UNIVERSITÀ DI PISA

DEPARTMENT OF COMPUTER SCIENCE
MASTER IN DATA SCIENCE AND BUSINESS INFORMATICS

FUNDAMENTALS OF BUSINESS MANAGEMENT

BUSINESS DATA SCIENCE FOR YOU CHALLENGE

The Inventory Stocks Value Determination

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Chapter 1

The food and bevarage industries

The dynamic global food and beverage industry, spanning production, processing, distribution, and consumption, has evolved significantly. Originating in ancient civilizations, it underwent pivotal changes during the shift from nomadic to settled agricultural communities. The Middle Ages brought innovations in food preparation, and the 15th-century European spice trade globalized flavors. The Industrial Revolution mechanized production, and the 20th century saw transformative developments like refrigeration and packaging, giving rise to supermarkets and fast-food chains.

1.1 Economic and Social Importance

The industry is a major economic driver, generating revenue, providing employment, and contributing significantly to countries' GDP. Its multifaceted nature spans agriculture, manufacturing, distribution, and retail. Global trade and complex supply chains characterize its international reach, fostering economic interdependence. Food's cultural significance preserves identity, impacting public health, and providing spaces for social interactions.

1.2 Sustainability

Sustainability is integral to modern business, addressing social, economic, and environmental impacts. Waste reduction, efficient resource use, and pollution mitigation are crucial. The food and beverage industry, a significant emitter, must prioritize environmental stewardship. Integrating sustainable practices presents opportunities, such as upcycling in food processing and adopting eco-friendly measures.

1.3 Market segmentation

Our industry analysis categorizes the market into distinct segments, focusing on different product types:

- **Dairy Products**: The dairy products market offers a diverse range of items derived from milk, known for health benefits and global popularity. Key components include milk, cheese, yogurt, butter, and cream. Factors driving the market include increased consumer awareness of health benefits, demand for convenient and nutritious options, and a trend towards incorporating dairy into functional foods. Sustainability concerns in dairy farming impact the industry, prompting a focus on eco-friendly practices.
- **Baked Goods**: Baked goods are central to culinary traditions worldwide, satisfying diverse consumer preferences. Key components encompass bread, pastries, cakes, and cookies, crafted with various flours and sweeteners. The market balances traditional recipes with innovative creations, influenced by consumer lifestyle changes and a growing demand for natural and organic

products. Challenges include fluctuating commodity prices, ingredient sourcing complexities, and the need for sustainable production practices.

- **Beverages**: The dynamic beverages market includes soft drinks, juices, bottled water, coffee, tea, energy drinks, and alcoholic beverages. Key components cater to hydration, nutrition, socializing, and relaxation. Beverage manufacturers, global and local, shape the market through continuous innovation, product diversification, and health-enhancing offerings. The sector is characterized by fierce competition, branding strategies, and marketing initiatives to capture consumer loyalty.
- **Ready-to-Eat Meals**: The ready-to-eat meals market meets the demand for convenient dining solutions, offering fully prepared packaged meals. Key components include a variety of dishes and cuisines, addressing the needs of busy individuals. Manufacturers focus on innovation, preserving flavor and nutritional value, while accommodating changing dietary preferences. Factors influencing the market include evolving consumer lifestyles, health trends, and a desire for transparent ingredient sourcing.

Chapter 2

Inventory management systems

Inventory management, crucial for business success, efficiently captures stock movements through a system combining hardware and software tools in the supply chain (Kafyetta, 2016). Saleemi (2004) underscores its importance for preserving investments, reducing costs, and enhancing affordability. The primary objective is to minimize downtime due to stock shortages and manage inventory carrying costs effectively. Various types of inventory control systems, highlighted by Ali et al. (2014), play a pivotal role in daily operations, boosting overall performance. These include shipping, purchasing, receiving, warehouse storage, turnover, tracking, and reordering of inputs. Adoga & Valverde (2014) stress the significance of ensuring correct inventory availability at the right time to meet client demands. En-Kanselu (2008) distinguishes two main forms: perpetual and periodic, each with subsystems like barcode and RFID, contributing to increased supply chain productivity and efficiency. Efficient inventory control is essential for organizational success.

2.1 Perpetual inventory control systems

The perpetual inventory control system ensures continuous updates of inventory records, providing real-time information on item movements. It's preferred for its accuracy and speed when integrated with a database and barcode scanners. However, drawbacks include high implementation costs due to technology dependence, maintenance expenses, potential discrepancies between recorded and actual inventory, and challenges in identifying inconsistencies, theft, and scanning errors. Careful consideration of strengths and weaknesses is vital in system selection to impact organizational performance positively.

2.2 Periodic inventory systems

Periodic inventory control systems differ from perpetual systems as they do not track inventory daily but rather allow establishments to determine the opening and closing levels of inventory within specific time frames. Encompassing actual inventory amounts, these systems adjust the purchases account balance to match end inventory cost when the physical inventory is complete (Chopra, 2015). Unlike perpetual systems, periodic inventory systems are known for their user-friendly nature and entail fewer challenges in implementation.

2.3 Barcode inventory control systems

Barcode inventory control systems are regarded more precise and effective than physical inventory operations. When utilized as a fragment of an entire control inventory system, barcode systems instantly update levels of inventory whenever labors scan them using a barcode scanner or mobile device. Enkanselu (2008) describes the advantages of using bar-coding in inventory control system management procedures, such as maintaining precise data of all inventory transactions, eliminating time-consuming data errors that may occur frequently with manual or paper systems, and minimizing manual data entry errors.

2.4 Inventory control management practices/ techniques

Various inventory control management practices or models underlie the effective management of inventory control systems to ensure the optimal quantity of inventory for running a profitable and cost-effective business. Primarily applicable in large-scale organizations, such as manufacturing industries, these practices include Stock Review, Automatic Replenishment, ABC Inventory Model, Just-In-Time (JIT) Inventory, Economic Order Quantity (EOQ), and Vendor Managed Inventory (VMI).

2.4.1 Stock review

Stock review is a straightforward inventory control system management technique, particularly suitable for small-scale organizations. It involves frequent manual or automated reviews of existing inventory against anticipated future demands. While it is simple to implement, its labor-intensive nature and susceptibility to errors require careful application (Adamu et al., 2014).

2.4.2 Vendor managed inventory (VMI)

Vendor Managed Inventory is a supply network approach where the supplier manages the buyer's inventory. The vendor has access to the buyer's inventory and demand information, with the responsibility to refill it based on mutually agreed-upon inventory control principles. This collaborative approach aims to enhance efficiency, reduce holding costs, and ensure a continuous supply of goods (Smaros et al., 2003).

2.4.3 Automatic replenishment

Automatic replenishment is a technologically advanced inventory management technique that automates the reordering process when inventory reaches a predetermined level. This minimizes the risk of stockouts, ensuring consistent product availability. Leveraging real-time data and automated systems, it enhances operational efficiency.

2.4.4 Economic order quantity (EOQ)

EOQ minimizes inventory costs but requires a comprehensive understanding of usage, ordering, holding costs, and order quantity. Despite challenges, it contributes to cost reduction and business efficiency.

2.4.5 Just - In Time (JIT) inventory

According to Farzaneh (2012), JIT can eliminate garage, investment, insurance, ordering, and shipping costs. However, it is contingent on the current circumstances. In the ideal circumstance, when all of the parameters are met, it is more cost-effective to choose JIT over EOQ since it results in a simultaneous reduction in purchase price, protection charge, and ordering fee, as Farzaneh recommends (2012).

2.4.6 ABC Inventory Model

Mandal's (2012) ABC Inventory Model categorizes items based on their cash value within the overall inventory. Ng (2007) emphasizes the need for heightened control over high-value "A" items, requiring strict supervision and skilled attention. "B" items, falling in the middle range, receive moderate attention, balancing cost and importance. Meanwhile, "C" items, the least expensive, require basic control with minimal managerial attention. Aligned with the Pareto principle, Lyson (2006) asserts that a small percentage of items (A items) significantly contributes to overall value, justifying prioritized management efforts. The ABC Inventory Model efficiently optimizes resources and directs managerial attention where it is most impactful.

2.5 Conclusions

In conclusion, effective inventory control is a strategic and multifaceted process requiring careful consideration. The selection of inventory control systems depends on factors such as organizational size, product nature, and business objectives. While technological advancements provide innovative solutions, a thorough evaluation of each method's strengths and weaknesses is essential.

Chapter 3

Our target company - Bonomelli

In order to apply inventory management strategies, we decided to focus our work toward a single representative company. After considering various possibilities our choice fell on Bonomelli s.r.l. which is an Italian food and beverage company specialized in herb and plant based products.

3.1 The history

In 1908 Luigi Amedeo Bonomelli opened his first herbal pharmacy in Milan; his passion and competence, in 1926, resulted in the famous Camomilla Bonomelli. Constantly searching for the best raw materials, in 1939 in Foggia he founded the first Italian experimental centre for the study, cultivation and drying of chamomile leaves. Bonomelli has developed a wide-ranging and multifaceted array of products; in addition to chamomile, it also infusions, herb teas and plant based supplements to serve as point of reference in the functional beverage and natural well being sector.

3.2 Income statement

BONOMELLI S.R.L.
STATEMENT OF PROFIT OR LOSS
AND OTHER COMPREHENSIVE INCOME
FOR THE YEAR ENDED 30 APRIL 2023

	EUR	EUR
Description	**30-Apr-2023**	**30-Apr-22**
Revenues	101.816.845	101.756.343
Variation of inventory	(1.398.869)	1.217.549
Other revenues	1.796.426	1.354.304
Gross Profit	**102.214.402**	**104.328.196**
Operating Expenses	84.929.729	85.722.326
Administrative Expenses	9.333.675	8.834.912
Selling Distribution Expenses	4.477.843	3.013.047
Operating Income	**3.459.847**	**6.757.911**
Financial Expenses	(719.929)	(669.130)
Net Profit before Tax	2.753.226	6.088.781
Income Tax Expenses	(552.520)	(1.129.873)
Net Profit After Tax	**2.200.706**	**4.958.908**

Table 3.1: Income Statement of Bonomelli s.r.l.

3.3 Balance sheet

BONOMELLI S.R.L.
STATEMENT OF FINANCIAL POSITION
AS AT 30 APRIL 2023

	EUR	EUR
Description	30-Apr-23	30-Apr-22
ASSETS		
Non-Current Assets		
Property, Plant Equipment	16.803.827	17.140.472
Current Assets		
Inventories	12.702.342	14.034.742
Accounts Receivable	22.822.172	19.194.910
Other current assets	115.414.032	111.821.916
Accruals and deferrals	124.081	138.833
Cash Cash Equivalents	63.557	773.139
Total Assets	**167.930.011**	**163.104.012**
EQUITY LIABILITY		
Shareholders' Equity		
Share Capital	8.500.000	8.500.000
Revaluation Reserve	36.725.288	36.725.288
Profit/loss	2.268.036	5.026.238
Other reserves	96.952.619	91.993.709
Total risk provision	634.113	593.107
Severance pay	578.856	575.730
Current Liabilities		
Short Term Loan	22.075.894	19.564.295
Accruals and deferrals	195.205	125.645
Total	**167.930.011**	**163.104.012**

Table 3.2: Balance Sheet of Bonomelli s.r.l.

3.4 Group Policies

In the following section we will use the data contained in the financial statement and balance sheet to evaluate the company policies. In the Figure 3.1 we can see a dashboard that will help us to visualize how some important data changed in the years. Our analysis will focus on the basic information that characterize a company's behaviour in terms of investments and resources management.

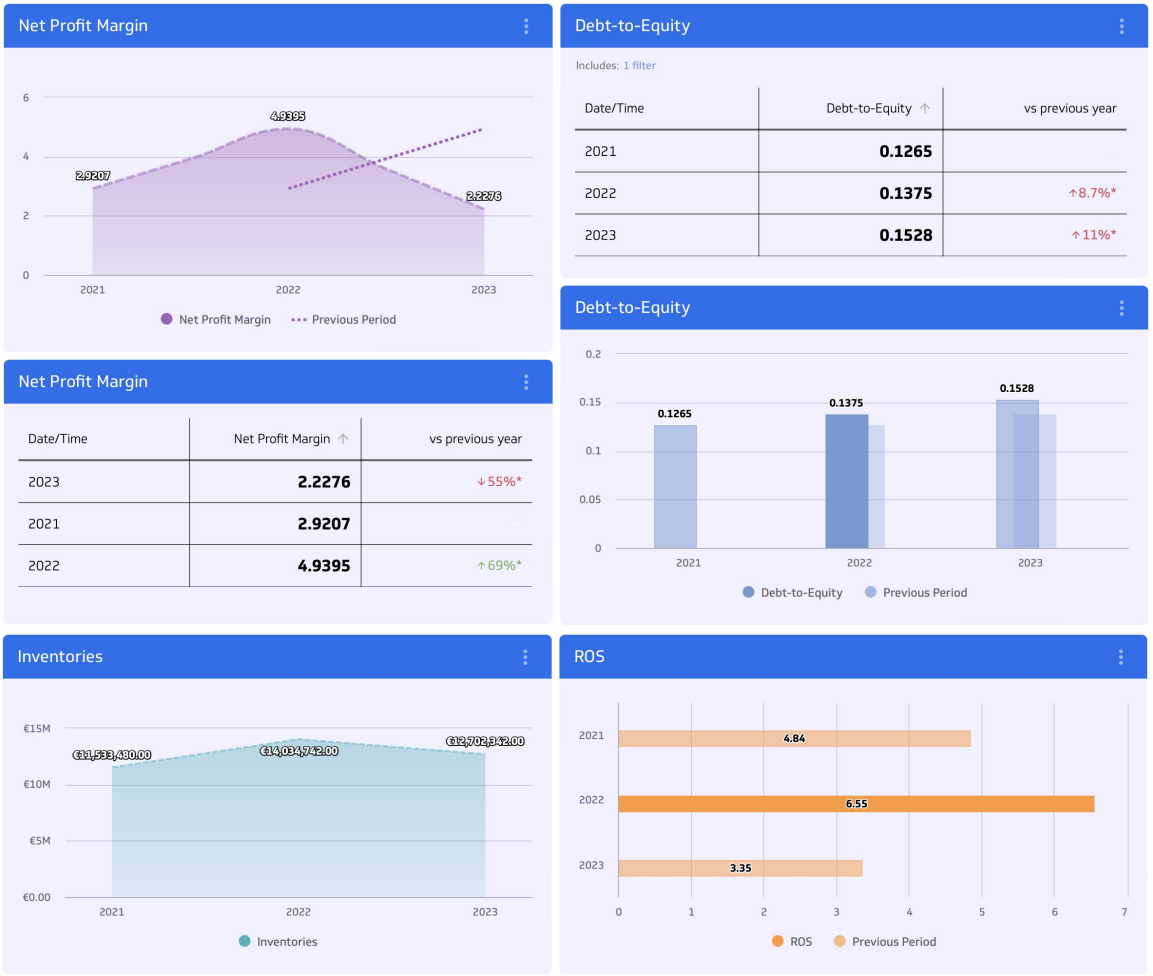

Figure 3.1: Financial Dashboard of Bonomelli in years 2021 - 2023

3.4.1 Profit margin index

The first index that will be observed is the **profit margin**, this index represents the percentage of profit a company makes for each dollar of revenue it generates. A high value of this index indicates that a larger percentage of each sale translates into profit after accounting for all expenses, that means that the company has an effective cost management or higher efficiency. The index is calculated using the following formula:

$$\textbf{Profit Margin} = \frac{\textit{Net Profit}}{\textit{Sales Revenues}} \cdot 100$$

Our analysis led to the following result for this index:

$$\begin{aligned}\textbf{Profit Margin}_{2021} &= 2.92\\ \textbf{Profit Margin}_{2022} &= 4.93\\ \textbf{Profit Margin}_{2023} &= 2.22\end{aligned}$$

This can be considered a low value for the index, but to say this we would need to do a complete different analysis based on the costs structure, the market and his competitors. For our interests we can use this numbers to say that the company register a massive loss on the earnings in 2023 compared to the previous year's performance, this is supported by the fact that the Net Profit has dropped more

than 50%, going from €4.958.908 in 2022 to €2.200.706 of the 2023, despite the fact that the revenues from sales has remained pretty much the same. We can say that they may not be so interested to obtain the maximum profit from their activities in this particular moment, instead they sacrifice some of it to gain a part of the market from the competitors, this can be done for example applying strategies to lower the prices in order to bring up the sales.

3.4.2 Financial Leverage

The Financial Leverage indicates the proportion between debt and equity, is the strategic endeavor of borrowing money to invest in assets. The goal is to have the return on those assets exceed the cost of borrowing funds that paid for those assets. The goal of financial leverage is to increase an investor's profitability without using additional personal capital.

$$\textbf{Financial Leverage} = \frac{Total\ Debt}{Equity}$$

The situation of our company's financial leverage is the following:

$$\textbf{Financial Leverage}_{2021} = 0,12$$
$$\textbf{Financial Leverage}_{2022} = 0,13$$
$$\textbf{Financial Leverage}_{2023} = 0,15$$

This value suggests us that to achieve its goals, Bonomelli s.r.l. relies more on his own equity rather than from debt, we notice that this index can be slightly in contrast with the previous we have calculated. Often a low value of financial leverage means that the company hasn't so much interest in expanding, since applying such strategies using equity is very difficult. But even the value of the index is low, it should be read as the company that is undertaking the process to expand the shares, it can be deducted from the growing value of Financial Leverage. This thesis is strengthen by the value of **short term loans**, that has registered a big grow, going from €17 millions to €22 millions, meaning that the company combines his equity to a growing amount of external investments.

3.4.3 Inventories

Inventory valuation is an accounting practice that allowed to find out the value of unsold inventory stock at the time they are preparing their financial statements. Inventory stock is an asset for an organization, and to record it in the balance sheet, it needs to have a financial value. This value can help to determine the inventory turnover ratio, which in turn will help the company to plan the purchasing decisions. There are different ways to calculate the the value of the inventory, in this case it was calculated by the FIFO method.

$$\textbf{Inventory value} = \textit{Cost of oldest inventory} \times \textit{Amount of inventory sold}$$

The FIFO method is an excellent indicator of your brand's ending inventory value. Because your older products have already been sold and shipped out, it's your newer products that are still hanging out on your warehouse shelves. That is to say, they're an accurate representation of the cost of goods available for sale (which is an amount needed to run through your inventory valuation).

3.4.4 ROS

Return on sales (ROS) is a financial ratio assessing the percentage of business operating profit earned from net sales or net revenue. The Return On Sales (ROS) formula uses earnings before interest and

taxes in the numerator for operating profit. In the denominator is used the net sales or net revenues on the income statement The return on sales ratio measures operational efficiency and profitability.

$$\textbf{ROS} = \frac{\textit{Operating Profit}}{\textit{Net Sales Revenue}}$$

Return on sales is a profitability ratio and efficiency ratio.The higher the return on sales, the more profitable the business. Company goals should include increasing the return on sales metric, revenues, and operating profit. Increasing ROS shows business profitability improvement. Instead, decreasing ROS means that the company's profitability is eroding, either due to a lower sales level or increased operational costs and expenses. It's important to keep in mind that the return on sales ratio formula does not take into account non-operating activities like financing structure and taxes. Things like interest expense and income tax expense, for example, are not included in ROS calculation because they aren't considered operating expenses. Not including these figures enables leadership, investors and creditors to understand the core operations of your business and its profitability. In our case the situation of our company is shown in the bar chart of the Figure 3.1. We can see how values have a big change during the years especially there's a critical decrease from 6.55 in 2022 to 3.35 in 2023

3.4.5 Conclusions

Based on this brief analysis led on the company's numbers we can extract an idea of what is the policies followed in the last year of business. The numbers tell us that, even if the capital structure isn't already on point, the company is starting to expand his presence on the market, to assume a central role in the industry, this can be deduced also from the participation in other companies that operate in the same business as them.

Chapter 4

Performance evaluation

Assessing company performance is crucial in the long-term success as it provides a clear overview of the current state of the company and offers guidance on where to focus resources, time and efforts to achieve meaningful improvements. In the subsection below, it will be explained how a company can manage this stage.

4.1 KPIs and benchmarks

Key performance indicators (KPI) refer to a set of quantifiable measurements used to track a company's overall performance in relation to its established goals. Typically they are involved in the internal processes and provide lots of useful information about the state of a firm. Once the indicators are settled and obtained, the benchmarks are extremely powerful tools because consist in comparing your performances to the past, to different divisions within the company (internal), or to the ones of your competitors that act in the same market (competitive). They also help the firm to set realistic and reachable goals. These two measures are both vital during the business' strategy elaboration, the tracking progress and the problem's awareness phase in which you can identify gaps and opportunities.

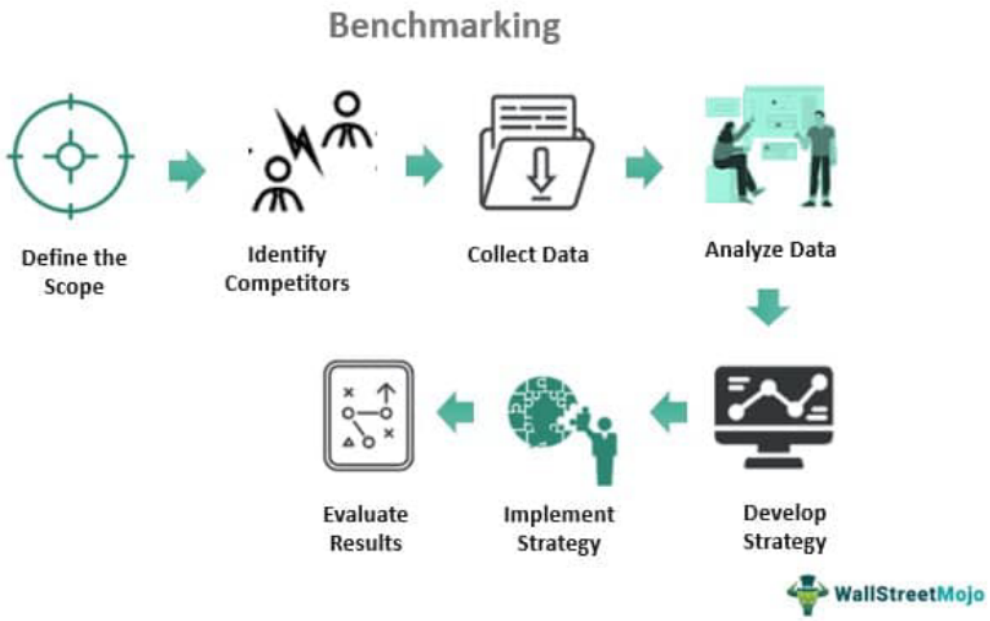

Figure 4.1: Benchmarking process

4.2 KPIs for our client

It can be challenging to determine which metrics are actually worth using. In fact, it's easy to adopt some that are either too distant from our goals or don't provide the information we seek. Keeping in mind our company's objectives and needs, a list of useful indicators (about company's operations and management) is presented below:

- **Inventory Turnover:** a measurement that tracks how many times the inventory is sold and replaced over a set period of time (usually a year). Especially in this sector, perishable items are a daily concern and understanding how to avoid this situation is quite important. As shown in formula (4.1), the higher this metric is, the quicker the company cycles its inventory. Therefore, a low value may suggest that it remains in stock for a longer period.

$$Inventory\,Turnover = \frac{Cost\,of\,Goods\,Sold\,(COGS)}{Average\,Inventory\,Value} \tag{4.1}$$

- **Days Inventory Outstanding (DIO):** a measure of inventory management effectiveness that represents the average number of days inventory remains in stock before being sold. A low value indicates that the firm is able to turn its inventory into sales quickly.

$$DIO = \frac{Average\,Inventory}{Costs\,of\,Goods\,Sold} * Number\,of\,Days \tag{4.2}$$

- **Stock-out Rate (SR):** measure that tells us how often a specific item's inventory is depleted. When the formula returns a high value, it means that there could be some issues related to inventory management or demand forecasting.

$$SR = \frac{N.\,Stockout\,order}{Total\,customer\,orders} * 100 \tag{4.3}$$

- **Fill rate:** the percentage of orders fulfilled directly from available stock. A high fill ratio suggests good product availability.

$$Fill\,Rate = \frac{N.\,orders\,fulfilled}{Total\,N.\,orders} * 100 \tag{4.4}$$

- **Cash Conversion Cycle (CCC):** a metric that expresses the time (in days) that it takes for a company to turn its investments in inventory and other resources into revenue. The lower this metric is, the better is for the company.

$$CCC = DIO + DSO - DPO \tag{4.5}$$

  Where DIO is taken from formula (4.2), DSO[1] stands for "Days sales outstanding" and DPO[2] stands for "Days payables outstanding".

- **Production Yield:** measures the percentage of finished products obtained from initial materials. Higher yield indicates better production efficiency.

$$Yield = \frac{Goods\,parts\,produced}{Total\,N.\,parts\,started\,in\,production} \tag{4.6}$$

[1]DSO tells how long it takes to collect cash generated from the sales. It is obtained by dividing *average accounts receivables* and *revenue* per day.

[2]DPO takes into account the amount of money that the company owes its current suppliers for the inventory and goods purchased and it represents the time span in which the company must pay. It is obtained by dividing *average accounts payable* and *cost of goods sold* per day.

Through the usage of these metrics it's even more clear how KPIs play a pivotal role in a company's decision-making process, especially in inventory management and product optimization strategies.
For istance, when analyzing KPIs related to inventory turnover, such as the rate of sales or the speed at which products leave the warehouse (outbound transactions), companies gain insights into the performance of individual products. This insight informs them whether certain products are *slow-moving*, indicating potential issues in demand, pricing, or market interest. Moreover, considering the product shelf life alongside outbound rates is crucial. Products with a limited shelf life and low outbound transactions pose a significant risk of expiry or spoilage, leading to financial losses. This intersection of data can prompt decisions regarding markdowns, promotions, or even discontinuation of such products to mitigate losses and optimize inventory space. If a product instead consistently demonstrates high outbound rates and profitability, it might warrant increased procurement to capitalize on its success. Conversely, products with consistently low performance metrics may signal a need for strategic adjustments, including potential removal or repositioning in the market.
KPIs not only assist in identifying which products to focus on for increased sales but also shed light on the cost implications of maintaining excess inventory. Excessive stock ties up capital and incurs additional costs related to storage, handling, and potential obsolescence. By leveraging these metrics, companies can seek a balance between supply and demand, ensuring optimal inventory levels to meet customer needs while minimizing storage expenses.
Ultimately, the power of KPIs lies in their ability to provide actionable insights for companies to fine-tune their inventory management strategies, streamline operations, and optimize profitability in a competitive market landscape.

Chapter 5

The mockup

In our featured case study, our client presented a crucial challenge: the need for an advanced inventory management solution. Their vision encompassed a model that not only gauged the value of their inventory but also fine-tuned stock levels through insightful analysis of operational data. Rising to this challenge, our team conceptualized and brought to life a two-parts solution: the first part consists in the *Inventory Estimator*, a web application tailored for seamless inventory valuation and stock level monitoring. The second part remains a web application, centering its attention on the meticulous estimation of crucial *Key Performance Indicators (KPIs)*. These KPIs serve as invaluable metrics, illuminating the company's overall health and facilitating insightful comparisons with industry counterparts.

5.1 Inventory Estimator Tool

The Inventory Estimator is more than just a tool; it is a strategic asset that empowers businesses to effortlessly assess the value of their inventory while maintaining optimal stock levels. In the subsequent sections, we delve into a comprehensive exploration of this software, elucidating its features and highlighting the transformative impact it can have on operational efficiency and financial management.

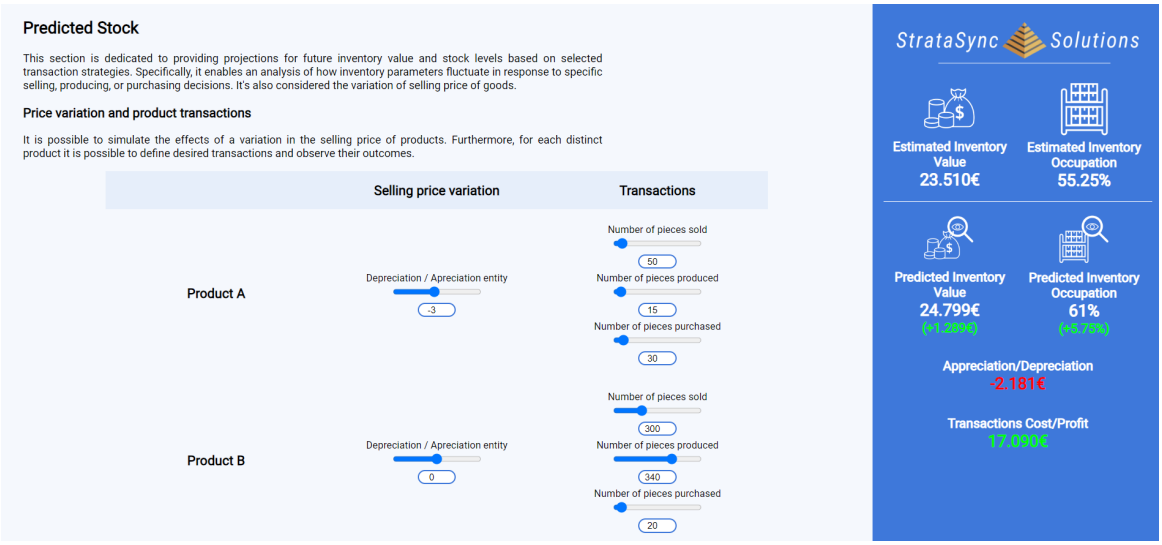

Figure 5.1: Screenshot of the Inventory Estimator Tool webapp

5.1.1 The idea

Our objective was to deliver impactful results with minimal input data, ensuring that our application remains both swift and user-friendly. To achieve this, we meticulously identified the essential information required to generate the desired outcomes. Our approach involved devising efficient formulae capable of transforming raw input data into meaningful insights. Our commitment went beyond merely

estimating the current value of an inventory. We envisioned a tool that not only provides a snapshot of the present but also forecasts future scenarios based on predicted activities. In essence, our software not only calculates the current inventory value and occupancy but also foresees the outcomes of specific operational activities, considering the evolving value dynamics of products over time. This holistic perspective equips businesses with a predictive edge, enabling informed decision-making and strategic planning for the future.

5.1.2 Technical details

The prototype we crafted as a mockup for a potentially more complex solution was developed using fundamental web languages: HTML, CSS for structural elegance, and JavaScript for back-end processing. The application unfolds with a spacious left-hand interface for user input and a dynamic right-hand vertical bar displaying real-time outputs. There are two main sections:

- **Current stock**: users are prompted to input the maximum inventory capacity, the quantity of distinct products stored, and for each product, specifics such as the number of pieces, estimated selling price, transaction costs (covering both production and purchase), and the spatial footprint of a single product unit. Leveraging this data, the contribution margin for each product is computed. Subsequently, these margins are harnessed to calculate the current estimated inventory value and occupation.
- **Predicted stock**: this section accommodates user indications regarding potential selling price fluctuations over time and predicted transactions for each product. Armed with this information, the application not only forecasts the estimated inventory value and occupation but also computes the overall cost of appreciation/depreciation of products and the projected costs or profits associated with the predicted transactions.

This thoughtfully designed interface not only streamlines user interaction but also encapsulates a powerful engine, empowering businesses with comprehensive insights into both their current and future inventory dynamics.

5.2 KPIs Estimator Tool

Accurate inventory information is undoubtedly crucial, but understanding how to leverage and distill that data into key values for assessing the company's overall performance is equally essential. To address this need, we've introduced the *KPIs Estimator Tool*—a software designed to effortlessly and rapidly generate Key Performance Indicators, providing the company with valuable insights in a streamlined manner.

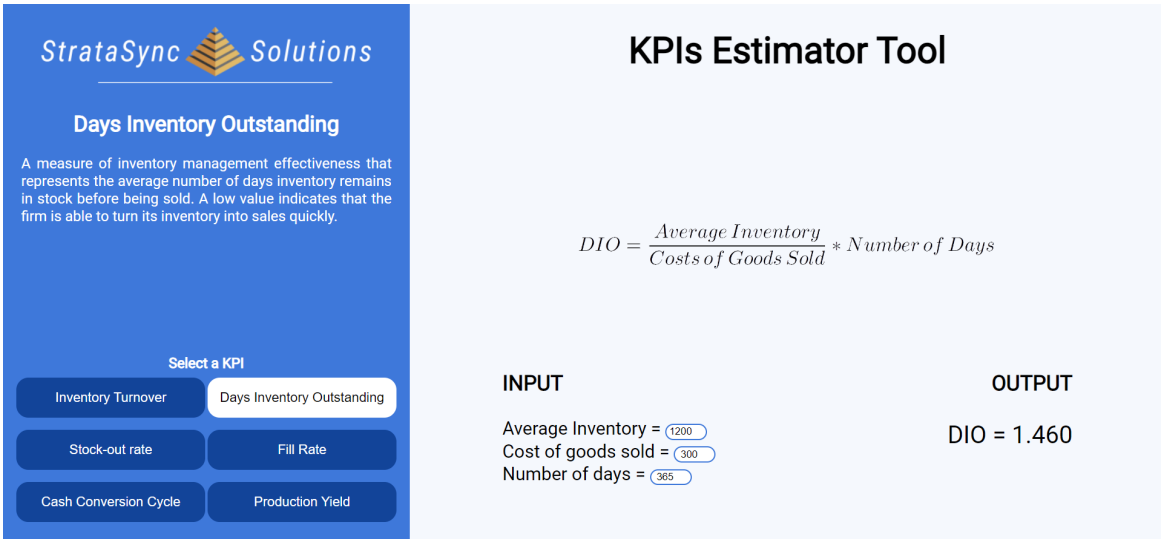

Figure 5.2: Screenshot of the KPI Estimator Tool webapp

5.2.1 The idea

Beyond the mere presentation of numbers, our focus was on instilling a deep understanding of KPIs—what they represent, how their computations unfold, and the practical utility they offer. Our aim is to enable users not only to effortlessly retrieve results but also to comprehend the nuanced meanings behind those outcomes. To realize this objective, we've designed the app to spotlight a detailed narrative on the significance of each KPI, coupled with its corresponding formula, as illustrated in the subsequent section.

5.2.2 Technical details

Constructed with the same technologies employed in the first part, the prototype now features a left-aligned vertical bar housing buttons for users to select their desired KPIs. Once a KPI is chosen, the left bar provides a detailed description of the selected indicator. The rest of the page on the right is dedicated to presenting the mathematical formula used for KPI estimation, accompanied by the necessary input requirements. As users input the requested data, the output is instantly generated in real-time.

Chapter 6

Budget estimation

Bonomelli s.r.l. asked us for help in order to manage in the best way possible their inventory, after a first evaluation, we've decided to propose them the mockup presented in the previous chapter that uses data from the official documents of the company (like balance sheet and financial statement) to calculate which are the optimal levels of inventory and to track all the movements that it registers.
After that we've led an analysis based on the costs that the company would have faced to develop and to adopt that solution. The process has helped us to recognize three main classes of costs:

- Development costs
- Integration and Implementation Costs
- Ongoing Operational Costs

6.1 Development costs

The first costs we should consider are the ones that the company will face for the development of the application. If the company don't have a developer between its employees they need to hire someone: an individual or most likely a team of developers including a code expert to ensure that the code is built to be reliable and to work optimally and a designer in charge of the visual part to make the software easy to use also for the people not used to interact with such applications, crucial aspect to ease the introduction of the applications. To work in an optimal way the application need to store information properly, in order to achieve that the data should be stored in databases and saved in a server so a higher level of safety could be ensured. To save some costs the company would prefer a solution like DBaaS, a cloud computing service that don't need hardware components.
Breakdown of the development costs' analysis:

	Yearly wage	**Hourly wage**
Front-end developer	€ 35,000	€ 18
Back-end developer	€ 32,500	€ 17

Table 6.1: Developer's average wage

An optimal solution that we would recommend is the service offered by Amazon "RDS", that helps to handle the data in a proper and safe way. The solution we would adopt offers 9 hours of use per day, as we assumed a 8-hour shift for all the employees, so we let the system running a little bit more than that to ensure a safe storage of the data, also we should consider that the company is very active on the market so they want to have a lot of space for their daily transactions, so we offer them 2TB of space for their records that saves the informations in local for 7 days before move them to the cloud. This service will cost about €3.672,65 every month.

6.2 Integration and Implementation Costs

The second step to make the application a new component of company's routine is considering how to deal with the current programs that they're using, we want to avoid situations of conflict between our app and the running software that employees are using, so we need a prior study of the systems to develop the solution in the smartest way possible. After that we need to set up the data migration from the old apps to the new one, it will take some time where the company can't use their systems and the technicians should supervise the whole process. Once the technical integration of the system is done we should consider the costs of the train program designed for the employees and management, so they can learn how to use effectively the new application, this costs should cover either the time that the employees spend in the lectures instead of working and the tutor's wage. To calculate how costly is for the company to train its employees, we take the yearly gross cost that is €67.150.

6.3 Ongoing Operational Costs

After the application is developed, tested and injected into the company's routine, it becomes more and more important during time, from that comes the need to take care of the system to avoid major failures or situations that can harm the productivity. A constant maintenance is the only way to reduce drastically the failures, moreover the system is likely to be improved following the new technologies used by the company and the increment of activities (either in quantity or in variety) that the company faces. Also there should be settled a budget to cover unforeseen expenses or adjustments during implementation that can occur in the process of adoption of the application.

6.4 Conclusions

At the end of the analysis we could do a prospect of the costs that the company have to face. Based on the requirements of the app and the system on which it has to be implemented, the development phase should take around three months of work, where the team gathers all the functionalities desired by the company then proceed to the design phase and lastly to the actual development of the application. So given the salary of the two professional that will work on the project for three months we should consider €17.000 to hire them. In the first part are also included the DbaaS costs, since we're dealing with a medium-small company, the 2TB solution should fit properly, so we add €44.071 to the expense (note that the service has a monthly fee, so the cost we're considering is for a 12-months service).
After the development costs are done, we should move to the integration part, starting from the employees' training, it should take no more than 20 hours of training observed the fact that the employees are already familiar with the use of softwares, so the cost of the training can be considered as the number of hours the employees are busy in the training multiplied by their hourly wage (€9.50), on top of this we must add the tutor's wage (that we assume is €20/hour) also multiplied for the number of hours that he will spend lecturing. We observe that the company has 139 employees so the total amount for the training course will be €26.810.
So the company should face costs for **€87.881** in order to built a system that performs well and that is reliable to use. Furthermore the maintenance costs are very low, in fact this costs are included in the developing services, exception made for the extraordinary maintenance. So we offer a solution that don't affect much the company activities on a long term plan and that have a low impact on the year in which the app is introduced.

Appendix

Executive summary

The first task our team had to handle was choosing a team name, logo, and the roles of each member. Initially, we decided to create a tentative project outline to understand the workflow we would follow. Meetings were held once a week (more or less) both online and in-person. This frequency allowed us to monitor step by step the progress and ideas emerging from each component. In the first few weeks, we focused on a general study of the context and the problem at hand so that we would have a clear and precise idea once we began the process. At this point once the first tasks were assigned to each component the project began. As the work progressed, we realized that the roles initially established were not totally in line with the tasks that each component was dealing with and so we decided to revise and correct our initial predictions. The tasks performed by each component are explained below:

Irini - Team Leader She was in charge of writing Chapter 2 (Inventory Management System). After that she took part in Chapter 3, creating the dashboard and contributing to the group policies part. Finally, she also handled the report structure on overleaf.

Fabio - Mock-up developer He managed the whole part dealing with mock-up, from creation to development. He also provided the explanation of the latter on the report.

Cristian - KPIs He contributed to the part of Chapter 3 with the development of the financial statements of the target company. He also took care of Chapter 4 regarding the KPIs considered.

Mattia - Budget expert He contributed to Chapter 3 by extrapolating the group policies of the target company and managed Chapter 6 regarding budget estimation.

Charles - Presentation expert He managed the review and summary of chapters 1 and 2. Then he contributed to the development of the financial statements of chapter 3. Finally he took care of the presentation of the project.

We initially looked at a very large company, but after a few weeks we realized that the financial statements taken into consideration were too complicated since the company had multiple subsidiaries. Also since in the consolidated company there are also internal movements between subparts, the resulting financial statements would have been distorted. In light of this, we focused on a smaller company than the first one so as to have a more appropriate situation.
Meeting with AI Log mentors was crucial in developing our work and resolving our concerns. It allowed us to understand the target audience of the new company on which we would have to shift our focus to continue our project. After getting the right advice and direction, we decided to have more meetings in relation to the time remaining to converge toward a conclusion.
The professor's willingness to build groups of people with different backgrounds allowed us to contribute different ideas that led to a more complete analysis of the problem. In addition, although the groups were created at the beginning of the course, at a time when there was no familiarity between the members, we managed to establish an excellent climate which allowed us to work in harmony, completing the project in the best possible way.

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