. Think of notebooks, readers, bicycle lights, or presents of the University. The shop is run by students who work at the SU.

1.2 Research Motivation

In the past few years, the UnionShop has operated at a loss, an average amount of 35.000 euros per year. This loss affects the entire Student Union organization, as money spent on the shop cannot be invested in offering more facilities for students to achieve more than a degree. The UnionShop has operated the same for some years now and needs a creative solution to turn the business around.

The UnionShop wants to maximize the profit they can get out of their products while maintaining a reasonable price for the students that buy their products. However, choices regarding the sales strategy or costs made are not substantiated by data. There is no central place where all the data can be stored and easily retrieved from the past. The UnionShop needs an information system to store all their data to make the best managerial decisions regarding the management of the shop.

1.3 Research Objective

The goal of this research is to reduce the loss that the UnionShop is currently making. This will be done by providing the UnionShop with a new information system where they can put in their orders, sales, suppliers, and fixed charges. This makes it easier to make decisions regarding the reordering of products or to look back at the performance of the past years to spot trends. It will prevent the UnionShop from making bad decisions which would lead to unnecessary costs.

1.4 Core problem

The core problem needs to be found to determine what the real problem is that needs to be solved. This problem can be identified by the use of a problem cluster, which can be found in Figure 1.1. The problems in the problem cluster are linked in a structured way to make the situation clear. The following core problem is found by the use of the problem cluster:

The UnionShop does not process their data effectively to create an overview of their performance.

Simple data, such as when a new order is placed and what this order contained, is difficult to retrieve and hence difficult to analyze. The data is not in a database wherein a few clicks the wanted information can be found. This makes it a real challenge to calculate numbers like future demand or to check why there were some many costs made in a particular year. Information of what products are the most profitable for the UnionShop is therefore also difficult to determine.

Decisions are now made on intuition and are not substantiated by a calculation. This could cause reorders to not be ordered in the correct quantity.

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The norm for this problem is to have all the data in a clear and easily accessible database where new data can easily be added and data of past years is retrievable. The reality is that the data is at different places and some data is not even stored at all.
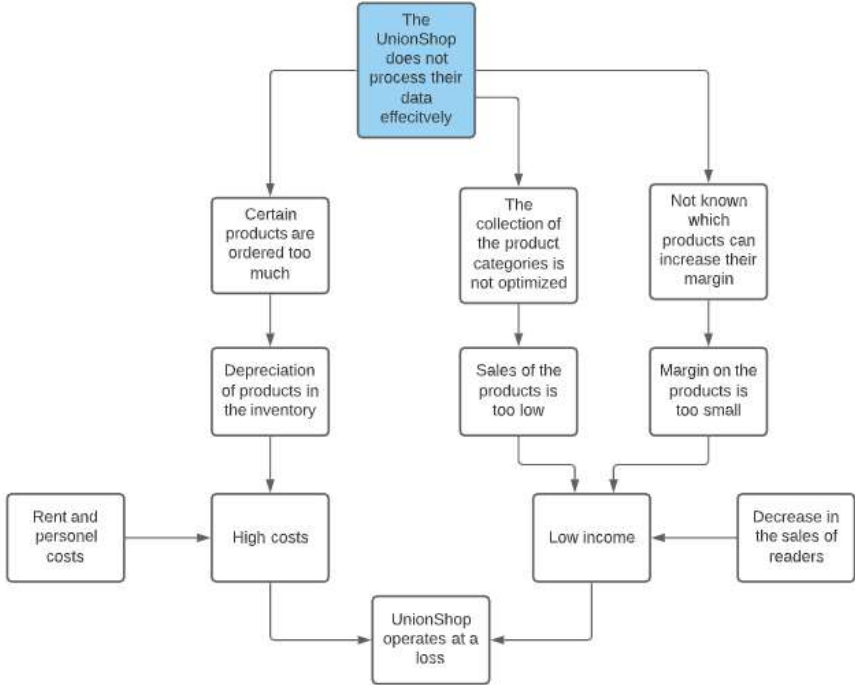
Figure 1.1: Problem cluster of the UnionShop

1.5 Research Questions and Approach

Several research questions are made to solve the core problem that is defined in the previous section. There is one main research question that describes the knowledge problem that the UnionShop currently has. The research should provide an answer to the research question and solve this knowledge problem. To answer this research question, multiple sub-questions are defined that stand for the different stages of this research.

MQ: How can an information system be created for the UnionShop that displays its performance?

SQ-1: How is the data of the UnionShop currently processed?

To answer this question there needs to be investigated how all the invoices, sales, or inventory levels about the UnionShop are currently dealt with and stored. Also, the current way of operating the UnionShop and the financial performance will be described since it is useful to know.

SQ-2: What types of information systems can be implemented at the UnionShop?

A literature study will be performed to gain more insight into different information systems and their advantages. Also, the implementation of such systems will be researched.

SQ-3: How to create an information system for the UnionShop that contains all their data?

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Once the right information system for the UnionShop is found, a system can be created for the UnionShop in a program such as Excel, Microsoft Access, or MySQL. It should be easy to operate and new data can be quickly added. The new system will give insight into numerous KPIs.

SQ-4: How can the UnionShop implement the new information system?

The research will provide the UnionShop an explanation of what the value of a new information system will be to them and what costs can be avoided in the future or where extra revenue can be obtained.

1.7 Research Scope

The scope of this research is limited to giving the UnionShop insight into what the value of an information system for them can be and how to implement such a system into the UnionShop. All the revenue and expenses will be covered, however, the information about the stock of products in the past is not available. All the information that is useful for the UnionShop and that is available will be in the scope of this research. The applications for these information systems will be limited to products of Microsoft since they are already used.

1.8 Deliverables

After answering all the research questions, this research will finally deliver the following:

- A description of how the current information is processed
- A literature study on the different information systems
- Information system made for the UnionShop in Excel
- Recommendations on how to implement the improvements

The deliverables should be easy to understand for the company and they should be able to use a better system with minimal effort. After the research, the UnionShop should understand what the benefits are of processing all their data in a structured way and better decisions can be made based on calculations with the new data.

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2. Current Situation Analysis

In this chapter will be discussed how the UnionShop has operated in the last few years and how this way of operating influences the financial performance of the UnionShop will be described in subsection 2.1. There will be looked at the trend of the overall performance, the selling price in subsection 2.2, the suppliers and orders in subsection 2.3, and the inventory management in subsection 2.4. The way the information is processed right now will be described in subsection 2.5. The current situation will be analyzed in subsection 2.6. What literature is needed to improve the performance of the UnionShop will be concluded in subsection 2.7. The data that is used in this chapter is collected from monthly sales receipts from the checkout system and various Excel balance sheets from the last years.

Due to the COVID-19 pandemic, the UnionShop has been closed for a large amount of time. This leads to partly inaccurate and not usable data of the last two years.

2.1 Overall Financial Performance

The initial reason for this research was that the UnionShop was not performing as it would like to. Every year, the UnionShop receives a large amount of money from the Student Union to break even. This is an average amount of 35.000,- euros each year.
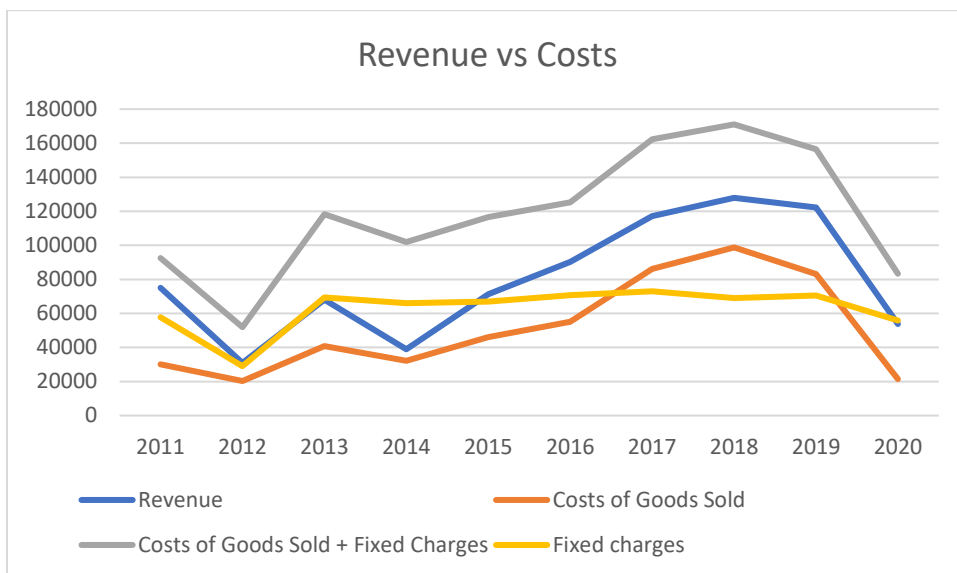
Figure 2.1: Line chart of the Revenue and Costs from 2011 till 2020

The data in the graphs is gathered from year reports of the UnionShop. The revenue rises at the same rate as the costs. However, the profit that the UnionShop makes from selling the products is not compensating enough for the fixed charges (personnel costs and rent). The fixed charges are on average 55% of the total costs of the UnionShop. This is why there needs to be found out what possible and feasible scenarios there are for the UnionShop to compensate for the fixed charges. It should be the case that the gap between the revenue and the costs of the UnionShop gets smaller if the number of sales grows.

The remaining of section 2.1 will give a better image of how the revenue and costs are built up for the UnionShop.

Income of the products

The UnionShop creates revenue by selling a lot of different products. The prices of these products variate from 1 euro notebooks to 60 euros relationship gifts. To keep the listing of sales clear in a balance sheet, products are divided into different product categories.

Printing (Xerox)	Items (Clothing + Bicycle Parts + Promotion Items)
Office supplies	Relationship gifts
Syllabi Fee	Dry cleaner
Clothing printing	Tickets
Other	

Not all product categories are based on the sales of items. The UnionShop also provides services, such as printing or being a delivery point for a dry cleaner. To which extent the different product categories contribute to the overall revenue and profit will be made clear via the dashboard in subchapter 2.6.

Central Support

The UnionShop receives compensation from the Student Union each year to break even at the end of the year.

Purchases products and services

The purchases are made at different suppliers. Some products are ordered at the regular supplier of the University. For other products is the UnionShop free to choose where they want to order them.

Fixed Charges

The fixed charges for the UnionShop consists of the rent of the shop itself, which has arisen in the last years by a few thousand euros, and the cost for personnel. The salary also has risen since September 2021 because the hourly rate has risen for all the employees. As mentioned earlier, the fixed charges are on average 55% of the total costs that the UnionShop makes yearly.

2.2 Selling price

The selling price of the products that the UnionShop sells is in most cases based on a doubling of the purchasing price of the product. From there on the manager will think about what a reasonable price would be for the product. The UnionShop looks at the prices of other sellers of the same kind of product and asks other students at what price they would buy the product for, to eventually determine the initial selling price. This is not done by a survey or predetermined panel but by asking around at members of the Student Union or employees of the UnionShop. If a product does not sell up to expectation, the price simply gets lowered by a certain amount. The selling price of products has changed throughout the years based on experience with the products. There is no fixed profit rate, for example, 10%, that the UnionShop used to determine the selling price.

The price of the relationship gifts needs to be determined in consultation with the University since they also sell the same products via their platform. So both parties need to set their price at a somewhat equal level to attract customers to both shops. This is only the case for the products that both the University and the UnionShop sell. For the other products, it is up to the UnionShop to determine the selling price.

2.3 Suppliers and orders

As briefly described in section 2.1, the UnionShop does not have complete freedom in where they buy their products. Relationship gifts all need to be bought via a special marketing department of the University of Twente. So there is no room in that product category to search for any cheaper suppliers that could offer a better deal to the UnionShop. While there are cheaper options out there, the UnionShop is restricted to the supplier that the University chooses.

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Furthermore, the UnionShop has contracts with companies such as Robitex and Xerox (printing) for the use of their services. The UnionShop pays a fixed amount of money each month to Xerox and in return, they can use the printer that is being serviced by Xerox. All the revenue that they make above this fixed amount of money each month is profit for the UnionShop. The UnionShop does not need to pay additional money to Xerox for their services, only the fixed amount that they pay each month.

Also, if the UnionShop wants to buy new UT sweaters with a print on them, this needs to be ordered via the supplier of the University. This does not need to be a minimal amount, but the supplier provides a discount if the UnionShop orders a certain amount. However, this discount is only profitable for the UnionShop if they want to add a new collection of sweaters and t-shirts to the UnionShop.

For other products, there is no pre-determined order policy or order size. Employees check the receipts of what products have been sold a lot that day and based on that information new products could be ordered. For most products it is not necessary to purchase a certain amount of products with each order, but, for example, a product has ordering costs of 10 euros and the selling price is quite low, then it is more profitable to order more products to compensate for the ordering costs.

2.4 Inventory

The inventory levels of products get tracked in two different ways: at the end of every quarter, all the inventory gets manually checked by the employees and via a checkout system. If ordered products are added to the inventory they are manually counted and then added to the inventory level that is known by the checkout system. Bought products by a customer will result in a decrease in the inventory level of the checkout system. To check whether the actual inventory of the shop equals the checkout system, all the products get manually counted. A difference will be corrected in the checkout system but does not occur often. Such a difference could occur when not all sold products are registered by the employee in the checkout system. It is not the case that there is a difference of tens in the counting but it could differ a couple of products per quartile. Of course, the employees need to prevent this from happening but it is not a huge problem. Most of the time, this happens to problems that get sold a lot in a busy period of the UnionShop, so at the beginning of each quarter.

2.5 Data Management

A short description is given of how relevant information to the UnionShop is processed:

When an order is placed at one of the suppliers of the UnionShop, the receipt for this order is stored in an Outlook folder. So, to check the expenses of a product all the receipts have to be checked to find when a product is bought and in what quantity. There is a transaction overview of all the expenses that the UnionShop makes on their OFI number, but it is not specified what particular product is bought and in what quantity. Only at which company the expenses are made, what the amount was, and in which month it was purchased.

A new order will not automatically be added to the inventory of the checkout system. An employee has to do this manually and sometimes it does not happen. Inventory levels can only be retrieved from the current inventory levels of the checkout system. So, any inventory levels of the past months cannot be seen. The inventory gets fully manually counted once every 3 months as mentioned in Section 2.4.

Product names on the receipts that are retrieved from the checkout system differ from the product list that the UnionShop keeps track of. This makes it messy to analyze the products. There is also no difference in the system between any sizes of clothes and products that do not have an inventory number to easily track.

The sales of products can be seen in the checkout system. It can be reviewed from specific days, weeks, or months. The products are split up into different categories and grouped at the receipt. The receipt

contains the quantity and the revenue generated from the review period. The file retrieved from the system is an HTML file, which is difficult to import into a program like Excel because of its format.

Every year, the UnionShop makes a balance for the revenue and expenses of every product category. However, how these posts are calculated is difficult to find. A reason for that is the different names of the product categories on the receipts, the transaction overview, and the product overview of the UnionShop itself. This makes it difficult to address certain costs to a certain product category.

2.6 Analysis of the current situation

As can be seen in figure 2.1, the UnionShop is not getting closer to breaking even. The profit that the UnionShop is making during a certain period does not compensate for all the expenses the UnionShop has to make to sell their products. This subsection will give an overview of where there is improvement potential and to what extent.

2.6.1 Revenue

Since there is a list of almost every product and its purchasing and selling price, the profit margin of the products can be calculated. This gives an overview of if every product from a certain product category has an average gross profit margin or if the product is an outlier. Table 2.2 gives the average gross profit margins of the product categories to keep the numbers clear.

Category	Percentage
Items	25,62%
Office supplies	22,35%
Relationship gifts (UT merchandise)	22,45%
Tickets	13,88%

Table 2.2: Average gross profit margin of the product categories based on purchasing and selling price

When looking at the gross profit margins of the individual products for any big outliers, only find 5 products of the whole product collection that have a significantly higher margin are found. The rest of the products have a spread within 10 to 15 percent of the average.

The revenue of the other categories is based on services and does not have a predetermined purchasing and selling price. The University supplies the UnionShop with syllabi and asks them to sell it. The shop receives a certain fee per reader sold.

As mentioned before in subsection 2.2, the UnionShop is not entirely free in determining the selling price of its products. Hence, not in the determination of the profit margins of the products. Around 40% of the revenue that the UnionShop makes, comes from products where the selling price needs to be reconciled with the University. The University has a larger budget than the UnionShop and can sell the same products for almost the purchasing price, while the UnionShop wants to receive way more profit from it. The University wants branding for the UT so the more merchandise the better. That is why the selling price via the University is as low as possible. However, if this research can provide the UnionShop with an information system that will provide them with a clear overview of all their data, they will be able to check at what selling price the most products were sold. An approximation of the optimal selling price can thus be found by looking at historic data. Optimization of the selling price will generate more revenue.

2.6.2 Fixed Charges

As briefly mentioned in subsection 2.1, the fixed charges consist of the rent of the shop and personnel costs. The rent is determined by multiplying the surface of the UnionShop in square meters times the price per square meter. The price per square meter is determined by the University. Currently, the UnionShop rents 112 m2 for the shop itself and 69,5 m2 for storage capacity. The price per square meter is 177 euros this year. The University raises the rent almost every year. It is possible to rent less storage

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space and let other parties use the storage as well. The UnionShop could decrease the storage space by half/ a third with the amount of inventory that they currently own and the space efficiency of the storage. The UnionShop pays around 37000 euros rent per year and could save up to 9000 euros (46 m2 x 177 euros) if they would decrease the storage space that they rent right now.

The UnionShop has opening hours from 10:00 till 17:00 every business day (apart from holidays). There is always 1 employee working except the first week of every quartile because it is a very busy week. Not all the employees are on the same salary scale. The manager, for instance, earns more money than a normal employee. It costs the shop 35000 euros every year to pay the salaries. The UnionShop is flexible in its opening hours and could also close a day of the week.

2.6.3 Ordering

The ordering process of the UnionShop is not regulated. Every Thursday an employee of the UnionShop walks around in the shop and writes down which products are almost sold out. These products get reordered by a certain amount, but there is no calculation in what the best order amount should be. As a result, the UnionShop orders a lot of products without knowing if these will sell in the same year because of the lack of data. They aim to sell the products within six months after the order.

When looking at the distribution of the income and the expenses over the past 10 years, the gross profit margin percentages are found. The averages in figure 2.2 below give insight into how much of the expenses are covered with the revenue generated each year. These averages differ a lot from table 2.2. This can be explained by the large purchasing volume that the UnionShop uses to receive volume discounts and that the shop sells the products until the inventory runs out, hence the reason for the negative margins. For every category, there are a couple of years where the categories have a negative gross profit margin. Some years have been such a big outlier that something weird is going on. Margins that lie below -100% are exceptional and are very rare. However, with the current information system of the UnionShop, it is very difficult to trace what the reason was for this which leaves the manager guessing what could cause all this. When income and expenses for the different product categories are better tracked, it should be prevented that such big outliers arise. It occurred in 2019 that there was a flood in the warehouse which caused a lot of the inventory to be destroyed. Other reasons for such highly negative margins could be that products are not selling and that such products get old below the purchasing price. To determine the right order quantity, more data is needed that is currently available. An information system will make it able to calculate what the right quantity should be and unnecessary costs will be prevented.
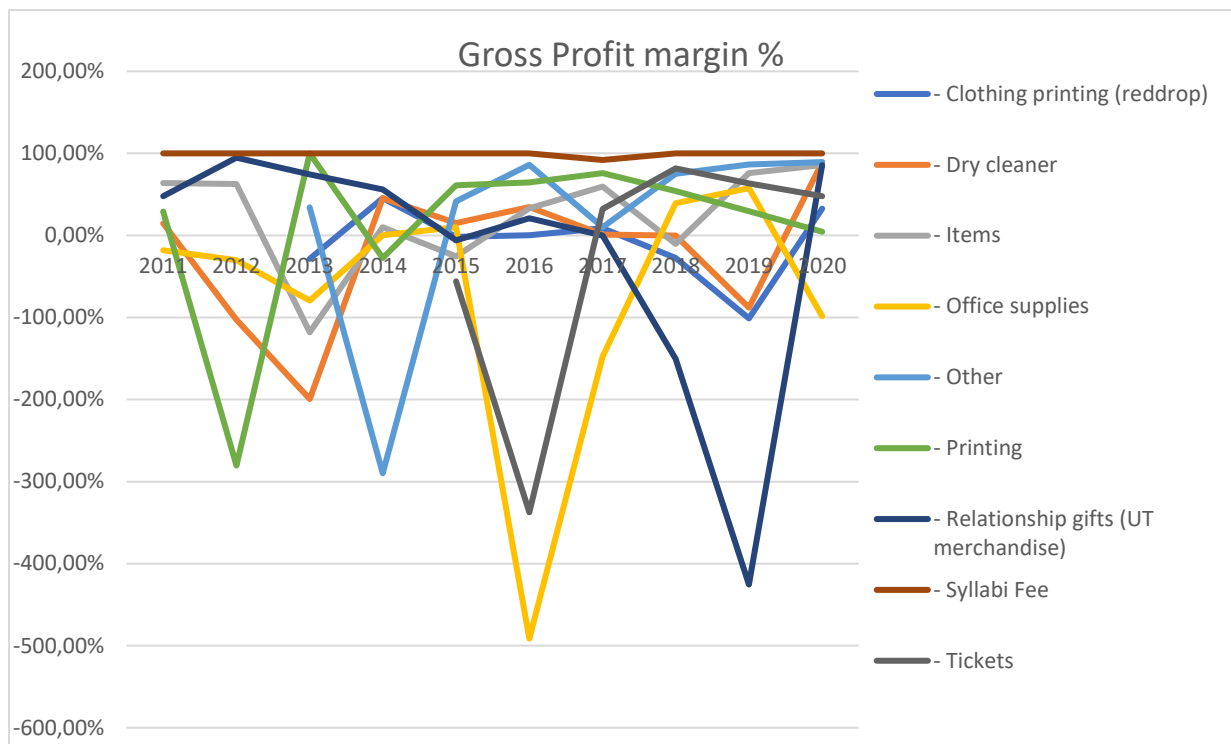
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Figure 2.2: Gross profit margin of different product categories from 2011 till 2020

New Products

The UnionShop is constantly working on adding new products to the shop to keep the students interested in the collection. Once a product is made up it will be added to the shop with a certain selling price. Weekly will be monitored if the new product has been sold a lot. So beforehand there has not been calculated how many products they want to sell within a certain time and if the products are worth to keep selling. The new product is not compared with the performance of similar products. If the comparison shows that similar products did not perform that well based on the historic data that should be stored, the UnionShop should consider if it is profitable to add the product.

2.7 Conclusions

Based on the analysis of the current situation some conclusions can be made:

- The UnionShop needs an information system to improve in the following areas: order quantity of products, determination of the right selling price, and introduction of new products. The information system will keep all the data in one place so that data is easily available and analyses can be made quickly to see any trends. Also, calculations can be performed with ease for the right order quantity and selling price to decrease costs and increase revenue.
- Data is not consistent about product names and categories. Products should be assigned with an SKU number to make data handling easier and product categories should be the same throughout the checkout system and information system.
- The build-up of revenue and costs of a month or year should be available and correct to seek room for improvement and to adjust their strategy.
- The checkout system that the shop is currently using is outdated. The inventory of products is not easily tracked and the export function is limited to only one data format which is difficult to process.

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This chapter gave insight into the current way of managing the data of the UnionShop and where there is room for improvement. The introduction of a new information system should help the UnionShop with its decision-making and strategy. The next chapter will contain a literature study dedicated to finding the right information system for the UnionShop and its advantages. Furthermore, there will be found out how data should be managed and how to display the performance of a business.

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3. Literature Review

The literature review of this chapter will explain the concepts of Business Intelligence (BI) and their advantages. An introduction to BI will be given and continued with data management. Furthermore, different kinds of analyses that could be performed within a BI system are mentioned and how to monitor the strategy of a business. There will be explained how to compare the desired performance with the actual performance to maximize the profitability of the company.

3.1 Business Intelligence

"*Business intelligence (BI) is a combination of processes, policies, culture, and technologies for gathering, manipulating, storing, and analyzing data collected from internal and external sources, to communicate information, create knowledge, and inform decision making*" is a definition by Foley and Guillemette (2010) based on 30 articles about descriptions of the concept BI. A Business Intelligence System is all about the maximal utilization of all the information and data that is relevant to a business. The system helps with reporting, forecasting and prediction, and trend analysis (Turban and Sharda, 2010). A BI system has four components: a *data warehouse*; *business analytics*, to analyze the data from the data warehouse; *business performance management,* to monitor and analyze the performance; and a *user interface* such as a dashboard. By analyzing the historical and current data of a business, performances, and situations, managers are more informed to be able to make better decisions (Turban and Sharda, 2010). It is a content-free expression, so the definition of BI means different things to different people (Sharda and Delen, 2017).

3.1.1 Data warehousing

A data warehouse is a pool of various kinds of data to support any decisions a business has to make. It is also storage to find current and historical data that might be of interest to managers. Data is organized by detailed information about the data, such as sales, kind of products, or product category. The data warehouse should be able to integrate all different types of formats of data that are collected for the data warehouse. Think of invoices that are in a different format than receipts from a checkout system.

A database contains historical data and does not display the real-time status of the data. The historical data can be used to detect any sort of trends that support the decision-making of a business. The so-called *online transaction processing* (OLTP) systems are used to handle a company's ongoing business, such as transactions, total sales of the day, or the new inventory level. A data warehouse, on the other hand, is a distinct system as storage to make analyses on, also called an *online analytical processing* (OLAP) system (Sharda and Delen, 2017). Both systems are heavily connected since the OLTP system is the source data for the OLAP system.

A *data mart* is a subject-oriented segment of the bigger database. Once the source data is extracted, transformed, and loaded (ETL) into the data warehouse, this data can again be divided into these data marts by ETL. There are a couple of Data Warehousing Architectures that combine the data marts in a certain way. Below are the ones that would fit the data type of the UnionShop.

Hub-and-Spoke Architecture: Consists of a central database and several dependent data marts which makes it easy to customize interfaces and reports. It is probably the most famous architecture nowadays.

Centralized Data Warehouse Architecture: The centralized data warehouse architecture is almost similar to the hub-and-spoke architecture except that it does not have dependent data marts but is one big data warehouse. It provides access to all the information at once instead of accessing it via different data marts.

Data inconsistency happens when the same attribute may have different values. The attribute may also have different names in different systems, which leads to confusion in the data (Laudon and Laudon, 2018).
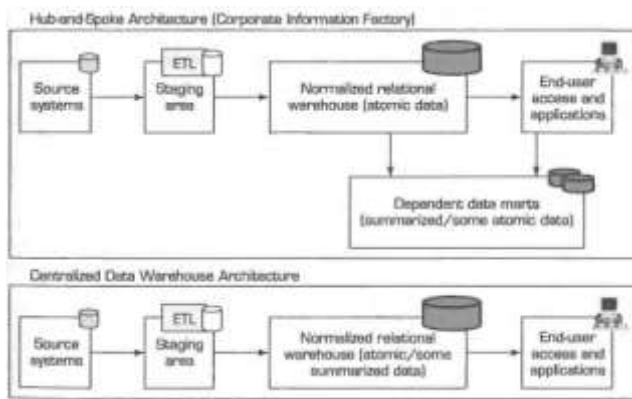
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Figure 3.1: Warehouse Architectures (Turban and Sharda, 2010)

3.1.2 Business analytics

"*Analytics can be seen as the process of developing actionable decisions or recommendations for actions based on insights generated from historical data*" by (Sharda and Delen, 2017). It is the part of BI where the data from the warehouse is processed and analyzed (OLAP). The data is manipulated so that useful results can be obtained. The analyses can provide a business with next-level analytics to understand patterns better and even to develop forecasts. When a business knows what is happening and what is going to happen, it can make the best decisions for the future. Business analytics is closely related to Business Performance Management (BPM) of subsection 3.1.3.

One can divide business analytics into three types: descriptive, predictive, and prescriptive.

Descriptive

Descriptive analytics is all about monitoring what happened in the past and what is happening right now. It is a combination of reports, dashboards, and data warehousing and enables a business to gain more insight into its current performance. The outcome of a descriptive analysis provides a business with well-defined business problems and opportunities.

Predictive

In contrast to descriptive analytics, predictive analytics tries to determine what is going to happen in the future. This is done by *data mining* and statistical techniques such as forecasting or classification algorithms. Predictive analytics should provide an accurate projection of future events and outcomes.

Prescriptive

Based on the analyses of predictive analytics, a business should decide what they should do and why they should do it. The goal is to optimize the performance and to provide a decision for a specific action. These specific actions can contain a specific amount for a reorder or a yes/no decision for a problem.

Since the UnionShop needs an information system, a descriptive analysis will be the main focus of the analytics. When the descriptive analytics are well analyzed and have been used for half a year, there will be enough data to start with predictive and prescriptive analytics. This will be a goal for the UnionShop that they should want to achieve.

3.1.3 Business Performance Management

"*Business Performance Management (BPM) can be described as a series of business processes and applications designed to optimize both the development and execution of business strategy*" by (Foley and Guillemette, 2010). It uses the reports and analyses from the business analytics from a strategic point of view. Where business analytics uses bottom-up extraction of information of data, provides BPM

top-down enforcement of corporate-wide strategy (Turban and Sharda, 2010). The top-down view gives insight into the performance of a business and makes it easier to make strategic decisions. BPM encompasses three key components (Colbert, 2009):

1. Closed-loop management and analytic processes that address financial as well as operational activities
2. Tools that define strategic goals and then measure and manage performance against those goals
3. Processes, which include financial planning, reporting, and monitoring of key performance indicators, linked to organizational strategy

These closed-loop processes are a continuous process of asking yourself, where do we want to go? how do we get there? how are we doing? and what do we need to do differently?

A balanced scorecard (BSC) is a performance measurement system that translates any type of goal into a measurable number. Not only financial measurements can be performed but also the achievements of various KPIs such as the number of extra sales. It is a clear way of making targets for a business itself when they are planning their strategy and it focuses on maximizing the profitability of a company. The balanced scorecard follows several phases (Kaplan and Norton, 2000):

1. Determination of the strategy
2. Determination of critical success factors per perspective
3. Determination of the KPIs
4. Determination of the norm values

3.1.4 Dashboard

A dashboard is used to get a quick and clear overview of all the performance measurements from a business. Just as a scorecard, a dashboard provides visual displays of important information that is arranged on a single screen so that the information is easily explored. It is the 'end product' of a BI system where managerial decisions should be made way easier. Managers should indicate their preference on performance indicators that they want to have displayed on the dashboard.

The dashboard should be made according to the wishes and needs of the users with the use of the data that is available or possible to obtain. The dashboard should give the numbers context and related graphs or figures shown should be grouped. The labels of the dashboard should also be clear for the users.

3.1.5 Implementation of a Business Intelligence system

The implementation of a BI system can be costly and time-consuming since the whole business will be working with a new database and applications. Employees and managers need to get used to the new way of working and decision-making. All the different information systems should be integrated into one system (Turban and Sharda, 2010) to function as one entity. The implementation of BI is possible when all systems are integrated into each other.

How long the implementation of a BI system takes is based on the complexity of the business behind it (Nedelcu, 2014). The four components mentioned above are also all part of the implementation of a BI system. They need to be created to the needs of the company and should fit with the information systems. It is up to the company how complex and integrated they want their systems to be.

Luckily, the complexity of the data and the whole business system itself of the UnionShop is not very complex and is suitable to design a BI system.

3.2 Other information systems

Business Intelligence is of course not the only information system that could be used for businesses. Other information systems are, for instance, Management Information System (MIS), Decision Support

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System (DSS), or Inventory Management System (IMS). BI could be seen as an overarching system that combines all systems into one clear system. Also, an MIS includes information about employees and attendance which is not needed in our case. When using a BI, the managers can decide what to include in the monitoring for their business and what is not relevant.

3.3 Conclusion

- The UnionShop does not produce complex data consisting of millions and millions of rows. Therefore it is only necessary to create a database that combines all the information from different information systems into one central system that contains different data elements.
- The UnionShop needs descriptive business analytics to analyze its current performance.
- A BI will help the UnionShop with making managerial decisions based on historical data/forecasted data which was formerly not possible.
- The type of data marts that will suit the UnionShop the best is the Centralized Data Warehouse Architecture since the UnionShop will not be working with very complicated data warehouses and is used by smaller companies. A central warehouse will be the most beneficial for them.
- The use of a balanced scorecard will make it possible to track the performance and the desired performance of the UnionShop in a clear way. It can be used to assist the UnionShop in achieving its desired goals and strategy by following the 4 phases mentioned in subsection 3.1.3.

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4. Solution Design

In this chapter will the basics of a Business Intelligence system for the UnionShop be made. Firstly, in subsection 4.1 will be described what the goals of the BI system are and what data is currently available to fulfill the goals. In subsection 4.2 will be described how the database is built around the available data and how more information can be obtained from the available data. In subsection 4.3 will be explained what kinds of analyses can be made with the data based on the wishes from the UnionShop. Managerial decisions can be made based on these analyses and there can be checked if the right decisions are made by using performance measures in subsection 4.4. A dashboard will be designed to summarize all the information in a quick overview in subsection 4.5.

4.1 Goal of the Business Intelligence system

As described in chapter 3, a BI system can help a company with various purposes. The BI system should be made according to the wishes of the user. Once the wishes are clear, it will be needed to determine if the wishes can be fulfilled with the available data and what needs to be done to obtain the missing data.

4.1.1 User's wishes for the information system

A list of information that the user would like to use when making a managerial decision was made after some conversations with the manager of the UnionShop. The information should be available within a few clicks to make the decisions easier. The following list will contain the preferences of the manager what can be obtained from the information system and what data is needed to live up to these preferences:

Optimize the Selling Price

The manager would like to see what the revenue of a product was with a certain selling price to decide on what the selling price should be. The same product could have been sold for different selling prices throughout the years so that would be interesting data to look at. The data that is needed for this wish can be obtained by looking at the sales over a certain period the user asks for. The sales data will contain the revenue and corresponding quantity that will make it possible to calculate the revenue under a certain selling price.

Target Revenue per Category

The manager wants to know to which extent each product category contributes to the total revenue each year and what revenue the other product categories would need to generate to compensate for another category. The goal is to compensate for all the personnel costs each year so it can be calculated what the yearly target is for a product category each year. Only the personnel costs are chosen because the manager believes it is not reasonable to make enough profit to compensate for the rent as well. The data needed for this are the sales of each month per product category and the budgeted personnel costs for the year.

Target Revenue per Day

The UnionShop is also interested in the average revenue of all the sales they should generate each day to compensate for the personnel expenses each year. The data that will be needed for this number are the personnel costs of a year and the average profit margin of all the products. Together they can calculate the target revenue per day.

Order Quantity

To determine what the right order quantity would be, the manager can base their decision on the sales of a product over a certain period. For example, if the UnionShop wants to introduce a new product and wants to know the initial order size. The number of sales can be estimated by looking at similar products that the shop was already selling in a period.
The data that is needed to determine this are the sales of the individual products and the invoices which contain information about the purchases.

Overview of current performance
The BI system will also contain financial reports of previous years and the current year. All the revenue and expenses that were made will be automatically included in the report. The data will contain the sales, invoices, and miscellaneous revenues and expenses (furtherly described in subsection 4.1.2)

4.1.2 Data availability for the desired information
Based on subsection 4.1.1 there will be determined what data is already accessible for the UnionShop and what data should be gathered to give the UnionShop their desired information.

The following available data will be extracted, translated, and loaded into the database:

- Sales per week or month consisting of the quantities per SKU and corresponding revenue which come in an HTML file from the checkout system
- Invoices per email that contain the purchasing data of the products including price, size, color, and vendor
- Selling prices per SKU based on the current prices in the checkout system
- Miscellaneous revenues and expenses, such as the service costs of the checkout system that are manually added by the user

Not all the data that is needed for the information system is completely available. For example, the invoices are not complete and hence the data of the inventory levels is not entirely correct. All the purchases are made on the OFI number of the UnionShop, they are all summarized in an overall transaction overview of the year. The invoices of these purchases are less well documented by the UnionShop and are not stored in a central place. This makes it difficult and time-consuming to find all the invoices. The manager of the UnionShop does not think it's worth it to search and gather all the invoices and load them into the BI system. Mostly because the data from previous years gives a distorted picture of the normal sales before the COVID-19 crisis. The manager wants to start with the BI system from January 2022 and start collecting and loading all the data into the system. This means that not all the historic data from the last years will be available in the data warehouse. Also, the checkout system currently does not keep track of the size or color of clothes that are getting sold. To make decisions about the order quantity of clothes, this information should be included in the checkout system. This can be done by renaming the products in the checkout system with the attributes included, such as size and color.

4.2 Database
With the goals of the BI system clear, a database around the available data can be built. As mentioned in the previous subsection, the data needs to be extracted, translated, and loaded into the database. This is done by the use of Power Query in Excel to translate the data from the checkout system and the mails into the same format. This is an automated process that makes it easy for the manager of the UnionShop to import any new data to the data warehouse. The sales file in HTML format needs simply to be saved in a folder and will be imported. Any new purchases can be added by one copy and paste per invoice. Once all the data is translated it can be loaded into different data marts. There was concluded in subsection 3.3 that a *Centralized Data Warehouse Architecture* would suit the data management of the UnionShop the best. Therefore, the available data is separated into different marts in figure 4.1 below. The data marts are stored in de same database so that all the users can access all the information at once. In our case, the data warehouse will be an Excel file where the different sheets represent the different data marts. The data marts are divided in such a way that they will support the user's wishes and that all the calculations can be made. Microsoft Excel is chosen because the data of the UnionShop is not very complex and the managers preferred to make calculations in Excel.

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The product is the basis of almost every data mart with its corresponding product attributes as can be seen in figure 4.1. Currently, the UnionShop is not working with attributes like color or size. For future analytical purposes, the two attributes will be added to the data marts.
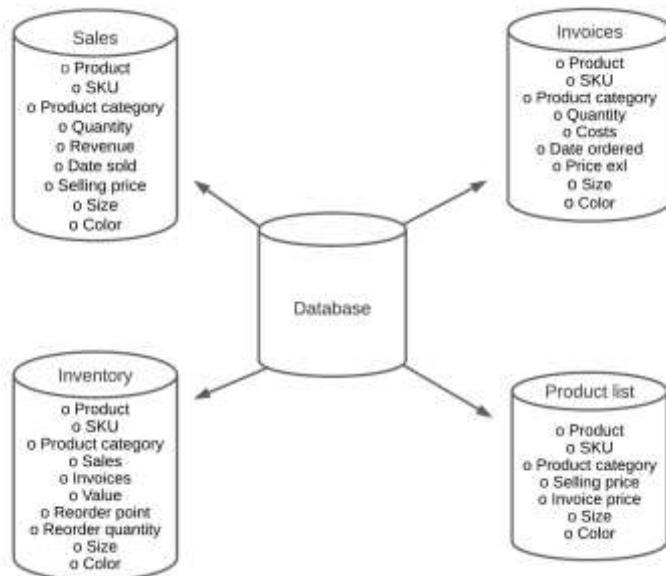

Figure 4.1: Overview of the different data marts of the data warehouse

The data from the online transaction processing system of the UnionShop cannot be directly connected to the data warehouse, since the checkout system is not capable of doing so. Therefore can the real-time transactions not immediately be updated in the warehouse but could be done daily. The sales of a day, week, or month can be imported via Excel Power Query and directly be translated into an Excel sheet.

Since all the data is coming from different sources, the product names and categories are not the same. The UnionShop should use the same product names, product categories and even introduce SKU to stay consistent throughout the data warehouse. Advice on how the UnionShop should start using the new data warehouse from January 2022 onwards will be given in chapter 6.

4.3 Business Analytics

As described in subsection 3.1.2, the second step of a BI system is analyzing what decisions should be made by looking at the current performance. This subsection will describe how business analytics should be designed for the UnionShop and how they would benefit from it.

There will be started with the descriptive analytics of the UnionShop where all the data gathered in the data warehouse will be analyzed. The UnionShop will benefit from accurate information such as the sales performance of their products or product categories, the inventory levels at certain points in time, or in what month it generates the most revenue. The new data warehouse makes it possible to gain insight and monitor these numbers within a few clicks. It will tell the manager of the UnionShop how the UnionShop has been performing, not only on the level of products but also the financial performance of the company such as which months were profitable and what unexpected costs were made. Also, the UnionShop can set targets that they want to achieve each week or month to compensate for their fixed charges.

Since the UnionShop did not have an information system where all the information is combined and the distorted situation around the current COVID-19 pandemic, is it difficult to make predictive analyses for the UnionShop. From now on the shop should store all their data in the data warehouse to make

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reasonable predictions about future sales or costs. It will display all the information that is needed to make decisions for the future.

These decisions will be made in the prescriptive phase of the business analytics. However, this phase of business analytics is outside the scope of this research and therefore will the system not be able to make these forecasts. More data about the purchases of products will need to be collected to start making forecasts. This contains data about inventory levels of the products and the reorder history. This data will be collected once the shop starts using the system. The forecasts can be made once a year of purchasing   data   is   collected.
The manager of the UnionShop is always eager to know what the best decisions are for the shop. The decisions should find the right balance between generating more revenue and minimizing the costs involved. The most obvious decisions to decide upon are the selling price, reorder quantity, product collection, or vendors. However, these decisions should also fit into the strategy of the shop. The strategy of the UnionShop will be described in the following subsection.

4.4 Business Performance Management

Where the Business Analytics from subsection 4.3 provides a bottom-up view, does BPM provide a top-down approach. The strategy of a company can be translated into different processes and performance can be measured. This is done by making a strategy map and a complying balanced scorecard of the company. The strategy map and BSC will make the processes measurable and aim for targets. It will also point out what the critical success factors are of all the processes and how they are connected. In figure 4.2 will be shown what the strategy map and BSC of the UnionShop look like.

	Strategic objectives		Objectives	Measurements	Targets	Action plans
Financial	Profitability	More revenue	• Cover personnel costs additional to COGS • Increase revenue	• Revenue for every category per month • Total revenue of a year	• Targets = % average contribution to the total revenue • Increase 10% first year	
Customers	Sell wanted products	Best prices	• Increase the number of customers that like the products • Find the right balance between selling price and sales	• # sales of new products per quartile • Revenue per selling price	• Revenue generated by new products from 2022 onwards be 10% of total revenue • Find selling price that generates the most profit over a quarter	• Look at sales of similar products to predict the sales of a new product • Test different selling prices and find the most profitable
Internal Business	Improve data management	Improve analytics	• Fast data collection • Easily readable analytics and numbers	• Data storage in information system • Make decisions based on analytics	• All new data should be stored in the system and correspond to OFI number (Yes/~~no~~) • All decisions should be supported by information from the BI system (Yes/~~no~~)	• Users need to get used to putting their data into the system with ease • Calculate numbers that are needed with the tools of the BI system
Learning and Growth	Develop information system	Learn benefits of an information system	• Built an information system for the UnionShop • Acquire knowledge of information systems • Develop skills	• Finished BI system • Strategic job readiness	• After 1 year the system is ready for predictive phase (a year full of order data is gathered to make the first forecasts) • After first year of use 100%	• Start with a basic system and work towards next phase • Let the user find out how the system works untill it takes little effort to work with the system

Figure 4.2: Strategy Map and Balanced Scorecard for the UnionShop

Further explanation of figure 4.2

- Users of the BI system consist of the manager and employees of the UnionShop

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- 'Data storage in information system' can be measured if at the end of the year all the revenue and expenses that are made match with all the revenue and expenses booked on the OFI number. Everything will be booked on the OFI number so if the system will match 100% all the numbers will be the same.
- The 'Finished BI system' measurement is difficult to measure but when time goes by will the system be finetuned. A rough guess is taken that the system will be near completion after 1,5/2 years working on and with the system since the more data the UnionShop stores the more analyses can be made.
- The 'Strategic job readiness' measurement can be measured after a year by asking the users if they can use the BI system from now on with no help needed from the creator.
- All measurements can be extracted from the information displayed in the dashboard or other sheets of the Excel file.

The strategy map and BSC will give the manager a clear overview of where the strategy will take them and what targets need to get fulfilled to achieve this strategy. Some targets are set to be achieved within years, the reason for this is that some changes in the current way of working take some time to get used to. The UnionShop has been operating the same way for quite some years so it is difficult to adapt this right away. By consistently monitoring the measurements and actively following the action plans that are described in the BSC, the UnionShop should be able to change its way of operating.

BPM is not only about using tools to achieve your desired strategy, it is also about monitoring your current performance with the use of KPIs and various financial reports. Some measurements are already described in figure 4.2, however that are not all the interesting KPIs for a retailer that the UnionShop could monitor. The KPIs help the company understand where there is room for improvement. The list below will give a brief explanation of all the KPIs that will be included in the dashboard of subsection 4.5.

Year over Year Growth
This graph shows what the performance, the revenue generated per month, of a company has been compared to previous years. It will show the managers of a company if their company has been performing better or worse.

Sell-Through Rate per SKU
The sell-through rate calculates the amount of inventory sold in a certain period relative to the amount of inventory that is received. It is a useful KPI for a company since it shows how quickly a company can sell its inventory. A company aims to maximize the sell-through rate.

The equation is the following: $\frac{Number\ of\ items\ received}{Number\ of\ items\ sold} * 100\%$

Sales by Category and SKU
It is useful to track which category or SKU generates the most revenue because you will get to know your customers better and to which categories more attention should be paid to increase the revenue.

Profit Margin
It is one of the most common KPIs to track if your company is generating enough profit to cover all operating and overhead costs.

More KPIs could have been added that would be interesting for the UnionShop, however, the shop does not possess a checkout system that makes it possible to deliver the data needed. Think of the average transaction value, the combination of products that are bought, or the time of the day when the most/least customers buy products at the shop. This will give the managers more information about the behavior of the customers and they could respond to the needs of the customers. They will get to know

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if they can save personnel costs by using different opening hours if they see that most customers buy something between a certain period every day. Another example would be that if a notebook and pencils get sold as a combination frequently they can advertise with a discount when the combination of products gets bought. This could convince customers to buy the products when they are hesitating.

4.5 Dashboard

A dashboard is built to summarize all the information that has been selected in the previous phases of creating a BI system. All the graphs and figures are made in Excel with the use of Excel Power Query to translate all the data into the right format. Various pivot tables are used to create the right graph for the required purpose. With the use of user-friendly slicers is it possible to select the products, product categories, dates, and quarters that the user would like to see on the dashboard. It will give the user information about the measurements that are selected in the strategy map and BSC of subsection 4.4 and will also include the additional KPIs.

The dashboard also contains some tools to calculate future profitability when future sales are estimated with a profit margin. The user can insert the variables and the tool will calculate the profit. The future sales need to be filled in manually for an SKU that the user wants to calculate the profit for. The estimation can be made by looking at historic data of similar products such as the sales and corresponding selling price.

4.6 Conclusion

- It is difficult to create an information system when all the different data sources use different product names and product categories. The UnionShop should be consistent in all the data and should even consider implementing Product ID numbers to make data management simpler.
- Since it is a basic data warehouse there is some automation into data formatting, however, the user does need to perform some manual work to input all the data.
- The data of the UnionShop is more accessible and easy to perform analyses on. The data that the user wants to have a look at can be seen within a few clicks.
- The manager has the opinion that it is not worth it to search and gather all the data that is not included in the dashboard yet. For this research, I also believe that the time-consuming job of gathering all the data does not outweigh the benefit of completing the data. There is enough data in the data warehouse already to help the manager with making decisions.
- Since not all the data will be included in the data warehouse yet, calculations of the sell-through rate will not be possible to perform. Once the UnionShop starts collecting all their data from the start of 2022 this will become possible.

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5. Results From Business Intelligence System

In this chapter, the results of the new information system will be described in subsection 5.1. The section will also cover the conclusions that can be made from the graphs. The information consists of the sales of the products over the last 3 years containing the revenue, quantity, and corresponding selling price. In subsection 5.2 will the manager of the UnionShop receive some examples of choices that could be made with the use of the system. Subsection 5.3 will cover the overall feedback of the manager on the system and subsection 5.4 will conclude on all the results.

5.1 Graphs and Results of the BI System

This subsection of the research will highlight the graphs that represent the information that the user of the system would like to see to make better decisions. The graphs are part of the dashboard that will be included in total in appendix C Some general conclusions are drawn from the information that is displayed in the graphs.

Selling Price

There will be started with the revenue that is made for a certain selling price. The following graphs show a couple of interesting results where the user could obtain some interesting knowledge from. Conclusions per graph will be made.
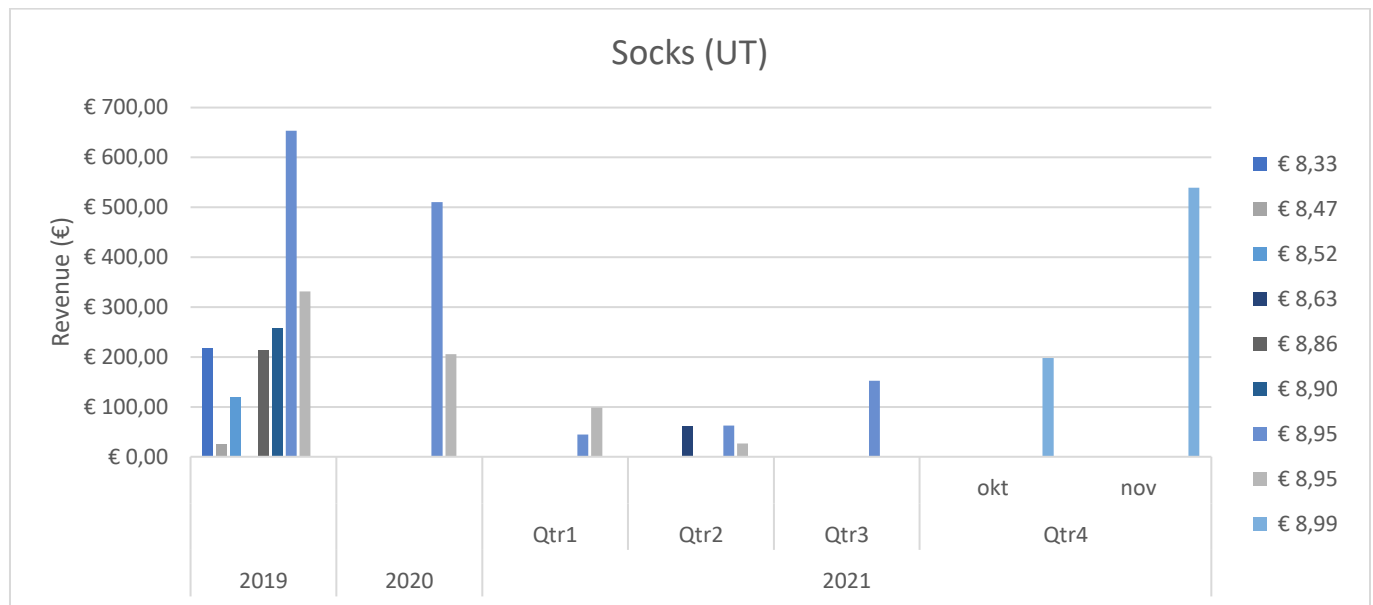

Figure 5.1: Histogram of the revenue with the corresponding selling price for Socks (UT)

One of the noticeable aspects of figure 5.1 above is that the socks will get sold to the customers even with an increase in the price. With the current data, it is not possible to retrieve information if it were the same SKU or different versions of the product. The new way of data storing, described in chapter 6, will make this possible. The highest price of €8,99 that the socks are ever sold for generates more revenue than all other selling prices. The manager could try to increase the price even further to see what the revenue will be.
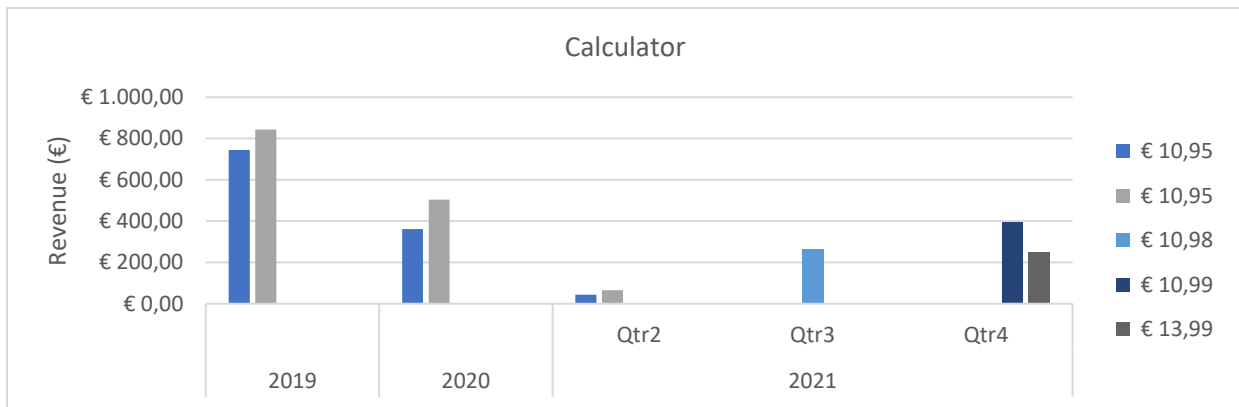
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Figure 5.2: Histogram of the revenue with the corresponding selling price for Calculator

The second highlighted graph is about the selling price of the calculators. As can be seen in figure 5.2 above, there has been an increase in the selling price of the calculators. The graph shows that the increase does not necessarily lead to higher revenue. This does not directly mean that the sales are lower with a higher selling price since the sales are also influenced by the time of year. The UnionShop could keep selling at a higher selling price to see what the sales will be in the coming months.

Revenue per product

The next graph is implemented into the dashboard to get an idea of the progress of the sales of products. It will tell the user if the existing products are still in demand by the customers or if a new product will catch on at the customers. It will also give more insight into the revenue per selling price as described in the section above. In figure 5.3 below, a trend can be spotted since the sales of the Travel Mug increased in the fourth quarter for three years in a row now. This could, for example, be caused by the cold weather so that the customers buy the product to keep their liquids warm. The UnionShop could use this trend to their advantage when they would increase their selling price in that period and lower it to their original selling price once the peak is over. In theory, they would generate more profit by doing this.
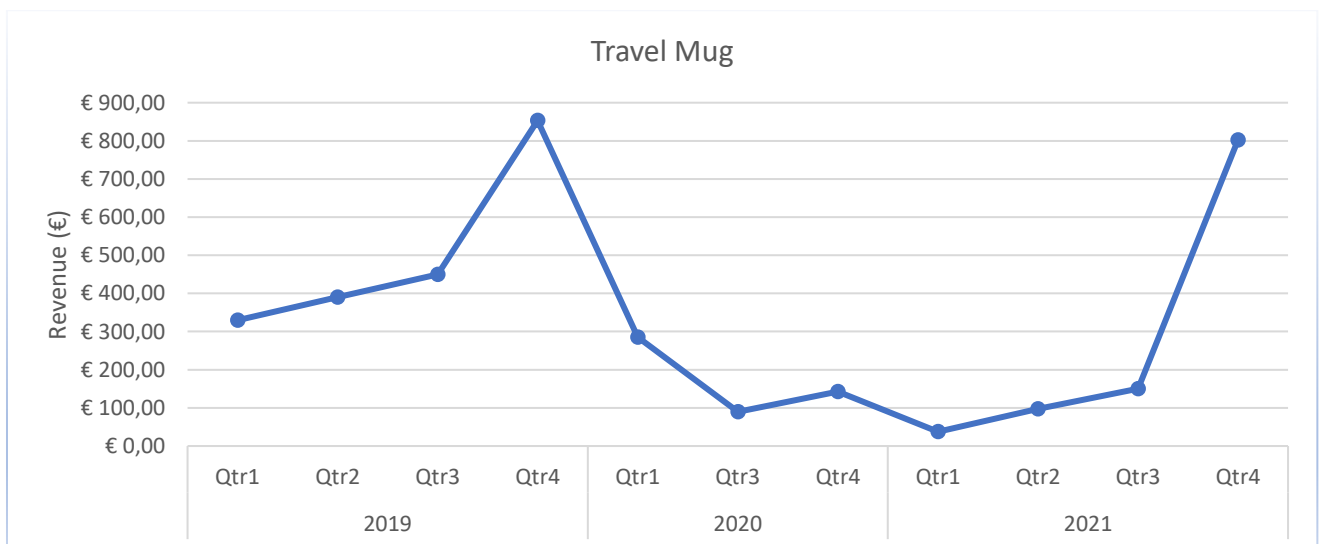

Figure 5.3: Revenue of the Travel Mug over the years

Target per category

As described in subsection 4.1.1 one of the wishes was to know how much revenue a product category

should generate per year to compensate for the personnel costs. Figure 5.4 below shows for the year 2019 if the targets have been achieved or not. It is a top-down approach that will tell what the performance of the quarter/year is/was. The targets have been calculated by taking the average percentage that a product category contributes to the total revenue of a year and multiplying this by all the cost of goods sold + the personnel costs.
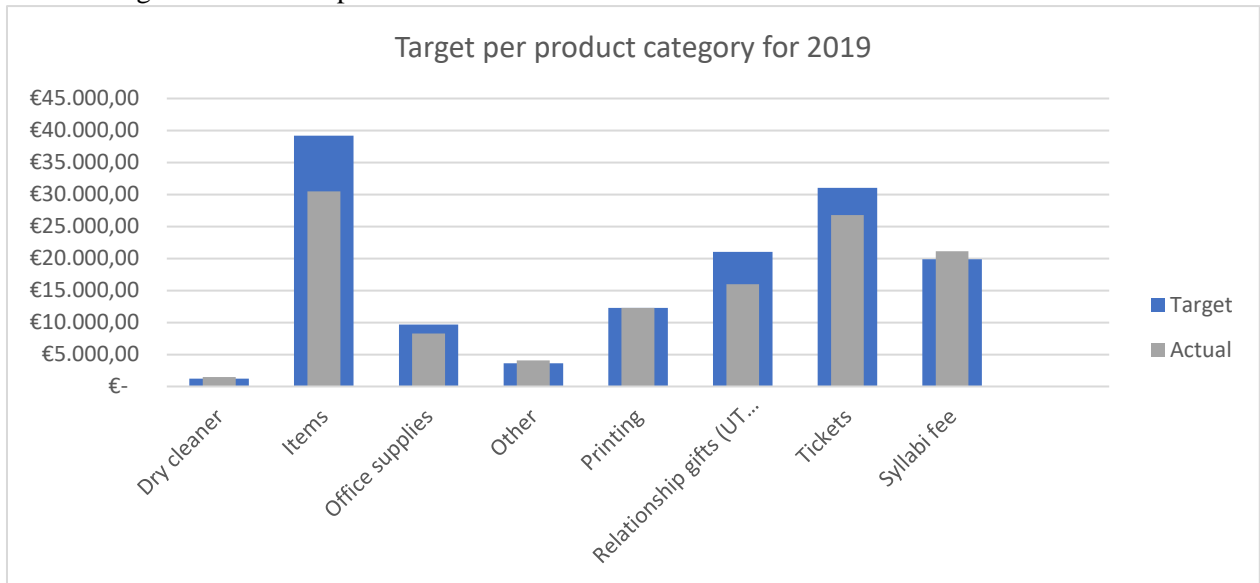

Figure 5.4: Histogram of the targets for product categories to cover personnel costs for 2019

For the year 2022 will the targets only consist of the personnel costs since the revenue and the costs of goods sold will be subtracted from each other leaving the gross profit.

Top 10 products based on revenue
The dashboard also contains a graph that displays the top 10 products based on the revenue. The user can select whether the top 10 is based on the entire product collection or within a product category. When the user monitors this KPI it is important to pay attention to the specific contexts of each product.
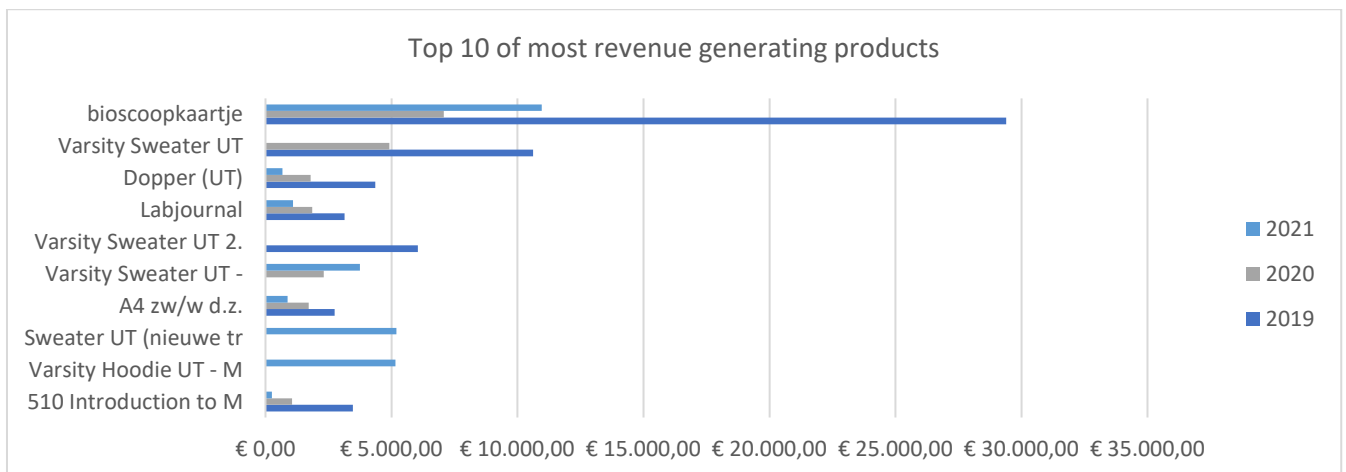

Figure 5.5: Bar diagram of the top 10 most revenue-generating products

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Inventory development

The figures below show the inventory levels and sales of two products over the last years. Only the ordering history of the UnionShop from 2019 is available and for both products can be seen that two times inventory is added. For the Join The Pipe Fles it is weird that so much inventory is bought even though the product is not selling that well. What also can be seen is that the quantity was so high that it took two years for the whole inventory to sell out. The same story applies to the Umbrella (UT). The order size was probably this high because it looked like a good deal to go for the volume discount. This should make the manager question if the time to sell was intended with the order size or if too much risk was taken by ordering so much inventory.
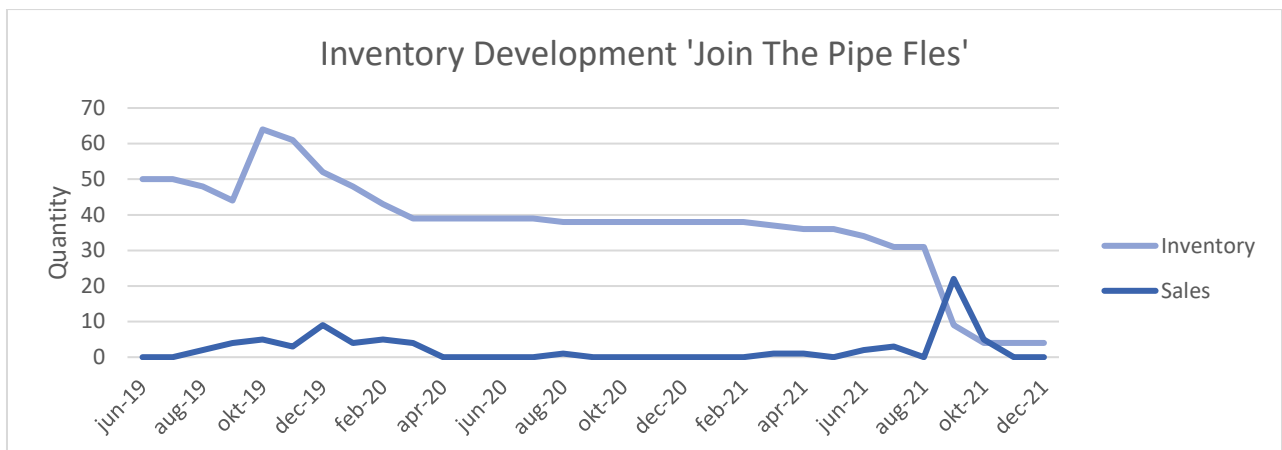

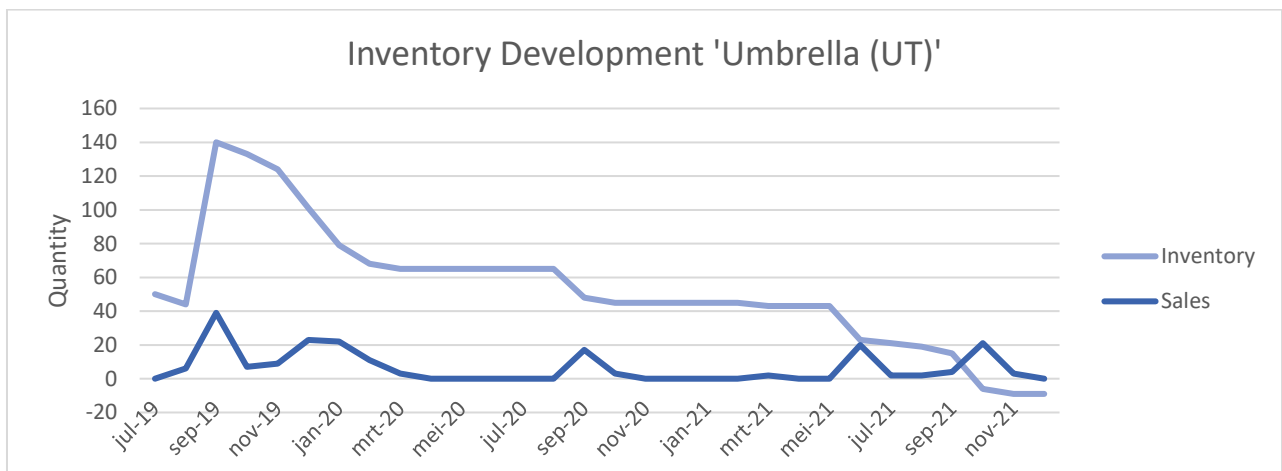Figure 5.6:Line chart of the Inventory Development of the product 'Join The Pipe Fles'

Figure 5.7: Line chart of the Inventory Development of the product 'Umbrella (UT)'

5.2 User Test of the System

In this subsection will the BI system be used by the manager of the UnionShop to find out if other managerial decisions will be made when the information from the BI system of subsection 5.1 is given. The decisions will include the introduction of a new product and the review of some of the current products.

5.2.1 Introduction of a new product

The manager of the UnionShop was asked to give an example of a new product that was almost ready to be ordered and added to the collection of the UnionShop for the first time. The product that was used in this example was the Be-o-Bottle. According to the manager, it was going to be the new dopper which

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was a good selling product in the last few years. The purchasing price of the Be-o-Bottle is 10,55 excl. VAT. In the table below will be described what the train of thought was of the manager when making decisions on the order quantity and future selling price. The table also documented which elements of the BI system were used by the manager to substantiate the decision.

Task	Decision-based on experience and intuition	Reason	Decision-based on the BI system	Reason	Elements used of the BI system
Determine the initial selling price of the Be-o-Bottle	€15,95 incl. VAT	- Desire to generate € 4,- profit (€10,55 excl. purchasing price) - Other Universities sell for the same price	€15,95 incl. VAT	- The dopper had a selling price of €12,50 and the Be-o-Bottle is a better product - The sales of the dopper were also high	- Revenue of the dopper of the last three years - Selling price of the dopper
Determine first order quantity of the Be-o-Bottle	500 pieces	- Volume discount	500 pieces	- Calculation tool shows that if every week 10 Be-o-Bottles are sold the number of sales will be 500+	- Calculation tool - Sales of dopper over the last three years

Table 5.1: Train of thought of the manager of the shop when introducing a new product

5.2.2 Review on products from the collection
The BI system is not only useful to help with the introduction of new products but also to review the choices that were made in the past. The table below will contain the review of the selling prices of fast-selling existing products.

Product	Current price	Reason	Reviewed price based on BI system	Reason	Elements used of the BI system
Notebook	€ 9,- incl. VAT	Has always been the selling price since the beginning	€ 10,- incl. VAT	The sales of this notebook increased significantly in the first quarter of every college year. Trial to raise the selling price to € 10,- at the beginning of the academic year	- Sales quantity over the last three years - Revenue per selling price
Sweater (new)	€ 24,99 incl. VAT	Good selling product and because of € 14,50 purchasing price the manager wants to generate € 10 profit	€ 29,99 incl. VAT	One of the best selling products so try to generate more profit buy raising the selling price	- Revenue of the sweater from the introduction till now

Table 5.2: Train of thought of the manager of the shop when reviewing the selling price of current products

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As shown in the table above, the manager's choice changes when the system is used. The system highlights the trends that can be seen in the graphs and the manager makes a conclusion based on the information.

5.3 Overall Benefits

In this subsection will be described what, according to the manager of the UnionShop, the benefits are of the BI system for the UnionShop.

- The system was found easy to use and the implementation was also clear.
- Other decisions are made when the manager takes a rational look at the actual performance of products as also can be seen in subsection 5.2.2. Estimations that on forehand were made only in mind are now not so likely to happen. The tools in the system helped the manager with simple calculations that were never made before. It showed the manager that she should think twice before making decisions.
- The system is not only useful for making managerial decisions but also to discuss with the Traffic department of the University about the selling prices of products that they both sell. With the current situation, the UnionShop could decide to raise their selling price of top-selling products such as the Sweaters and the Dopper. They can try to use a higher selling price for 3 months and wait for what the revenue would be. If the revenue increases and so does the profit, this would be an argument for the Traffic department of the University to let them increase their selling price or to ask for compensation for the profit the UnionShop misses out on.
- The employees of the UnionShop that work in the shop itself also get more insight into inventory levels and sales. They could come up with promotions on items that are not selling as fast as they would like or can think along with the manager about any other changes to the shop. The employees would get involved more easily than before.

5.4 Results Balanced Scorecard

To monitor the measurements and corresponding targets from the Balanced Scorecard, an Excel worksheet is made. The manager will be able to see if the shop is performing as wished to achieve their goals. Therefore, figure 5.7 shows the overall performance of the shop including the goals that are made in the BSC.

Balanced Scorecard

		Measurements		Targets	
Revenue 10% increase from last year	Current Revenue	€	525,00	€ 84.835,77	
Target revenue per product category for 2022	Items	€	225,00	€ 39.191,89	targets based on data from 2019
	Relationship gifts (UT merchandise)	€	-	€ 21.057,53	
	Office supplies	€	-	€ 9.695,96	
	Other	€	-	€ 3.616,20	
	Printing	€	-	€ 12.288,75	
	Syllabi fee	€	-	€ 19.909,64	
	Dry cleaner	€	-	€ 1.216,06	
	Tickets	€	-	€ 31.023,96	
Revenue new products	Products added from January 2022 onwards	€	-	€ 52,50	10% of total revenue from the year

Figure 5.7: Snapshot of the Balanced Scorecard at the beginning of January 2022

There cannot be concluded anything from the BSC. This can be done after one year to see if the shop has achieved its goals or in between when the shop wants to know what the current score is. If categories did not achieve their goals there needs to be investigated why the sales have underperformed and, for instance, which products were expected to generate more revenue.

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5.5 Conclusion

- It is difficult to predict what is going to happen when the new products are introduced. This makes it also difficult to set the initial selling price or order the first volume. The market should be researched as well to help the system with these kinds of decisions. However, this is outside the scope of this research. The system does help with the substantiation of the decisions and is useful to closely monitor the performance of the products when they are added to the collection.
- For existing products does the system make it way easier to check the performance of products when changes are made. Also, information about the performance in the past is available within clicks which makes the job of the manager easier as described in subsection 5.2.2.
- As can be seen in figures 5.6 and 5.7, the shop purchases a large order quantity to receive a volume discount. However, this quantity can be seen as too large because all the products from these orders are only sold in two years. The shop should try to calculate beforehand if such a volume discount is profitable for them or if it is too much risk to keep inventory for such a long time.
- As described in the conclusion of subsection 4.6, I believe that it was not worth it to put a lot of time into the completion of the invoice data. Now that the system is tested by the manager I still think that the data incompleteness would not have influenced the decision of the manager. Due to COVID-19, it remains very difficult to make sales predictions and the data would not have given the manager a better insight into the predictions.
- The manager and the board of the Student Union are satisfied with the information system and the corresponding graphs and information.
- The more data is stored over time the better the BI system gets and more trends can be found.

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6. Implementation of the information system

In this chapter will be described how to implement the information system into the daily use of the UnionShop. Furthermore, there will be described how the system should be used to keep all the data complete and consistent.

6.1 Fresh start with updated product list

Together with the managers of the shop, a way was invented that was the easiest for them to use while getting the most out of the system. This means that there will be two individual information systems: one with the historic data and one with all the data from 2022 onwards. It was done this way to keep the data consistent and to prevent errors from happening when adjusting the product list. A new product list is chosen to update all the product names and to work with product IDs to keep the new system clear and consistent. The new product list will make it easier for the managers to make differences between the SKUs. Also, all the products will be divided into the right product category. The product IDs will have the following structure: the first number of the 4 digits will represent the product category so, for example, clothing will have number 1, and all the products that will fall under clothing will look like this: 1 - - - . When there is a difference in an attribute such as color, the product ID will be different.

The manager will still be able to look at the historic data for the sales of products from the past years, but all the new sales and purchases will be included in the fresh system.

6.2 Loading new data

The sales data will be loaded into the system as was done before. In appendix A will be explained how the data can be loaded into the system. The information system will automatically add the product IDs throughout the entire system when new data is added to keep the data consistent.
In consultation with the manager of the shop, there has been decided that new purchases will be manually added to the system. This will prevent data inconsistency in the future regarding product names. It will not cost the manager a lot of time adding this to the system since the only thing that will need to be filled in are the product ID, quantity, price, and date. In appendix B will be shown what this will look like. Miscellaneous expenses, like service costs for the checkout system, can be added the same way.

6.3 Use of the system

The system is ready to use for the UnionShop from January 2022 onwards. The system will start with the current inventory levels of the shop and all the sales and purchases will update the inventory levels. Historic data will be limited at the beginning of the new system but can always be found in the other information system. The Excel file can be used whenever the manager needs to look up something or when data needs to be added with the use of the dashboard. The new product list will make sure that the data from the checkout system and the purchases will be identical. To use the system to its fullest potential and to keep the data complete it is the responsibility of the manager to add all the manual data into the system.

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7. Conclusions and Recommendations

The past chapters have described why this research is necessary, what the problem is of the UnionShop, what literature is needed to solve this problem, how this problem can be solved, and finally what the results of the research were. This final chapter will conclude on the research that has been performed and will come up with recommendations for the UnionShop for the future.

7.1 Conclusions

1. An information system was needed to make better managerial decisions and to get an overview of the performance of the shop. The substantiated managerial decisions will contribute to better inventory management and determination of the selling price. Monitoring the performance of the shop will give insights into new trends and room for improvement. This all should lead to a decrease in the loss the shop makes.
2. An updated product list with better product names including attributes, the introduction of product IDs, and updated product categories will help with data consistency.
3. The department of the University (Traffic), which also sells merchandise of the University, and the UnionShop should coordinate with each other on how both parties can cooperate. The cooperation can and should be profitable for both. This means that Traffic should either increase their selling price or provide the UnionShop with a compensation for the profit they lose on the limitation in determining the selling price.
4. The BI system will help the UnionShop to decrease the loss they are making but will not make the shop break even in the short term.

7.2 Discussion and Limitations

The goal of this research was to build an information system around the available data of the UnionShop. There are different kinds of information systems but the research has chosen for a BI system. The implementation of a BI system into a big company can take years to be implemented. Since this research has a limited period there was no time to implement such an advanced system. However, since the UnionShop is only a small company with only one store the possibilities for implementation are limited.

Large companies use data servers to store their data. The data that the UnionShop generates and keeps up is limited. An Excel file is sufficient to manage all the data but the limited data results in limited analysis possibilities. There does not exist any data about the customers or order sizes in the shop. This data should be stored by the UnionShop to respond to customer needs or do more research into customer practices.

Another limitation of this research is that promotion and the probable benefit are outside the scope of this research. In this research, it will come to mind that it is obvious to use the promotion to boost the sales of the UnionShop.

A point to discuss is if a BI system is not way too complicated for a small company such as the UnionShop. As mentioned above is BI usually implemented in large companies with lots of employees that work on the perfection of the system. The UnionShop does not have this option and will be solely maintained by a few people. A BI system might seem out of their league, but the concept of such a system would work for the shop. The system gives the shop a structured way of dealing with and getting the most out of their data.

Although the result of the research will support the daily way of managing the UnionShop and once implemented also generate some extra profit for the shop, it will only cover a part of the losses the shop makes. The chances that the shop will break even when trying to generate as much revenue as possible are low. Something fundamental should change to decrease the fixed costs of the UnionShop. In subsection 7.3 will be described what possibilities there are for the UnionShop to decrease these costs.

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7.3 Recommendations for the UnionShop

1. The first recommendation is to invest in a new checkout system. The current checkout system is outdated in the way that the UnionShop is not able to assign multiple attributes to products, extract data in the right format, learn about the value of basket size and get to know their customers. The system is too simplistic and with the limitations of the system mentioned above the shop could receive more valuable data with an updated checkout system. It would also let the UnionShop track its inventory.
   Another possible benefit would be to track at what time of the day most customers come to the shop. This would let the shop conclude if they should use different opening times. This could reduce the costs of the personnel.

2. The following recommendations concern some points of attention for the UnionShop to get the most out of the system. The first point is that the UnionShop should document and load all data into the system. The system is only functional to the best abilities when all costs and revenue are well documented and up to date. The costs and revenue should correspond to all the costs and revenue that are booked on the OFI number.
   When changes are made regarding a selling price of a product, the user should document these changes and check after a while if the changes had a positive or negative influence on the revenue. If the changes will be forgotten then the shop will miss out on (extra) revenue.
   I would recommend the UnionShop to order a small batch of products when introducing a new product to the shop. The system will let the employees monitor the performance of the new product and let them check if it is a success. This prevents the shop from ordering too much of a product that does not work for the shop and leaving them with a lot of inventory.

3. The last recommendation concerns the concept of the UnionShop entirely. The information system that is built for the UnionShop will support them in day-to-day decisions and will let the employees monitor the performance of the shop. However, the fixed costs of the shop are too high every year to be compensated by the sales of the products. Something fundamentally has to change for the shop to reduce these fixed costs. I would recommend reducing the storage of the shop drastically. Most of the storage is not used and could be rented by other parties. Another possible change would be to use only half of the store. Most revenue is produced by only 10 to 15 percent of all the products so it would be possible to only keep the most valuable products for the customers. Both changes would drastically reduce the fixed costs of the shop.

7.4 Recommendations for Future Research

This research has described the principles of a BI system and applied the descriptive phase. It gives a clear image of the current performance but does not tell anything about the future. The predictive and prescriptive phases of the system can be applied in future research. These phases can only be reached when enough data is gathered to calculate new KPIs. Such KPIs include the EOQ, reorder point, and forecast of sales and will give the UnionShop even more information about the performance of their products.

Other future research would be marketing related to boosting the sales of the shop. Better promotions, advertisements, or even an online shop are all options that can be researched in the future.
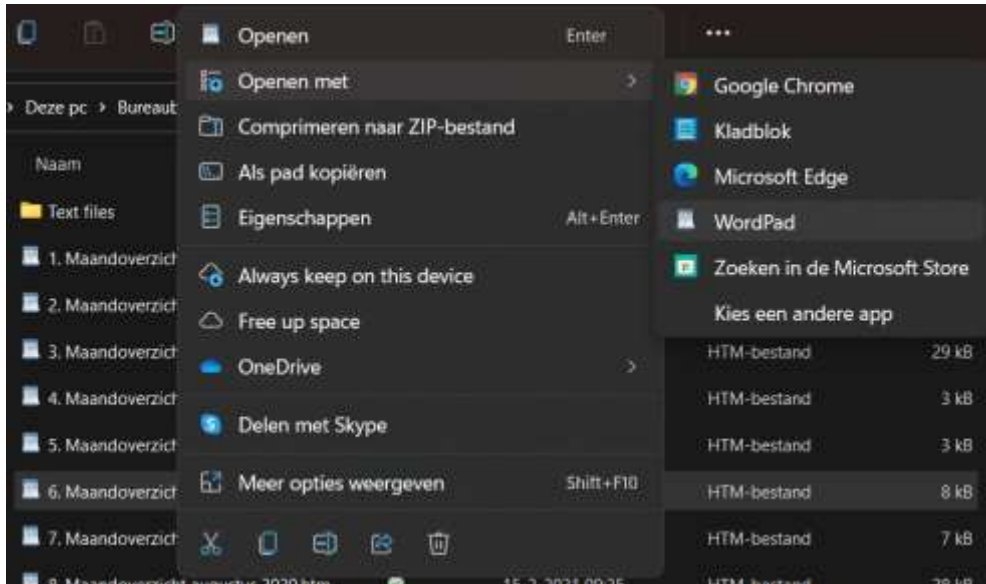
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8. References

Bogdan Nedelcu, (2013), Business Intelligence Systems, *Database Systems Journal*, 4, (4), 12-20

Chopra, S., Meindl, P., & Kalra, D. V. (2016). *Supply Chain Management: Strategy, Planning, and Operation* (6th ed.). Pearson Education India.

Delen, D., Turban, E., & Sharda, D. K. R. (2017). *Business Intelligence: A Managerial Approach, Global Edition* (4th ed.). Pearson Education Limited.

Foley, R., & Guillemette, M. G. (2010). What is Business Intelligence? *International Journal of Business Intelligence Research*, *1*(4), 1–28. https://doi.org/10.4018/jbir.2010100101

Kaplan, R., & Norton, D.P. (1993). Putting the balanced scorecard to work. *Harvard Business Review, 71*, 134-142.

Laudon, J., & Laudon, K. C. (2017). *Management Information Systems* (15th edition). Pearson Education Limited.

Sharda, R., Delen, D., & Turban, E. (2016). *Business Intelligence, Analytics, and Data Science*. Pearson Education.

9. Appendices

Appendix A:

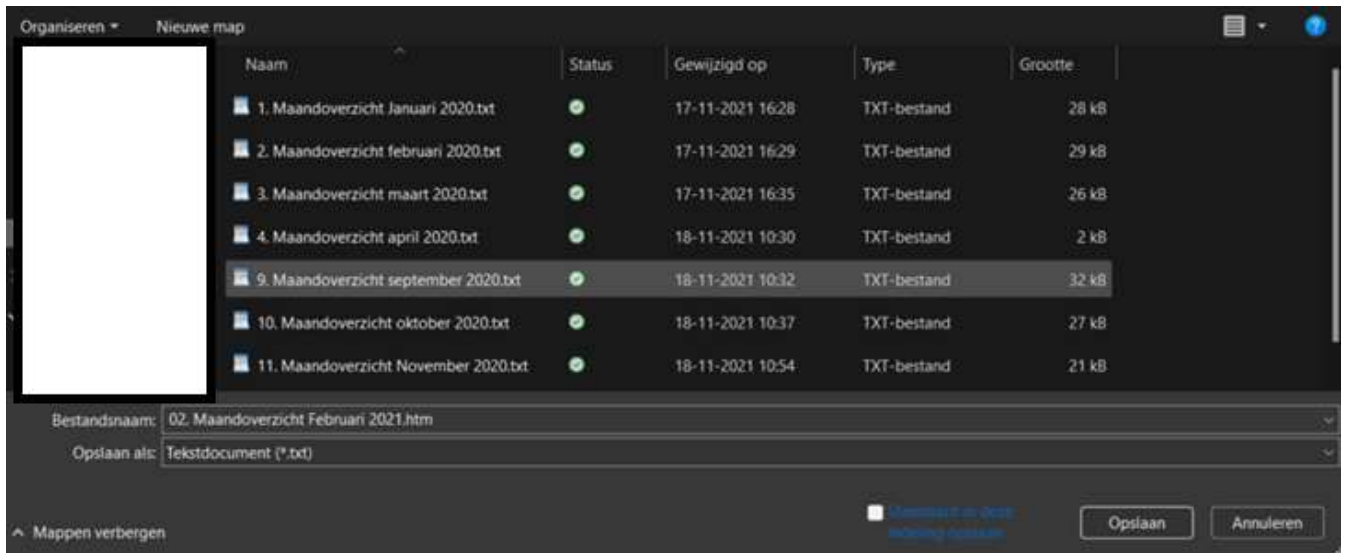*Instructions on how to load in the data from the checkout system*

Step 1: open HTML file from the checkout system with Wordpad

Step 2: delete the blue line in the text

Step 3: save the file in the designated folder

Step 4: select the "Sales" worksheet, select a cell in the table and click refresh to automatically add all the data

Appendix B
Instructions on how to add new purchases

The filled cells need to be done manually

Product ID	Product name	Category	Quantity	Amount	Date
1001			10	€ 150,00	17-1-2022

Once the product ID is filled the product name and category will be automatically be added

Product ID	Product name	Category	Quantity	Amount	Date
1001	Sweater Grey L	Clothing	10	€ 150,00	17-1-2022

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Appendix C
Screenshot of the dashboard of historic data

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