CONTINUOUS IMPROVEMENT PROJECT FOR MANUFUCATURING MANAGEMENT: STANDARDIZE AND OPTIMIZE THE DAILY PRODUCTION PLAN

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IM-Lab – Master's Thesis - Department of Management Engineering

POLITECNICO
MILANO 1863

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CASE STUDY: BAXTER

Abstract

The corporate factory of the American healthcare giant Baxter International Inc. located in Grostto, Lombardia. The company's main areas of concentration include chronic and urgent medical issues, including kidney illness. The business provides hemodialysis, peritoneal dialysis, infusion pumps, administration sets, drug reconstitution devices, remixed and oncology drug platforms, inhaled anesthesia and critical care products, pharmacy compounding services, parenteral nutrition therapies, and associated products. It also provides biological products and medical devices for hemostasis, tissue sealing, and adhesion that are used during surgical procedures. About 100 different nations are served by the company's direct sales force, independent distributors, medicine wholesalers, specialty pharmacies, and other alternative site providers.

The A3 problem-solving technique, a standard lean manufacturing practice that emphasizes problem-solving and continuous improvement, is used in this paper. This made it possible to address a new challenge in an organized way, which is how the chapters for this report were created. Understanding and clarifying the real problem statement which includes addressing who the problem affects and why it is a problem is the first step in the A3 technique. The problem is then more accurately statistically and qualitatively described by the problem breakdown. The data gathering method took the longest since it took several weeks to comprehend and map the process, as well as clean and logically analyze the data. As a result, it was possible to establish goals that were precise, quantifiable, and reachable, and root cause analysis was utilized to determine the fundamental causes of the issue and create solutions. Our team agreed on these countermeasures in close consultation with the Baxter management, and they were carried out while outcomes were closely monitored.

The problem defined as wasting too much time on non-value adding activities was addressed by the implementing countermeasures relating to the Baxter's production planning team. These countermeasures align with new capabilities and features in the production planning process, including a quicker procedure, calculation of the number

of batches, timing need for each batch, accessibility and modification of data, and increased tool confidence. The time needed for the daily production planning process was significantly decreased, according to the quantitative findings of this research. A qualitative survey analysis also revealed that the manufacturing department was quite happy with the upgraded tool. The project's objectives were therefore met, thereby cutting the time required for production planning, boosting user trust in the configurator, and offering suggestions for further development.

Key words: Manufacturing, A3 methodology, Production planning

This document does not contain classified information.

Abstract in lingua italiana

Lo stabilimento aziendale del colosso sanitario americano Baxter International Inc. con sede a Grotto, in Lombardia. Le principali aree di concentrazione dell'azienda includono problemi medici cronici e urgenti, tra cui malattie renali. L'azienda fornisce emodialisi, dialisi peritoneale, pompe per infusione, set di somministrazione, dispositivi per la ricostituzione dei farmaci, piattaforme per farmaci remixati e oncologici, prodotti per anestesia inalatoria e terapia intensiva, servizi di compounding farmaceutico, terapie di nutrizione parenterale e prodotti associati. Fornisce inoltre prodotti biologici e dispositivi medici per l'emostasi, la sigillatura dei tessuti e l'adesione utilizzati durante le procedure chirurgiche. Circa 100 nazioni diverse sono servite dalla forza vendita diretta dell'azienda, distributori indipendenti, grossisti di medicinali, farmacie specializzate e altri fornitori di siti alternativi.

In questo documento viene utilizzata la tecnica di risoluzione dei problemi A3, una pratica standard di produzione snella che enfatizza la risoluzione dei problemi e il miglioramento continuo. Ciò ha permesso di affrontare una nuova sfida in modo organizzato, ed è così che sono stati creati i capitoli di questo rapporto. Comprendere e chiarire l'affermazione del problema reale che include affrontare il problema e perché è un problema è il primo passo nella tecnica A3. Il problema viene quindi descritto in modo più accurato statisticamente e qualitativamente dalla ripartizione del problema. Il metodo di raccolta dei dati ha richiesto più tempo poiché ci sono volute diverse settimane per comprendere e mappare il processo, nonché per pulire e analizzare logicamente i dati. Di conseguenza, è stato possibile stabilire obiettivi precisi, quantificabili e raggiungibili e l'analisi delle cause principali è stata utilizzata per determinare le cause fondamentali del problema e creare soluzioni. Il nostro team ha concordato queste contromisure in stretta consultazione con la direzione di Baxter e sono state attuate mentre i risultati sono stati attentamente monitorati.

Il problema definito come perdere troppo tempo in attività senza valore aggiunto è stato affrontato dalle contromisure attuative relative al team di pianificazione della produzione della Baxter. Queste contromisure si allineano con le nuove capacità e

caratteristiche nel processo di pianificazione della produzione, tra cui una procedura più rapida, il calcolo del numero di lotti, la tempistica necessaria per ciascun lotto, l'accessibilità e la modifica dei dati e una maggiore sicurezza degli strumenti. Il tempo necessario per il processo di pianificazione della produzione quotidiana è stato significativamente ridotto, secondo i risultati quantitativi di questa ricerca. Un'analisi di indagine qualitativa ha anche rivelato che il reparto di produzione era abbastanza soddisfatto dello strumento aggiornato. Gli obiettivi del progetto sono stati quindi raggiunti, riducendo così i tempi necessari per la pianificazione della produzione, aumentando la fiducia degli utenti nel configuratore e offrendo suggerimenti per ulteriori sviluppi.

Parole chiave: Produzione, Metodologia A3, Pianificazione della produzione

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Executive Summary

Company Overview**:** Acute and chronic dialysis, sterile IV solutions, infusion systems and devices, parenteral nutrition therapies, premixed and oncolytic injectable, bio surgery products and anesthetics, drug reconstitution systems, pharmacy automation, software, and services are just a few of the essential renal and hospital products offered by Baxter International, Inc. It functions through the following segments: Asia-Pacific, Middle East & Africa, Europe, and the Americas. Davis Baxter established the business in 1931; it has its corporate headquarters in Deerfield, Illinois.

Background: This thesis is the first co-op between Politecnico di Milano students of the Industrial Management stream and the company. It won't be the last one and hopefully the work in this project will be the basis for the next one carried by the university, where there is still a space for improvement as shown in the future recommendations.

Introduction: Regarding the manufacturing department, a number of internal and external elements were taken into consideration in order to better grasp the issue. Several external elements, like abrupt orders, the external environment, and economic pressure, were not included in the analysis. While aspects under the production department's control, such as batch size and combining certain batches, were taken into account. Following the A3 approach, it was found that the issue statement refers to optimizing and standardizing the planning process because of the manufacturing department's heavy reliance on paperwork and repeated operations.

Problem Background: This problem was broken down further, mapping the process flow and determining where the process can be improved. This process is defined from when the manufacturing department initially takes the forecast demand from the supply chain department and according to that the monthly, weekly and daily plan issued. The critical variables were identified, such as number of batches for each order, the size of each batch, as well as the possibility of mixing some batches together to save up some time.

Goal Setting: The aim of this project is to standardize and optimize the planning process and reduce the manual intervention. Three main goals have been set, the first one to ensure that the manual intervention has been reduced is to eliminate paperwork as much as possible with a must to have target is transform at least one phase to be automated instead of paperwork, and nice to have been to eliminate the whole paperwork. While for standardizing the process and make it independent the target is to remove the worker from the whole process so it can be done automatically without the need of his experience, this will also help the process to be faster and save the worker time to spend it on something more complicated and specific.

Root Cause Analysis: Following the A3 lean methodology, we used fishbone diagram to define the main causes of main problem, which are Inefficient reporting system, Human error, Verbal communication, and Repetitive tasks during production planning. Then we used 5 Whys method to reach the root cause of each main cause.

Countermeasures: Therefore, the process of developing and implementing countermeasures was based on these aforementioned fundamental causes. The countermeasures were developed according to their impact on the sat targets and the ease of implementation, there were two main countermeasures developed. The first one was developing an Excel file where it can do all the calculations required to compute the number of batches, within this file all the constraints are already respected, and it is just a matter of copy paste for user.

The second tool developed was a VBA code where it gives the planned time for each batch separately with the changing time required, this tool will help the department to measure their plan with what is happening in the real world so they can get back and see what went wrong and improve it in order to not happen again in the future.

Lack of coding experience was the first obstacle to completing these countermeasures, thus our team spent the first month mostly mastering the various coding languages like python and VBA. While the large investments were meticulously planned and

implemented throughout the project lifetime, many of the fast wins were taken care of initially.

Monitoring of Results: The time required to finish the whole process was collected before applying any of the countermeasures then it has been cleaned and analyzed to determine the change after applying the new tools. The time to complete the process was dramatically decreased from an average of 19.2 minutes to 7.4 minutes, besides the worker that was involved in the process just because of his experience is now no longer needed to complete it. That saved up to almost 90 minutes of his time now available to spend on a more complicated task where they can use his expertise. Finally, thanks to the new tool now anyone can do the process without needing to be highly experienced or knowledgeable of the constraints on each line.

Success and Recommendations: Our efforts mostly succeeded in lowering the time it takes to create the daily production plan and boosting the manufacturing department's trust in utilizing the configurator as a planning tool. The management at Baxter also made the decision to make usage of the upgraded tool a normal procedure, promoting and supervising use while also streamlining the process. Additionally, our group meticulously recorded all protocols and instructions for using the tool, providing thorough change logs of the code for any upcoming configurator development

Continuous improvement is a crucial component of the A3 technique since it adheres to the lean methodology. By hiring a specialized crew to arrange the order of the orders, this project may be enhanced.

The time spent working on this project at the firm was generally advantageous and provided numerous valuable lessons. Before attempting any solutions, it was essential to comprehend the project, which is also a key component of the A3 structure. Investigating was necessary in addition to accepting facts at face value. In order to avoid future delays, it was important to learn from this experience. Several holdups were caused by neglecting to address the real problem at hand. Last but not least, having the backing of the firm and committed tutors along with clear and detailed guidelines was essential to the project's success.

Literature Review

An American business called Baxter was established in 1931 and specializes in offering a variety of healthcare items. As a result, they engage in international business and expand into the Italian and European markets. The business is now looking for methods to enhance and optimize its manufacturing processes. It is crucial to thoroughly examine both manufacture to order and make to stock production processes in order to identify potential areas for improvement and Baxter's best course of action. Additionally, the process of production planning will be further investigated to identify critical elements that affect the efficacy of the entire process within the organization and potential tools or techniques to help the manufacturing department.

Due to fierce market rivalry and technical advancements, client expectations for items are quite high. Customers anticipate a broad selection of high-quality items, the regular release of new models, and competitive pricing. As a result, the market is showing a number of noteworthy patterns. The most significant ones are: shorter product life cycles, intense cost pressure, improved manufacturing efficiency, higher product quality, etc. The complexity and technological sophistication of the products drive their manufacturing through networks including small, medium, and big businesses, which are characterized by highly specialized production and intricate supply chains. Quick and accurate planning, execution, and performance of orders are issues that are related to meeting client demands that are involved with the creation and manufacture of small batches of items in accordance with customer orders. In order to continue in business, industrial organizations must simultaneously take care of their own growth and continuously adjust their strategies to the rapidly shifting market conditions. Today, strategic management must be intimately correlated with operational management since only in such a setting can the business be adaptable, react rapidly to new possibilities, and pursue ever-evolving strategic objectives. Under these circumstances, industrial businesses are always looking for new techniques, devices, and strategies that might

provide them a competitive edge. They are starting to give cost management, economic effectiveness, and business process performance greater consideration.

MTS (Make-To-Stock) and MTO (Make-To-Order) production are two fundamental production environments that have been discovered in production management. Delivery from inventory to the client and refilling the level of inventory by delivering goods produced in line with the established production schedule are the core components of production for stock. In contrast, when a product is made to order, the customer's request defines both the product's specifications and the timing of manufacturing.

Make To Order Characteristic

Companies that manufacture unique and customized items to specific client requirements but not consistently or predictably on a regular basis are known as "make-to-order" businesses. A portion or all of the production in the MTO sector happens after the client order is received. MTO businesses have few regular items and unpredictable, erratic demand. The table below lists the key characteristics of systems that are made to order.

Criterion	Features of make-to-order systems
Type of products	Bespoke, high-variety, and tailored to the needs of the consumer
Production	merely a few common goods, not frequently repeated
Key problems	handling inquiries appropriately
Key strengths	flexibility, speedy decision-making, and productive employee cooperation
Weaknesses	lack of financial resources, lack of infrastructure, and lack of technological supremacy
Competitive factors	Price, technological know-how, delivery speed, fulfilling dependability, and deadlines

Crucial factors in winning the order	Realistic and current prices, realistic and current delivery dates, a reputation for technical expertise, a reputation for quality, a financing package, the archiving and retrieval of product data, an evaluation of the design, product skills, and facilities that are currently available, an estimation of lead times, costs, and profit margins, and effective coordination and communication between all departments are all necessary.

Table 1: Table to show the main features of make to order systems

In other words where it is simpler and more to the point, the main three advantages for this approach can be summarized in three points.

Reduces wastage: A stock of items that remains unsold represents a waste of resources, including the raw materials, money, and labor utilized to create it. Wastage and loss are reduced in MTO because items are produced in the quantity requested by the client after receiving their order.

Less inefficiency: There is a danger of inefficiency when a wide range of products are produced on a large scale since employees and equipment must follow diverse norms. Workers and equipment are often more productive in MTO since all efforts are directed toward producing the product in accordance with the customer's demands.

Greater variety: Only bespoke items are made and sold by MTO, hence a wider range of products are available. In actuality, it gives clients the goods in the exact form they desire.

While the head disadvantages for this manufacturing strategy would be as the following.

Irregular sales: When a certain customized product would be in demand is tough to predict. Therefore, there could be months with no sales at all and times with enormous sales. For instance, the need for military aircraft increases when there are hostile foreign relations, yet such circumstances are unpredictable.

Lengthy delivery time: Since production begins as soon as an order is received, the product takes some time to reach the client. Additionally, because customizing a product takes time, it can take longer to deliver.

Availability of raw materials: Because demand is unpredictable, it is essential to maintain enough raw materials on hand so that manufacturing can begin as soon as an order is received. Obtaining raw materials and delivering the finished product to the consumer take longer if the raw materials are not ready.

From the perspective of manufacturing strategy, SME's main advantages include flexibility, speedy decision-making, and employee cooperation, while disadvantages include a lack of technical expertise, superiority, access to infrastructure, and financial means. The correct handling of inquiries is a major issue for MTO firms. These businesses compete with other businesses based on their prices, technological know-how, delivery times, and dependability in keeping to deadlines. In order to win the contract, the proposal must include realistic and competitive delivery dates (DD) and pricing, while other variables, such as the company's track record for technical expertise, product quality, or the finance arrangement, may also be important. Each order in MTO systems could be distinct. A client requests a due date and a pricing decision when submitting an invitation to tender for a certain product. In order to make these judgments, it is necessary to archive and retrieve product data, evaluate the design, manufacturing, and facilities that are available, estimate lead times, costs, and profit margins, and effectively coordinate the efforts of all departments involved.

Manufacturing companies today are continuously looking for ways to gain a competitive edge. Permanent organizational structures are rare in modern businesses, and management has evolved. Combining new technology and organizations is one way to achieve a competitive edge. A multifaceted strategic management approach that emphasizes knowledge and human capital is now emerging. This process of adaptation and learning to adopt new habits has as its defining attribute is a relatively little time span measured in months or frequently even days. The social component is just as crucial as the company's economic and technological operations. The layers of strategic

management include: technological management, i.e., the synchronization of information technology and human resources. the social, political, and economic (power, human resource management, and finance) management subsystems management (assembling and preserving a set of beliefs, values, and principles that are which influence how the organization's personnel behave.

Businesses are proposing a variety of solutions to assist them effectively compete in the market in an effort to adapt to the current conditions, including:

1. Value Based Management (VBM)
2. Strategic Management
3. Performance Management
4. Business Process Management (BPM)
5. Business Process Reengineering
6. Benchmarking
7. Total Quality Management (TQM) and Six Sigma
8. Just-in-time (JIT) and Kanban
9. Activity-Based Management
10. Lean Management, etc

The use of these solutions has often greatly enhanced business operations and insured the success of several businesses. However, there are other instances where they have failed to deliver the desired outcomes. The lack of a relationship between efficiency improvement efforts and the company's strategy or the accomplishment of particular financial and economic goals are the two most frequent reasons of failures. It is necessary to make significant modifications to the corporate management and measurement system in order to increase activity efficiency. Modern-day strategies should strive to apply approaches and processes that enable the transformation of the vision, mission, and strategy into operational goals. The decision-making process inside the organization can be concurrently based on strategy, risk management procedures, and information if a long-term competitive advantage is maintained. The decision support system must include the following crucial components:

- efficient ways to respond to consumer inquiries by generating alternate due date plans and price.
- a requirement for comprehensive, dynamic planning and management that takes into account unconfirmed bids.
- successful capacity planning and management.
- flexibility to capture product development aspects throughout the order processing cycle.
- including a decision point for job release into planning.
- A high degree of collaboration amongst the departments playing a crucial part in MTO planning must be made possible.

Organizations are eschewing uniformity in favor of flexibility and variety. Short and medium-sized batches of items tailored to specific client requests are replacing the standard production of similar products. Make-to-order manufacturing businesses are created to not only complete production orders in accordance with customer specifications, but also to take care of their own growth. Businesses frequently modify their strategies because they need to be adaptable and fast to spot and react to new possibilities and dangers if they want to continue in business.

A tendency in technical globalization, which is reflected in new products and research capacities, is occurring concurrently with the quickening globalization of markets. The ability to access information and knowledge resources quickly, easily, and affordably is made possible by constantly developing information technology, which has not only accelerated technical progress but also set the stage for greater productivity and efficiency. The administration of a company that produces goods only in response to production orders necessitates meticulous planning based on up-to-date, correct information as well as a comprehensive review and monitoring of the execution of the authorized plans. The process of information collection, order planning, order verification, and order acceptance choices all play important roles in these businesses. Therefore, there is a critical need to develop measurement and evaluation systems that are specifically targeted at small and medium-sized industrial enterprises in the make-

to-order sector and that assist in the quick and efficient implementation of the strategy as well as the control and monitoring of its realization. Innovative management methods must be implemented and improved in businesses. In these circumstances, thorough measurement and evaluation of business activities are crucial.

In terms of socioeconomic growth, it is possible to notice a relative shift away from "hard" resources (assets) and toward "soft" assets, with "hard" assets becoming less significant (competencies, standards and cultural values, relationships, and attitudes). Modern information is developing into a crucial strategic asset that creates an advantage in cutthroat markets, and strategic management is developing into one of the most crucial facets of firm management. Along with soft assets, non-financial performance measures have also become more significant, primarily due to the growing significance of factors that will affect future performance but cannot be gauged by financial indicators (such as innovative products, technologies, human resource management, supply-chain relationships, etc.).

Two key implications for the management of contemporary firms may be derived on the basis of the examination of literature and production practices. First and foremost, businesses require management techniques and equipment to guarantee their continued presence in the marketplace. Because of this, the corporation is under intense pressure to adopt solutions that enable quick plan execution, monitoring, and control of its realization. Second, contemporary management techniques are generally targeted at enhancing business value, process efficiency, and resource effectiveness. utilized and their ongoing development, which increases the requirement for ongoing oversight and management assessing the performance of an organization using innovative techniques and enterprise outcomes. Systems of performance measurement are required to track the results of both the business's overall operations and the specific procedures that are used inside it.

Make To Stock Characteristic

According to Morikawaet al. (2014) and Melnyk and Denzler(1996), the production to stock environment is characterized by the fact that orders for the customer are fulfilled

straight from the "storage shelf". When a certain product's stock in the completed products warehouse reaches the so-called signaling level, or at regular intervals, production orders are issued to supplement stock levels. The delivery amount is then adjusted to the anticipated intensity of outflow. Demand projections are used to determine inventory control standards (quantitative forecasting methods). The mass, large volume, and medium volume manufacturing of unified goods are characteristics of the MTS model for steady and reproducible production throughout time. Production-to-availability (MTA), an advanced method of production planning, is becoming more prevalent in the context of the production for stock environment.

Production to availability (MTA) is a variation of the production to stock environment (MTS), whose fundamental premise is to maintain a level of finished goods in the warehouse so that the value is minimal, but which is distinguished by the fact that the product is always available to the customer, i.e., on the storage shelf and accessible. According to an examination of the theory, the fundamental presumptions of MTA are:

- Keeping an eye on market conditions and making sure that each consumer may buy things
- Daily determination of the number and variety of items produced, depending on current sales monitoring - more frequent inventory replenishment than in MTS
- Keeping the warehouse's inventory at a minimum level
- The prioritization of production orders through the use of the criteria "buffer status" and "bottleneck production capacity."
- The delivery cycle is treated as a variable whose value is dependent on the manufacturing department's present production capability, particularly the bottleneck

The MTS model is typical of the FMCG sector, which includes food, medicine, cosmetics, household chemicals, minor home goods, furniture, RTV equipment, and home appliances. The MTA model comprises related businesses with a focus on those where adherence to timeliness, product appropriateness for consumption, and a warranty of the product's utility are crucial.

Model / Criteria	MTS	MTA
The production model's goal	anticipation of minimum and maximum sales with a deadline for delivery and knowledge of losses brought on by shortages and excess inventory	ensuring that the product will be delivered to the consumer and will be available at such a high level that it will be impossible for rivals to compete with it
A starting point for producing plans	simulations and forecasts signal delivery (ordering)	Buffered status A supply that restricts production potential
Norms for stock control	They are provided as a mathematical model and are defined and explained in the literature.	They need to be defined, described, and presented as a mathematical model.
The duration of the planning	Aggregate plan (12 months) Rare stock refreshing (stock refreshing points are a product of planning norms)	Plan update - everyday (1 Day) more frequent supply replenishment (according to current consumption and refill capability) (bottleneck production capacity)
Instruments for planning	Methods of quantitative forecasting (projection or causative)	Buffer status Current planned utilization of production resources, focusing on the bottleneck
The methodology used to calculate the permitted stock level	Historical data Forecasts	Current stock level Buffer status
The foundation for initiating the command and deciding when it will stop	Warehouse standards: security stock and signaling stock	Percent of penetration of the buffer Buffered status Refill time

Main determinants of planning success	Capacity utilized Productivity	Availability of products
Planning-related risk	Financial losses (the price of stock-based money that has been frozen) Not timely delivering the products (production of another assortment)	Late delivery of products (costs associated with missed chances)
Production type	Both low and large serial volume manufacturing are possible. Mass production	Both low and large serial volume manufacturing are possible.

Table 2: Table to compare between make to stock and make to availability

An order policy in a make-to-stock approach is divided into two categories based on.

Continuous review: In a continuous review system with a fixed order quantity, the inventory is evaluated every day, and a fixed amount is purchased anytime the stock falls below a certain level. The reorder point designates this location.

Period review: Every time a sufficient amount is ordered to raise the inventory level to a particular level, the inventory is evaluated on a regular basis. This order amount is determined by the relative stock position at each review point, or instant. Because the stock planner attempts to maintain inventory between a minimum and a maximum stock level, this approach is known as the minmax policy.

A well-established MTS system may provide the industrial operation a number of benefits. The major ones are:

- Efficient scheduling: The shop floor knows when and how much to create since production capacity are scheduled in advance, and procurements may be more precisely planned. This improves resource and task utilization and gives the supply chain and inventories better control.
- Manufacturing in scale and scope: A high number of created units can share fixed production expenses since MTS systems produce things in big quantities. By lowering the average cost of manufacturing per unit, this enables businesses to

benefit from economies of scale. Comparable to this, economies of scope allow the production cost per unit to be reduced when an MTS operation produces several similar SKUs of various items.

- Increased flexibility: MTS installations often have a bigger Work in Process (WIP) footprint than pull-type processes since they produce in bulk. To provide a more seamless product flow across the system, WIP inventory can be employed to feed intermediate sub-processes. In order to maximize equipment uptime, shorten changeover times, and improve labor efficiency and overall equipment effectiveness, longer production runs of identical SKUs are made possible. Buffers, such as safety stock, are frequently used in MTS operations to give flexibility for swiftly changing production capacity.
- Quicker delivery times: MTS configurations create goods to stock, whereas pull-type modes are typically utilized to make customised products with longer lead and delivery periods. This indicates that goods are offered in the store as soon as the promotional period starts. Customers have the option to select a product and have it delivered simultaneously.

MTS has certain drawbacks while being effective for cost management and preventing lost opportunities in the manufacture of bulk commodities. The major ones are:

- Forecasts Must Be Accurate: In order to avoid stockouts or overstocking, an MTS system depends on precise forecasting. Inaccurate historical data or sales analysis may cause system shocks to last for a long time. The accuracy of these estimates can be significantly impacted by seasonal or cyclical sales cycles.
- Cash Flow Concerns: Due to excess inventory of raw materials, work-in-progress, or finished items stored in the warehouse pending purchase or shipping, small and medium-sized enterprises sometimes struggle with severe cash flow problems. In these circumstances, even minor changes to the MTS system might eat up operating budgets and cause production issues.
- Inventory Must Be Accurate: Raw materials, work-in-progress, and finished commodities are the three basic categories of inventory in MTS settings. Not only

must these subsets be precise at each stage of manufacturing, but they also need to be accurate during order tracking and transitions between stages. Because inventory is taxed differently at each step depending on law, inefficient inventory counts or values at any phase can have an influence on cost and output as well as tax obligation.

- Risk of Obsolescence or Perishability: Since many MTS items are quickly eaten, a bad prediction might make perishable commodities useless or necessitate cost-cutting to sustain sales. Similarly, overstocking caused by erroneous estimates may cause the residual stock in sectors like electronics to become obsolete when new technology replaces outmoded components.

The unifying factor across all of the aforementioned downsides is that they all call for precise planning, forecasting, purchasing, analysis, and decision-making. In order for an MTS system to function, all of these activities also require a significant amount of human contact. When team members try to make sense of data, create safety stock levels, bargain contracts

with suppliers, and plan production, the strong dependence on historical data and forward-looking analysis frequently makes it difficult to find ways to increase efficiency. Furthermore, SMEs frequently use a hybrid manufacturing style, with some goods being created to order and others being made to stock. This makes the issues raised by tracking several data sets for various business sectors worse.

Problem Statement

Baxter operates in the healthcare industry and offers a variety of medical products. Its product and service offerings include sterile intravenous solutions, generic injectable pharmaceuticals, parenteral nutrition therapies, infusion systems and devices, inhaled anesthetics, and surgical hemostat and sealant products. Dialysis for acute and chronic conditions is also included. Hospitals, rehabilitation facilities, renal dialysis clinics, nursing homes, and patients' homes all use the company's goods. Baxter distributes its goods through a network of independent distributors, medication wholesalers, specialty pharmacies, and other suppliers of alternate sites in addition to its own direct sales staff. In addition to the Americas, the Middle East, Africa, Europe, and Asia-Pacific, the corporation operates in these regions.

Numerous elements, both internal and external in terms of the entire business or sales department, have an impact on the company's operational success. The worldwide pandemic and wars, which have a severe impact on the supply chain and resource availability, are only two examples of the many unpredictable and uncontrollable external influences. Another external element that had a significant adverse impact on the corporation was economic pressure brought on by rising commodity costs. Since some customers ask for specialized solutions that are appropriate for their particular requirement, the availability of the technical specifications required by the customer is another important consideration.

Thus, daily production planning is one of the internal elements that affects the manufacturing department. The production team may thus regulate and manage this process appropriately. The manufacturing department's whole process was exceedingly time-consuming, including several feedback loops between numerous personnel, a lack of digital information flow, and missing information, as was discovered during the first month on site. The focus of this paper is on how these problems have kept the process from becoming autonomous and far from being optimized.

The problem statement is the first step of the A3 process, the one in which the problem is defined in its centrality and from which the following analysis will be based on. As explained before, the main goal of the project is standardizing and optimizing the planning process and reducing the manual intervention.

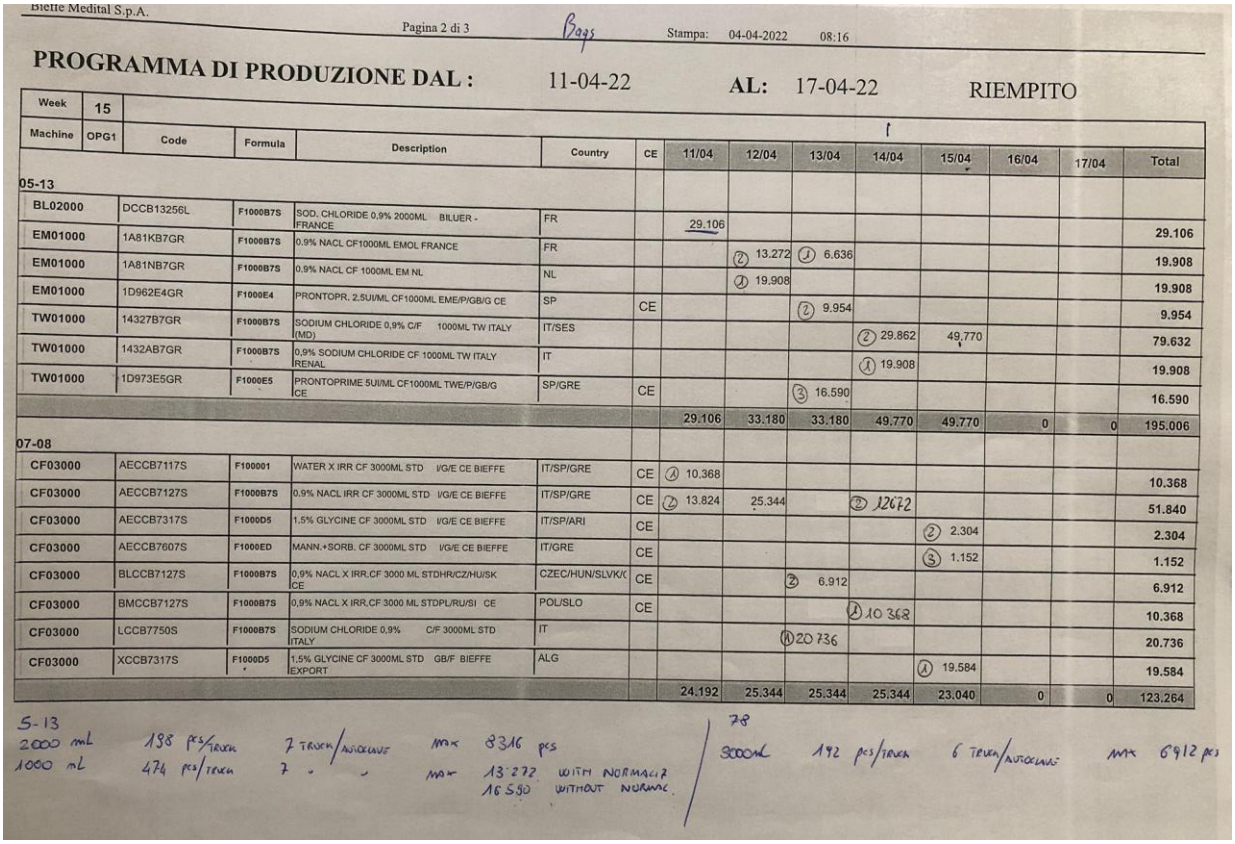
To do this is necessary to deeply analyse the manufacturing department and planning process to have a clear view of which activities the manufacturing and planning (M&P) supervisor manages and how he is doing the tasks. It has been done in various ways:

- Manufacturing plant observation
- Continuous alignment with M&P supervisor
- Analyzing data extracted from the company database
- Interview with employees who are involved in planning process

First day in Baxter, the M&P supervisor showed us the manufacturing plant and introduced the process; from the raw material warehouse and filling the tanks to finished products and packaging. It was necessary to have better understanding of planning and main problem. Next step was to concentrate on the planning process and know it in detail. The M&P supervisor described the whole process which starts from supply chain department and specially his routine tasks related to manufacturing planning.

The first phase of planning start at supply chain department, where there are two production planners. Base on the orders from customers and inventories in the warehouse, they have to plan the production for the next month, then weekly plan.

This phase is going to be done in GSC software and Microsoft excel. After that, they need to print the weekly plan and deliver the hard copy of these planning to M&P supervisor.



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PROGRAMMA DI PRODUZIONE DAL : 11-04-22 AL: 17-04-22 RIEMPITO

Week 15

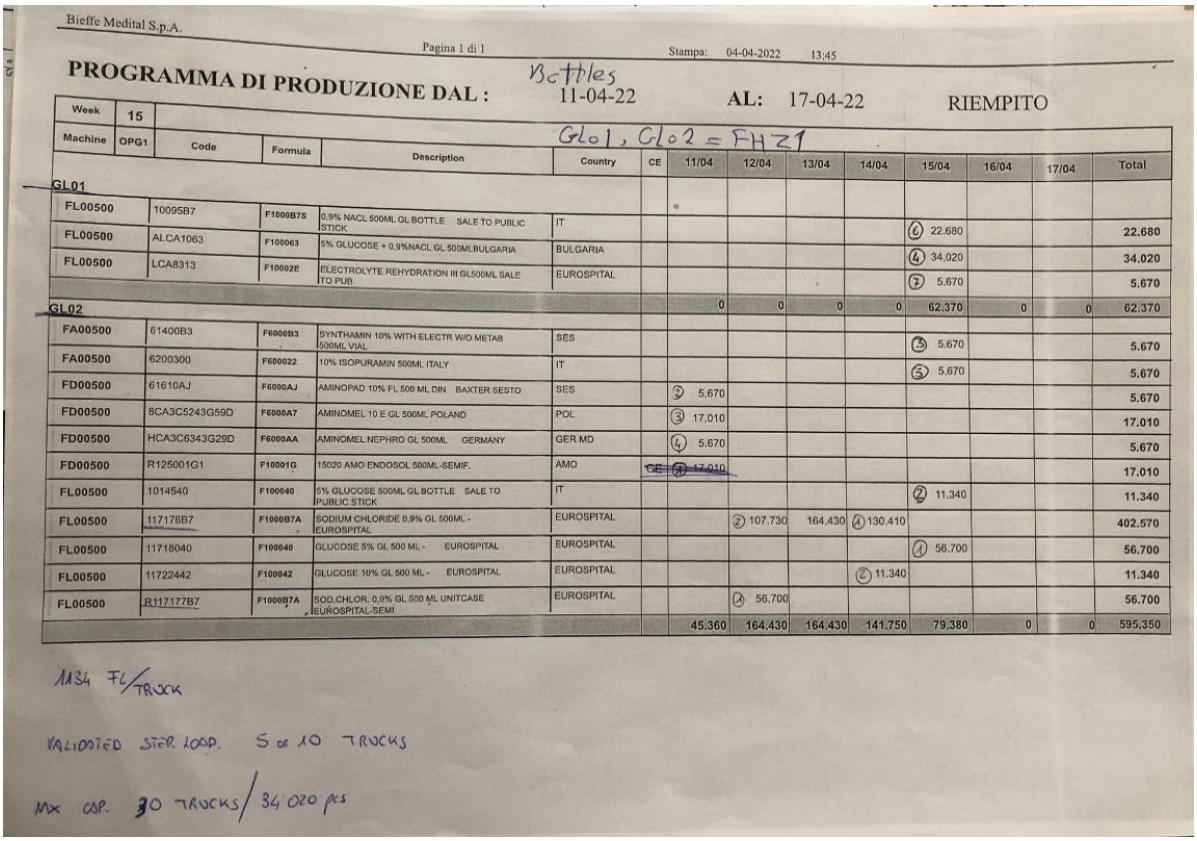
Machine	OPG1	Code	Formula	Description	Country	CE	11/04	12/04	13/04	14/04	15/04	16/04	17/04	Total
05-13														
BL02000		DCCB13256L	F1000B7S	SOD. CHLORIDE 0,9% 2000ML BILUER - FRANCE	FR		29.106							29.106
EM01000		1A81KB7GR	F1000B7S	0,9% NACL CF1000ML EMOL FRANCE	FR			(2) 13.272	(1) 6.636					19.908
EM01000		1A81NB7GR	F1000B7S	0,9% NACL CF 1000ML EM NL	NL			(1) 19.908						19.908
EM01000		1D962E4GR	F1000E4	PRONTOPR. 2.5UI/ML CF1000ML EME/P/GB/G CE	SP	CE			(2) 9.954					9.954
TW01000		14327B7GR	F1000B7S	SODIUM CHLORIDE 0,9% C/F 1000ML TW ITALY I(MD)	IT/SES					(2) 29.862	49.770			79.632
TW01000		1432AB7GR	F1000B7S	0,9% SODIUM CHLORIDE CF 1000ML TW ITALY RENAL	IT					(1) 19.908				19.908
TW01000		1D973E5GR	F1000E5	PRONTOPRIME 5UI/ML CF1000ML TWE/P/GB/G CE	SP/GRE	CE			(3) 16.590					16.590
							29.106	33.180	33.180	49.770	49.770	0	0	195.006
07-08														
CF03000		AECCB7117S	F100001	WATER X IRR CF 3000ML STD I/G/E CE BIEFFE	IT/SP/GRE	CE	(1) 10.368							10.368
CF03000		AECCB7127S	F1000B7S	0,9% NACL IRR CF 3000ML STD I/G/E CE BIEFFE	IT/SP/GRE	CE	(2) 13.824	25.344		(2) 12672				51.840
CF03000		AECCB7317S	F1000D5	1,5% GLYCINE CF 3000ML STD I/G/E CE BIEFFE	IT/SP/ARI	CE					(2) 2.304			2.304
CF03000		AECCB7607S	F1000ED	MANN.+SORB. CF 3000ML STD I/G/E CE BIEFFE	IT/GRE	CE					(3) 1.152			1.152
CF03000		BLCCB7127S	F1000B7S	0,9% NACL X IRR.CF 3000 ML STDHR/CZ/HU/SK CE	CZEC/HUN/SLVK/(	CE			(2) 6.912					6.912
CF03000		BMCCB7127S	F1000B7S	0,9% NACL X IRR.CF 3000 ML STDPL/RU/SI CE	POL/SLO	CE				(1) 10 368				10.368
CF03000		LCCB7750S	F1000B7S	SODIUM CHLORIDE 0,9% C/F 3000ML STD ITALY	IT				(1) 20 736					20.736
CF03000		XCCB7317S	F1000D5	1,5% GLYCINE CF 3000ML STD GB/F BIEFFE EXPORT	ALG						(1) 19.584			19.584
							24.192	25.344	25.344	25.344	23.040	0	0	123.264

5-13
2000 mL 198 pcs/TRUCK 7 TRUCK/AUTOCLAVE max 8316 pcs
1000 mL 474 pcs/TRUCK 7 " " max 13'272 WITH NORMALIZ
16590 WITHOUT NORMAL

7-8
3000mL 192 pcs/TRUCK 6 TRUCK/AUTOCLAVE max 6912 pcs

Figure 1: Figure to show the paper used to plan the number of batches for both line 5-13 and 7-8

He has to balance the machines and schedule daily planning efficiently to meet weekly and monthly plan. This step should be done by hand on the paper which is the one of the main non value added activities in this process.



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PROGRAMMA DI PRODUZIONE DAL : Bottles 11-04-22 **AL:** 17-04-22 RIEMPITO

Week 15

Machine OPG1 — Gl01, Gl02 = FH21

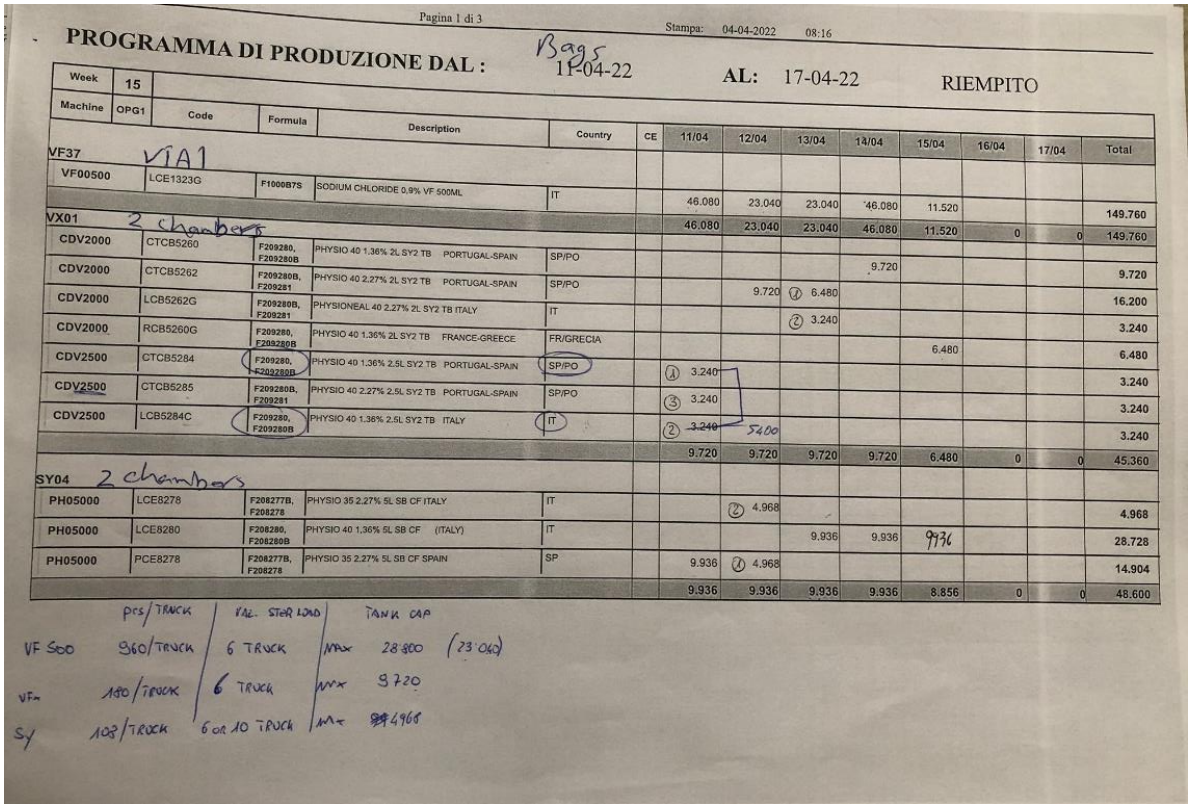
Code	Formula	Description	Country	CE	11/04	12/04	13/04	14/04	15/04	16/04	17/04	Total
GL01												
FL00500 10095B7	F1000B7S	0,9% NACL 500ML GL BOTTLE SALE TO PUBLIC STICK	IT						(6) 22.680			22.680
FL00500 ALCA1063	F100063	5% GLUCOSE + 0,9%NACL GL 500MLBULGARIA	BULGARIA						(4) 34.020			34.020
FL00500 LCA8313	F10002E	ELECTROLYTE REHYDRATION III GL500ML SALE TO PUB	EUROSPITAL						(7) 5.670			5.670
					0	0	0	0	62.370	0	0	62.370
GL02												
FA00500 61400B3	F6000B3	SYNTHAMIN 10% WITH ELECTR W/O METAB 500ML VIAL	SES						(3) 5.670			5.670
FA00500 6200300	F600022	10% ISOPURAMIN 500ML ITALY	IT						(5) 5.670			5.670
FD00500 61610AJ	F6000AJ	AMINOPAD 10% FL 500 ML DIN BAXTER SESTO	SES		(2) 5.670							5.670
FD00500 8CA3C5243G59D	F6000A7	AMINOMEL 10 E GL 500ML POLAND	POL		(3) 17.010							17.010
FD00500 HCA3C6343G29D	F6000AA	AMINOMEL NEPHRO GL 500ML GERMANY	GER MD		(4) 5.670							5.670
FD00500 R125001G1	F10001G	15020 AMO ENDOSOL 500ML-SEMIF.	AMO	~~CE~~	(1) 17.010							17.010
FL00500 1014540	F100040	5% GLUCOSE 500ML GL BOTTLE SALE TO PUBLIC STICK	IT						(2) 11.340			11.340
FL00500 117176B7	F1000B7A	SODIUM CHLORIDE 0,9% GL 500ML - EUROSPITAL	EUROSPITAL			(2) 107.730	164.430	(A) 130.410				402.570
FL00500 11718040	F100040	GLUCOSE 5% GL 500 ML - EUROSPITAL	EUROSPITAL						(1) 56.700			56.700
FL00500 11722442	F100042	GLUCOSE 10% GL 500 ML - EUROSPITAL	EUROSPITAL					(2) 11.340				11.340
FL00500 R117177B7	F1000B7A	SOD.CHLOR. 0,9% GL 500 ML UNITCASE EUROSPITAL-SEMI	EUROSPITAL			(A) 56.700						56.700
					45.360	164.430	164.430	141.750	79.380	0	0	595.350

1134 FL/TRUCK

VALIDATED STER. LOAD. 5 OF 10 TRUCKS

MX CAP. 30 TRUCKS / 34'020 pcs

Figure 2: Figure to show the paper used to plan the number of batches for glass line



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PROGRAMMA DI PRODUZIONE DAL : Bags 11-04-22 **AL:** 17-04-22 RIEMPITO

Week	15													
Machine	OPG1	Code	Formula	Description	Country	CE	11/04	12/04	13/04	14/04	15/04	16/04	17/04	Total
VF37	VIA1													
VF00500	LCE1323G		F1000B7S	SODIUM CHLORIDE 0,9% VF 500ML	IT		46.080	23.040	23.040	46.080	11.520			149.760
VX01	2 chambers						46.080	23.040	23.040	46.080	11.520	0	0	149.760
CDV2000	CTCB5260	F209280, F209280B		PHYSIO 40 1,36% 2L SY2 TB PORTUGAL-SPAIN	SP/PO					9.720				9.720
CDV2000	CTCB5262	F209280B, F209281		PHYSIO 40 2,27% 2L SY2 TB PORTUGAL-SPAIN	SP/PO			9.720	(4) 6.480					16.200
CDV2000	LCB5262G	F209280B, F209281		PHYSIONEAL 40 2,27% 2L SY2 TB ITALY	IT				(2) 3.240					3.240
CDV2000	RCB5260G	F209280, F209280B		PHYSIO 40 1,36% 2L SY2 TB FRANCE-GREECE	FR/GRECIA						6.480			6.480
CDV2500	CTCB5284	F209280, F209280B		PHYSIO 40 1,36% 2,5L SY2 TB PORTUGAL-SPAIN	SP/PO		(1) 3.240							3.240
CDV2500	CTCB5285	F209280B, F209281		PHYSIO 40 2,27% 2,5L SY2 TB PORTUGAL-SPAIN	SP/PO		(3) 3.240							3.240
CDV2500	LCB5284C	F209280, F209280B		PHYSIO 40 1,36% 2,5L SY2 TB ITALY	IT		(2) ~~3.240~~ 5400							3.240
							9.720	9.720	9.720	9.720	6.480	0	0	45.360
SY04	2 chambers													
PH05000	LCE8278	F208277B, F208278		PHYSIO 35 2,27% 5L SB CF ITALY	IT			(2) 4.968						4.968
PH05000	LCE8280	F208280, F208280B		PHYSIO 40 1,36% 5L SB CF (ITALY)	IT				9.936	9.936	9936			28.728
PH05000	PCE8278	F208277B, F208278		PHYSIO 35 2,27% 5L SB CF SPAIN	SP		9.936	(1) 4.968						14.904
							9.936	9.936	9.936	9.936	8.856	0	0	48.600

	PCS/TRUCK	VAL. STER LOAD	TANK CAP
VF 500	360/TRUCK	6 TRUCK	MAX 28800 (23.040)
VF...	180/TRUCK	6 TRUCK	MAX 9720
SY	108/TRUCK	6 or 10 TRUCK	MAX ~~9936~~ 4968

Figure 3: Figure to show the paper used to plan the number of batches for lines symphony, viaflex and viaflo

There are many constraints to consider through planning, so it needs high experience and comprehensive view of plant.

The constraints are:

- **Tanks**: There are 19 tanks with different capacities. In addition, the volume of the material in the tank should be more than minimum number of pieces in each batch.
- **Formula**: There are 546 codes with …. Different formula which cannot be mixed together.
- **Product size**: Each machine can produce different volume of products but not in a same time.
- **Truck load**: each line has a specific capacity for sterilization based on the multiplication of the trays in the trucks.

- **Normalization and sanitization**: Each day in the morning, tanks should be normalize and sanitize. Also at the beginning of the production of new formula, normalization and sanitization is necessary.

In addition, he is the only person that can do production planning. Because of that, this position can be the bottle neck of this process and connection ring between planning department and production line.

There are 2 stages in daily planning. The first stage is that the orders in each day for each machine should be sequenced. Then, based on the formula and sequence, orders will be allocated to specified tanks.

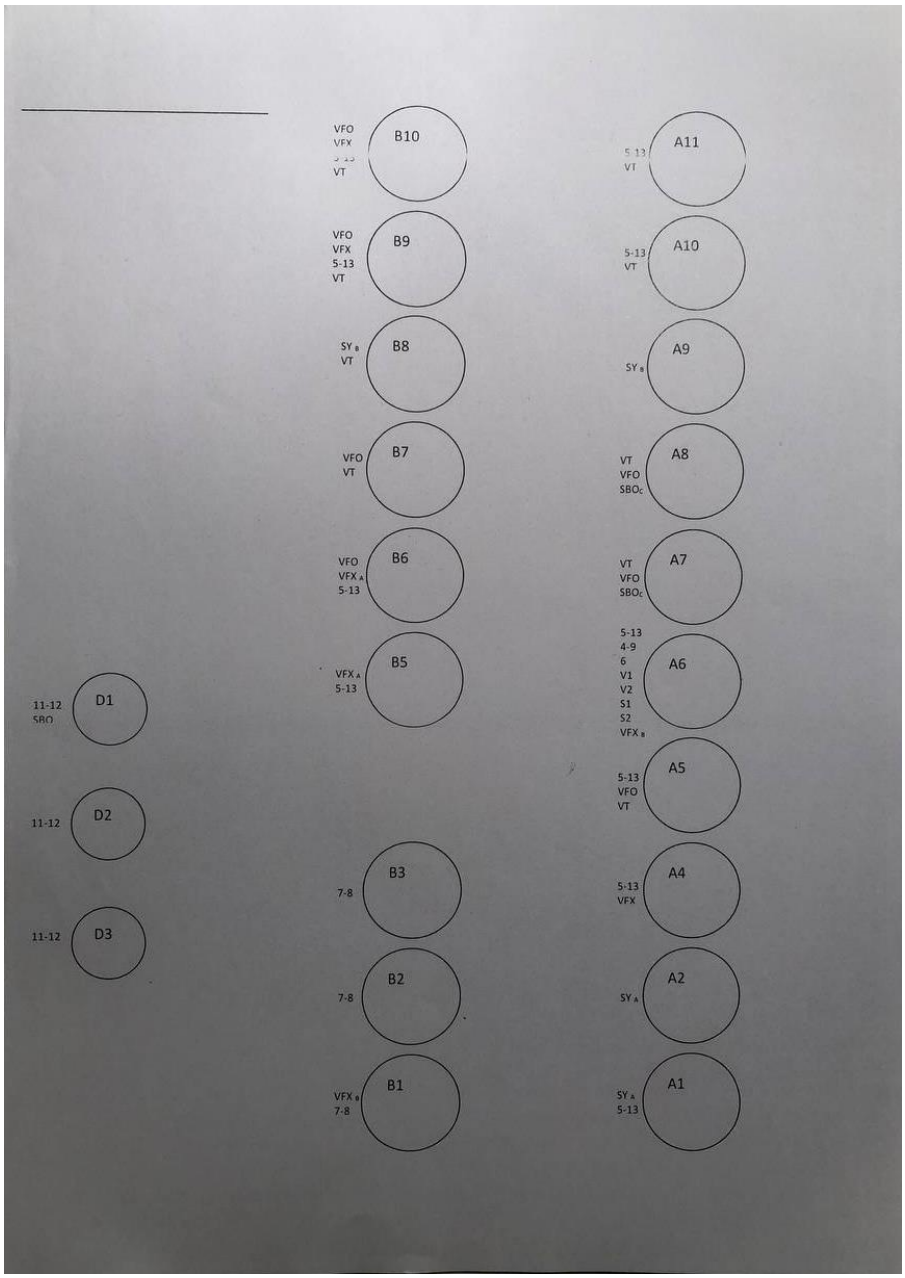

Figure 4:Figure to show the paper used to put the order of batches and if there is any mixing

After allocation, sheets should be passed to planning analyst to check and insert the numbers in GSC software and print the "Preventivo di Produzione Draft".

The second stage is revising and controlling the "Preventivo di Produzione Draft" by M&P supervisor manually. When he corrected the volumes and signed the draft, it can be assumed as "Definitivo" and it can be send to production line.

Problem Breakdown

The production plant consist of two different line:

- Clear flex
- Glass

In this project, the focus is on both clear flex and Glass line which has 6 machines with different specifications:

- Glass
- Viaflo (VFO)
- Viaflex (VFX)
- 7-8
- 5-13
- Symphony (SY)

Glass line

This line is producing 190 code in five different volumes:

Figure 5: Figure to show products of the glass line

50 mL

100 mL

250 mL

500 mL

1000 mL

For all the volumes the neck could be 29 or 32 mm.

Solution at glass line are most of the time drug and are for infusion therapies, nutrition therapies, amino acid cocktails and few API (active pharmaceutical ingredients).

The clear flex includes the rest of 5 lines:

Viaflo (VFO)

This line can produce 6 codes in bags with two different volume 500 ml and 1000 ml. These products are single chamber and all for IV (intravenous or infusion) in non PVC film.

Figure 6: Figure to show products of viaflo line

Viaflex (VFX)

This line is producing 39 codes with three different volume of 1500 ml, 2000 ml and 2500 ml. This line use PVC bags and FTP (filling trough port) technology. Products of Viaflex are 2 chamber bags.

Figure 8: Figure to show products of viaflex line

Figure 7: Figure to show products of viaflex line

Line 7-8

This line can produce 88 codes with multiple sizes 2000 ml, 3000 ml, and 5000 ml in single chamber bags. These are irrigation products and urological products.

Figure 12: Figure to show products of 7-8 line

Figure 11: Figure to show products of 7-8 line

Figure 10: Figure to show products of 7-8 line

Figure 9: Figure to show products of 7-8 line

Line 5-13

This line includes 2 machines which are working together and can produce 99 codes in multiple volumes: 250 ml, 350 ml, 500 ml, 1000 ml, and 2000 ml. These are IV and irrigation products in single chamber bags.

Figure 13: Figure to show products of 5-13 line

Symphony (SY)

This line produce 45 codes, only 5 liters bag with 2 chambers (3.75 + 1.25 L) includes renal therapy (peritoneal dialysis) with different glucose concentration. The tank capacity in this line depends on the VFO line, so it is necessary to plan VFO line before Symphony line.

Figure 14: Figure to show products of symphony line

Planning process

Two production planners receive the demand form the customer and, based on the capacity of each line, made a first planning schedule on monthly basis. M&P supervisor review the monthly planning based on manufacturing point of view and considerations like:

- Constraints
- Need of normalization and sanitization
- Optimization due to the best sequence of solution formulas
- Optimization based on the sizes, kind of valves for the bags, changeover

The monthly planning is reviewed among manufacturing and planning department and achieve the "final version" that is used for the material supplying and shift planning.

The final version of monthly planning is grouped in weekly planning and starting from the weekly planning, the critical task of M&P supervisor about daily planning is going to start.

the quantity per day of each day is divided in quantity per batch (defining the batches in the day) based on the line constraint like:

- Sterilization load
- Mixing tank capacity
- Throughput of the line
- Volume of the container
- Different formula of the solution
- Normalization and sanitization

Once the weekly quantities are divided in daily batches, the planning analyst manually types these numbers into GSC system to generate a draft of the daily program.

M&P supervisor reviews the drafts of each daily program to check the sequences and perform calculation (manually) to determine the volume of solution needed for each batch, based on size, pieces, need of normalization or not.

Planning analyst transfers all the notes and the calculations from the draft into the GSC system and generates the final version of the daily program. The final version is finally reviewed and approved by M&P supervisor. Only signed final version is allowed to be used in the plant.

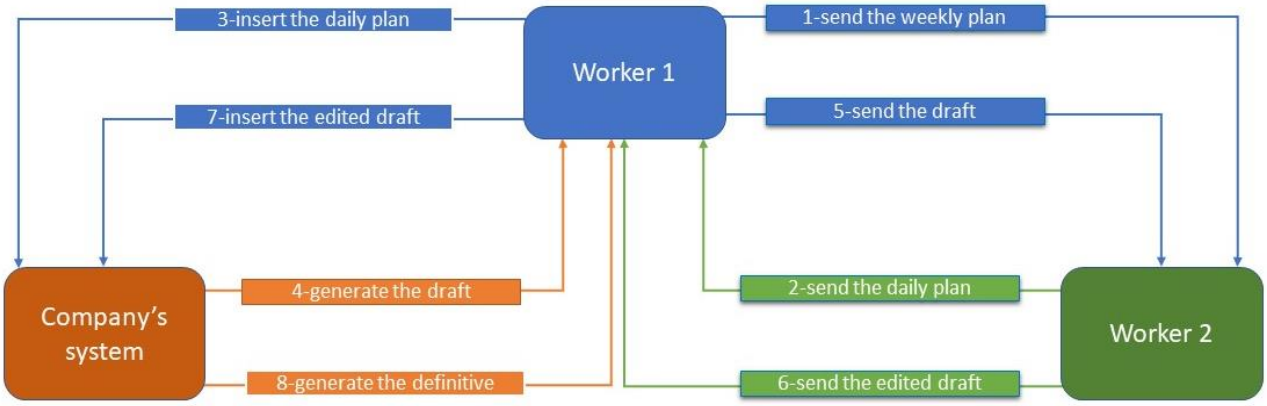

Figure 15: Figure to visualize to process

The filling process always starts with sanitization and using hot WFI (water for injection). After sanitization the machine is normalized and flushing validated amount of approved solution trough the line. Once the normalization is completed, first sample is collected and analyzed to confirm the assay; thus, the filling process is allowed. New sanitization will be needed in the following cases:

- After 24 hours of filling
- If a non-compatible solution must be filled after the finish of the previous batch

A new normalization will be needed if a compatible solution must be filled after the finish of the previous batch.

Target Sitting

The defining of targets for desired objectives is the next phase in the A3 framework. The management team of the organization consequently considered and decided upon the aims outlined below.

After analyzing the whole process and understand each step in it, therefore objectives that are explicit, quantifiable, achievable, meaningful, and time-based might then be established. We sat three main targets, first one is to make the process digital based instead of paper based, second one is to make it standardized so anyone will be able to perform it and lastly to reduce the whole process time.

The process was taking on average 10 pages per week between assigning tanks and calculating the number of batches. We established a must have (MH) and nice to have (NTH) targets the must have one was to reduce the paperwork for at least one phase so the probability of losing a paper or any inconvenient incident decrease, and the nice to have target was to eliminate the whole paperwork for both phases and transform the whole process to be digital so it will be easier to modify and faster.

The second goal which to standardize the process, because with the current situation there is a worker assigned for the daily planning just because he is aware of the constraints of each line and the process is dependent on him and his experience. So, the goal is to remove him from the process and make it independent that will also make more time for the worker to focus on other tasks that is more important.

Lastly, we measured the time required for the two phases which are the batch calculations and the tanks assignment for the worker to finish them for 1 month as the worker does it once in the beginning of the week for the whole week.

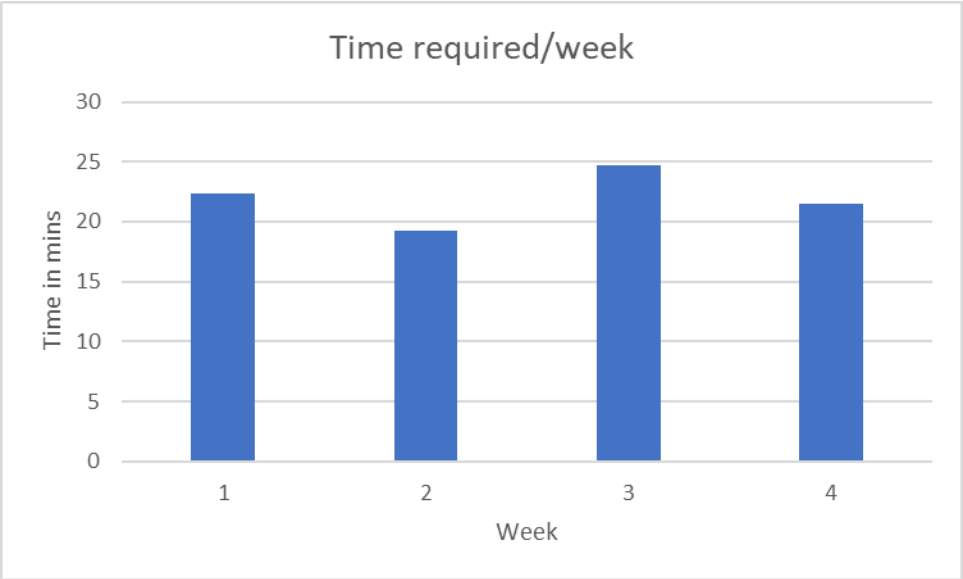

Figure 16: Figure to show time required to do the process by week

As shown in the table above the maximum was 24.7 minutes while the minimum was 19.2 minutes with an average of 21.9 minutes per week which results in 87.7 minutes per month. All that time spent by the worker just because he knows the constraints of each line and because of his experience. Since his manager sees that as a waste of the worker's time to spend this amount of time on this task because it is a non-value adding and he would like if the worker spent that time on something more complicated and suited to his experience so he can be more productive.

Root Cause Analysis

Fishbone diagram

The root-cause analysis is a problem-solving method useful for the identification of the root-causes. The starting point correspond to the main causes' definition. In order to fix them, there is a useful visual lean tool called "Fishbone" or ("Ishikawa diagram").

Mr. Ishikawa was convinced that 90% of the problems in a company could be solved with simple visual tools and the "Fishbone" is one of them. The "Fishbone" is a five-framework diagram composed by "five M": machine, man, management, method, and material. In the "fish's head" there is the problem, while on the different frameworks there are the main causes.

This is only the first step of the root-cause analysis. Then, each main cause must be traced back to find the root-causes, on which countermeasures will act.

The fishbone diagram is built through intense brainstorming session, in this phase, it is important to identify all the possible main causes. We discussed with several people in SCM, and production department, asking for their feedback.

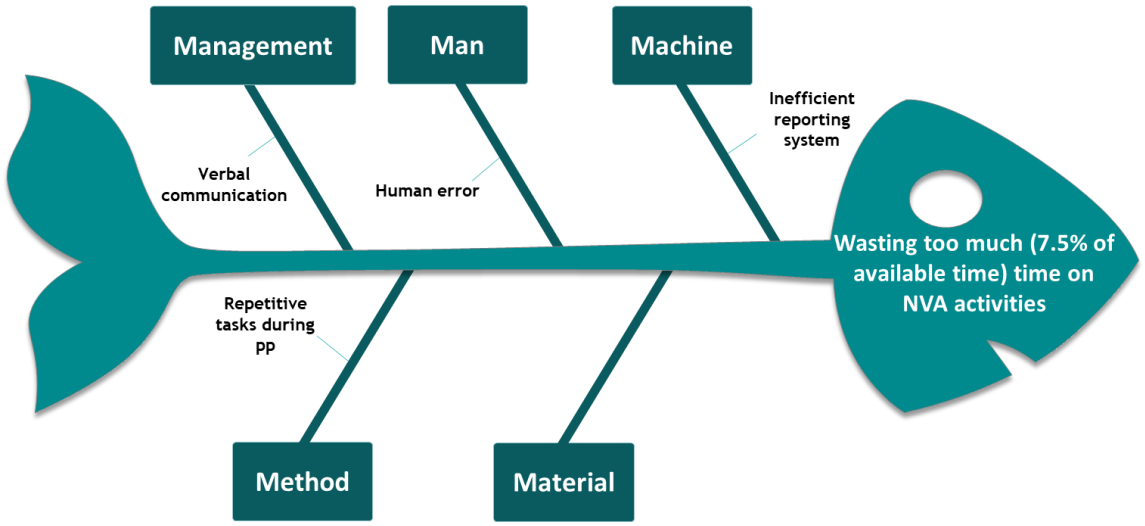

Figure 17: Figure to show the root cause of the problems

The first framework analyzed is the "Machine". Machine could have an impact on NVA activities for different reasons.

- Inefficient reporting system

  In Baxter, production planning is done by two different department. But the procedure of planning is different in these department. So, they prefer to have verbal communication and paper system.

The "Man" framework regards all the errors related to people.

- Human error

  As machine error, also human error have impact on NVA activities. Based on the observation, all the calculation for daily production planning is done by M&P supervisor with a simple calculator. Obviously, it is possible to make a mistake and he has to control and recalculate all the numbers.

In the "Management" framework problems arise from an incorrect operational process management.

- Verbal communication

  Main part of planning related to M&P supervisor is paper base. So SCM department should print and deliver weekly planning to M&P supervisor. In addition there is no integrated system to record description and tips. So if there is any comments, they should communicate verbally.

All companies follow structured "Method" and procedure to carry out their business. Sometimes these methods should be revised to identify opportunities for improvements.

- Repetitive tasks during production planning

  Based on our observation, during the daily planning for each week, some tasks should be repeated about 3 or 4 times by M&P supervisor and his colleague in SCM department when the tank allocation and daily planning go back and forth between them. Again we saw that all the calculations done manually.

Once the main causes are clearly identified and visually represented in the fishbone, the next root-cause analysis step is the root-cause definition. It is performed through another simple visual tool, the "Five Whys". Through the five whys, we must persist asking what's the problem cause until we find the root-cause.

The first main cause is "Inefficient reporting system" in "Machine" framework.

As already mentioned, the planning process is not automated because there are many constraints for each line, such as product size, tank's volume, sanitization and etc. These constraints originated from large basket of products and solutions in Baxter. Therefore, they have to response the orders and maintain their market share which is the root cause of this problem.

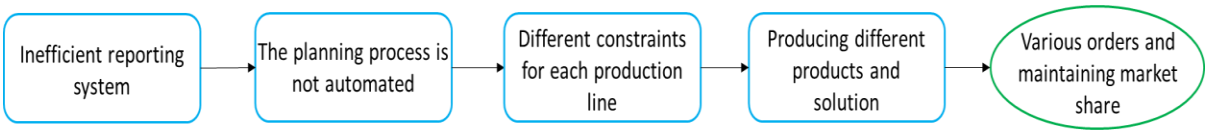

Figure 18: Figure to show the 5 why analysis

"Human error" in "Man" framework is the next main cause.

The main person involved in production planning is M&P supervisor. Based on our discussion with M&P supervisor and manufacturing manager, we understood the workload of this position. He is the intermediate ring between planning department and manufacturing line. Most of the time he has to move between departments. In addition, the daily planning is paper based and because of many constraints, it should be done by hand. In this situation, human error is likely.

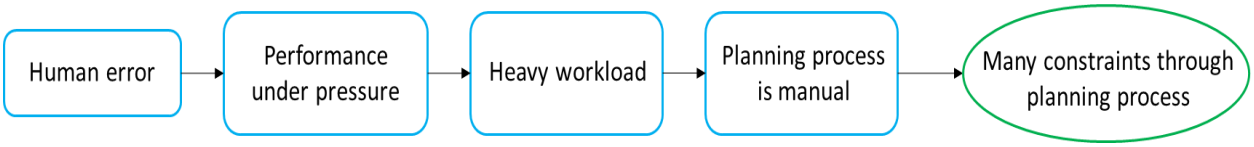

Figure 19: Figure to show the 5 why analysis

The third problem is "Verbal communication" in "Management" framework.

Most of the time M&P supervisor is not in a fixed place. He has to go to plant to monitor the production line and also go back to planning department for meetings and planning. In addition, if there is any mistakes in drafts or any comments, they have to discuss it in presence and there is not any integrated software for planning among departments. It should be mentioned, this kind of discussion is not rare during daily planning.

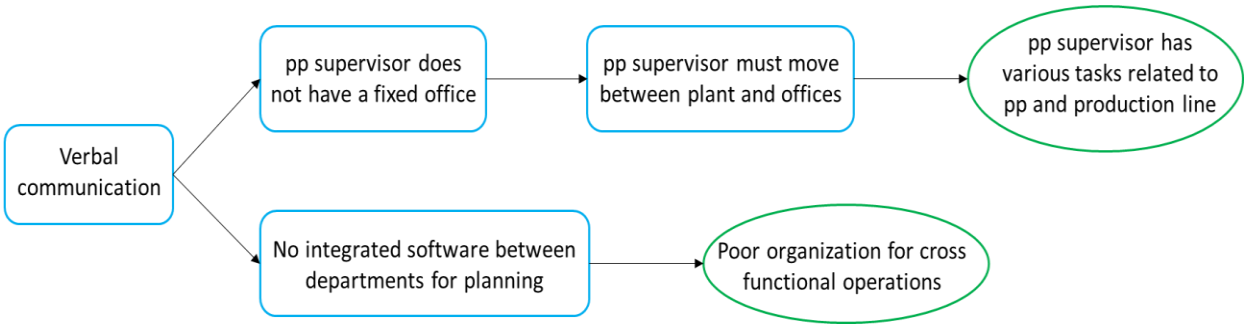

Figure 20: Figure to show the 5 why analysis

The last main problem is "Repetitive tasks during production planning" in "Method" framework.

There are some tasks during planning which are repeated more than one time and it is wasting time. When M&P supervisor made a first draft of tanks' allocation and daily planning manually, then his colleague recalculate all the numbers before registering in the system. After that for finalizing the program, M&P supervisor should correct some of the numbers based on his experience. This task can be the bottle neck of the production planning because he is the only person in the company who can accomplish this task. There was no training for planning operators and their skills did not improved.

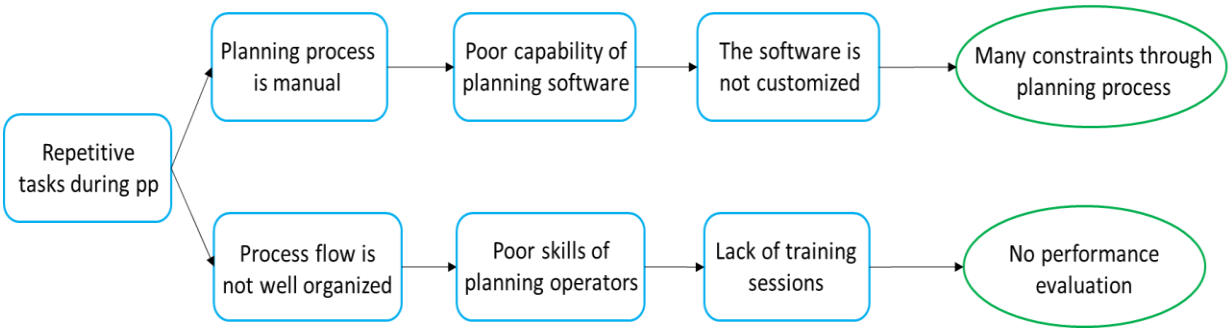

Figure 21: Figure to show the 5 why analysis

Develop Countermeasures

The A3 methodology's stage where the problem's fundamental causes are identified and mitigated is the creation of countermeasures. Once the underlying reasons of the issue were identified, it was concluded that repetitive tasks during production plan is a result of inefficient reporting system, which results from the absence of an automated planning process, efficient system for transferring intricate and precise data across departments.

The requirement for a tool that unifies the many software programmers in use, displays real-time data, enables departmental collaboration, and ensures the accuracy of data entry, computation, and ordering procedures was agreed upon.

During this stage of the procedure, our team and Baxter team brainstormed while working with the management and each department separately. This was a crucial step since the lean thinking methodology frequently employs "Gemba walks," which are focused on visiting to the impacted region or department physically and seeing how the process is carried out there with the appropriate team. This strategy will be discussed as part of the countermeasures since all countermeasures should always take the people who will use them in the future into account. We gathered and generated multiple concepts across several categories, The following table provides a summary of the many existing tools and add-ons that we considered to be beneficial.

Tool Name	Pros	Cons
Python	• Free and Open-Source. • Dynamic and can understand more complex scenario.	• Learning curve. • Require some programming knowledge.
Excel	• Workers already have experience in it. • Already implemented by the company	• Less dynamic.

Table 3: Table to compare between Python and Excel

There are several tools available for enhancing teamwork, communication, and production planning. Nearly all the tools may be adjusted to the needs of the business. We thought that two already-existing tools may work well. "Excel" and "Python," two well-known tools utilized in different industries, were the two tools selected. The

continuous improvement culture has an impact on them, and they also provide a variety of capabilities for project management and tracking.

However, it was determined after considering the pros and negatives of each software with the production planning department in the company that the effort required for deployment and getting past the learning curve outweighs the advantages of Python therefore, we went with Excel.

The work of digitizing all of Baxter's product catalogues was undertaken in the recent years. The database was outdated and not well organized. When examined more closely, it became clear that not all the catalogues' tables had been included into the database. There were some product's codes that the company stopped producing but still existing in the file. As a result, it was important to compare all catalogues' values to those in the database to see whether there were any wrong or missing values that were crucial to the operation of the configurator.

	CODE	FORMULA	OPG1_BF	VOLUME	VALVE	Machine	CAPACITY	MINIMUM CAPACITY
2	1D962E4GR	F1000E4	EM01000	1000	EM	05-13	16590	3318
3	13994E4GR	F1000E4	CF02000	2000	CF	Both	8316	1386
4	13985E5GR	F1000E5	CF02000	2000	CF	Both	8316	1386
5	1D973E5GR	F1000E5	TW01000	1000	TW	05-13	16590	3318
6	1D961E4GR	F1000E4	TW01000	1000	TW	05-13	16590	3318
7	13974E5GR	F1000E5	EM01000	1000	EM	05-13	16590	3318
8	1D980E5GR	F1000E5	TW02000	2000	TW	Both	8316	1386
9	13963E5GR	F1000E5	EM02000	2000	EM	Both	8316	1386
10	13964E5GR	F1000E5	EM02000	2000	EM	Both	8316	1386
11	13963E4GR	F1000E4	EM02000	2000	EM	Both	8316	1386
12	1ABHE40GR	F100040	EM00500	500	EM	05-13	29400	4200
13	14963B7GR	F1000B7S	EM02000	2000	EM	Both	8316	1386
14	1A89RB7GR	F1000B7S	EM02000	2000	EM	Both	8316	1386
15	1A150B7GR	F1000B7S	EM01000	1000	EM	05-13	16590	3318
16	1A13LB7GR	F1000B7S	EM00500	500	EM	05-13	29400	4200
17	1A180B7GR	F1000B7S	EM00350	350	EM	05-13	16170	2310
18	14333B7	F1000B7S	TW02000	2000	TW	Both	8316	1386
19	14331B7	F1000B7S	CF02000	2000	CF	Both	8316	1386
20	4CCB1323E	F1000B7S	EM00500	500	EM	05-13	29400	4200

Figure 22:Figure to show the updated database

As shown in the table above the excel file have a dedicated sheet to work as database, where it has the code of the product with its formula. The OPG1_BF represents the volume of the bag with the type of valve used in it. Finally, there is the machine or the line dedicated to that product with the maximum and minimum capacity.

There were 436 products in total, but the table size is up to 600 products just in case of new products in the future. Access to the database stated above is currently severely limited in order to safeguard the integrity of the data. Although this is common procedure, it is highly challenging to change or update information on the database because a password is needed to modify the sheet. This indicates that although the configurator utilizes certain settings, while the unauthorized workers won't have access to the database. Additionally, it is crucial that the data entered is accurate and error-free since otherwise, providing wrong numbers would compromise the database's integrity and cause problems for the business.

Since there are seven lines in the factory we developed seven sheets, each sheet dedicated to a specific line. The glass line did not have many constraints or special requirements, beside it was the line where our company tutor works on and responsible for. Therefor we started with this line to build the first draft and test the calculations, after several feedbacks and deep understanding of the process we managed to come up with this sheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	GLASS														
2	FILLING DATE	CODE	QUANTITY	FORMULA	CAPACITY	VOLUME	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF		FULL BATCH	LAST BATCH	REMAIN CAPACITY	MIX	OPG1
3	Monday, September 26, 2022	ALCA1323	39690	F1000B7S	34020	500	2	34020	0	x		5670	28350	28350	FL00500
4	Monday, September 26, 2022	ALCA1323	37422	F1000B7S	34020	500	1	9072	0	x		0	24948	24948	FL00500
5	Monday, September 26, 2022	ALCA1323	39690	F1000B7S	34020	500	1	14742	0	x		0	19278		FL00500
6	Wednesday, September 28, 2022	RHCA004603S	7620	F100048	9525	1000	1	7620	0	x		0	1905	1905	FD01000
7	Wednesday, September 28, 2022	HCA004603CMP	26670	F100048	9525	1000	3	9525	1	x	9525	5715	3810		FD01000
8	Thursday, September 29, 2022	12010G2	237600	F1000G2	132000	100	2	132000	0	x		105600	26400		FL00100
9	Friday, September 30, 2022	XCA0037WRP	26400	F6000P2	132000	100	1	26400	0	x		0	105600		FD00100
10	Friday, September 30, 2022	ABCA3CG114A39	7920	F6000ACA	132000	100	1	118800	0	x		0	13200	7920	FD00100
11	Friday, September 30, 2022	DCA3CG114X29	7920	F6000ACA	132000	100	0		0	x		0	5280	5280	FD00100
12	Friday, September 30, 2022	PCA3CG114N79	5280	F6000ACA	132000	100	0		0	x		0	0		FD00100
13	Saturday, October 1, 2022	HCA004315	26400	F6000AJ	132000	100	1	26400	0	x		0	105600		FD00100
14	Sunday, October 2, 2022	ALCA1323	39690	F1000B7S	34020	500	2	34020	0	x		5670	28350		FL00500
15	Sunday, October 2, 2022	PCA3CG114N79	5280	F6000ACA	132000	100	1	116160	0	x		0	15840		FD00100
16	Tuesday, October 4, 2022	ABCA3CG114A39	7920	F6000ACA	132000	100	1	118800	0	x		0	13200		FD00100
17	Wednesday, October 5, 2022	12010G2	237600	F1000G2	132000	100	2	132000	0	x		105600	26400		FL00100
18	Wednesday, October 5, 2022	HCA004603CMP	26670	F100048	9525	1000	3	9525	1	x	9525	7620	1905	1905	FD01000
19	Wednesday, October 5, 2022	HCA004603CMP	26670	F100048	9525	1000	3	9525	1	x	9525	5715	3810		FD01000
20	Thursday, October 6, 2022	XCA0037WRP	26400	F6000P2	132000	100	1	26400	0	x		0	105600		FD00100
21	Friday, October 7, 2022	ALCA1323	39690	F1000B7S	34020	500	2	34020	0	x		5670	28350		FL00500
22	Friday, October 7, 2022	12010G2	237600	F1000G2	132000	100	2	132000	0	x		105600	26400		FL00100
23	Saturday, October 8, 2022	HCA004603CMP	26670	F100048	9525	1000	3	9525	1	x	9525	7620	1905		FD01000
24	Sunday, October 9, 2022	XCA0037WRP	26670	F6000P2	132000	100	1	26670	0	x		0	105330		FD00100

Figure 23: Figure to show the developed sheet to calculate the number of batches for the glass line

As shown in the table above the worker has to paste only the values of three columns filling date, code and quantity. After that the sheet does all the calculations with variety of procedures and activities carried out automatically using formulas. Users have the option of manually entering numbers into the formulae or using cell references, in which

case the calculation will use the data present in the linked cells. starting from the first batch and then calculate the total number of batches, number of full batches if any and lastly the last batch. Usually when there is enough remaining capacity, and the formula of the next product is the same as the finished batch and it is in the same day they mix the two batches together to utilize more capacity of the tank. As seen also when the number of batches is equal to zero it highlights the cell by red so the worker can confirm that this order is already fulfilled with the pervious batches. Same as the database sheet, only the first three columns are open to edit while the rest are locked and protected with a password.

For symphony line there was one constraint which is they have to fill the viaflo sheet first in order to determine what is the capacity of the tank, in case the viaflo producing bags with 500 ml size in the same day the capacity of the symphony line is 4968 bags otherwise it is 4860 bags.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	SY			*FILL THE VFO FIRST*											
2	FILLING DATE	CODE	QUANTITY	FORMULA	CAPACITY	VOLUME	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF		FULL BATCH	LAST BATCH	REMAIN CAPACITY	MIX	OPG1_BF
3	Monday, October 3, 2022	LCE8278	3780	F208277B, F208278	4860	5000	1	3780	0	x	3780	0	1080		PH05000
4	Tuesday, October 4, 2022	PCE8278	5940	F208277B, F208278	4860	5000	2	3780	0	x	0	2160	2700		PH05000
5	Wednesday, October 5, 2022	PCE8278	9936	F208277B, F208278	4968	5000	3	2808	1	x	4968	2160	2808		PH05000
6	Thursday, October 6, 2022	LCE8277	9936	F208277, F208277B	4860	5000	3	2916	1	x	4860	2160	2700		PH05000
7	Friday, October 7, 2022	LCE8280	9936	F208280, F208280B	4860	5000	3	2916	1	x	4860	2160	2700		PH05000
8	Saturday, October 8, 2022	LCE8280	6048	F208280, F208280B	4860	5000	2	3888	0	x	0	2160	2700		PH05000
9	Sunday, October 9, 2022	LCE8277	6048	F208277, F208277B	4860	5000	2	3888	0	x	0	2160	2700		PH05000
10	Monday, October 10, 2022	LCE8280	9936	F208280, F208280B	4860	5000	3	2916	1	x	4860	2160	2700		PH05000
11	Monday, October 10, 2022	PCE8278	5940	F208277B, F208278	4860	5000	2	3780	0	x	0	2160	2700		PH05000
12	Wednesday, October 12, 2022	LCE8278	5940	F208277B, F208278	4860	5000	2	3780	0	x	0	2160	2700		PH05000
13	Thursday, October 13, 2022	PCE8278	6048	F208277B, F208278	4860	5000	2	3888	0	x	0	2160	2700		PH05000
14	Friday, October 14, 2022	LCE8278	9936	F208277B, F208278	4860	5000	3	2916	1	x	4860	2160	2700		PH05000
15	Sunday, October 16, 2022	PCE8278	5940	F208277B, F208278	4860	5000	2	3780	0	x	0	2160	2700		PH05000
16	Sunday, October 16, 2022	LCE8277	3780	F208277, F208277B	4860	5000	1	3780	0	x	0	0	1080		PH05000
17	Sunday, October 16, 2022	LCE8280	6048	F208280, F208280B	4860	5000	2	3888	0	x	0	2160	2700		PH05000
18	Tuesday, October 18, 2022	PCE8278	3780	F208277B, F208278	4860	5000	1	3780	0	x	0	0	1080		PH05000
19	Wednesday, October 19, 2022	LCE8277	6048	F208277, F208277B	4860	5000	2	3888	0	x	0	2160	2700		PH05000
20	Thursday, October 20, 2022	LCE8277	9936	F208277, F208277B	4860	5000	3	2916	1	x	4860	2160	2700		PH05000
21	Friday, October 21, 2022	LCE8280	9936	F208280, F208280B	4860	5000	3	2916	1	x	4860	2160	2700		PH05000
22	Saturday, October 22, 2022	LCE8278	3780	F208277B, F208278	4860	5000	1	3780	0	x	0	0	1080	1080	PH05000
23	Saturday, October 22, 2022	PCE8278	6048	F208277B, F208278	4860	5000	2	2808	0	x	0	3240	1620		PH05000
24	Monday, October 24, 2022	PCE8278	3780	F208277B, F208278	4860	5000	1	3780	0	x	0	0	1080	#N/A	PH05000

Figure 24: Figure to show the developed sheet to calculate the number of batches for the symphony line

Because of this constraint the symphony line capacity is dependent on the viaflo line and that's why there the message to fill the vfo first, the row is frozen so it appears even while scrolling down to avoid any human error if the worker forgot.

With viaflex it has only one special condition, that it does not matter the volume of the product in the mixing phase. Where usually the mixture takes the filling date, formula and the volume into consideration. All the previous data should be the same as the next order to mix it with the current one.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	VFX														
2	FILLING DATE	CODE	QUANTITY	FORMULA	CAPACITY	VOLUME	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF		FULL BATCH	LAST BATCH	REMAIN CAPACITY	MIX	OPG1
3	Monday, October 3, 2022	LCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
4	Tuesday, October 4, 2022	LCB5260G	10,800	F209280, F209280B	9720	2000	2	7560	0	x		3240	6480		CDV2000
5	Wednesday, October 5, 2022	CTCB5260	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
6	Thursday, October 6, 2022	RCB5260G	9,720	F209280, F209280B	9720	2000	1	9720	0	x		0	0		CDV2000
7	Friday, October 7, 2022	RCB5260G	6,480	F209280, F209280B	9720	2000	1	6480	0	x		0	3240		CDV2000
8	Saturday, October 8, 2022	LCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
9	Sunday, October 9, 2022	RCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
10	Monday, October 10, 2022	RCB5260G	9,720	F209280, F209280B	9720	2000	1	9720	0	x		0	0		CDV2000
11	Tuesday, October 11, 2022	LCB5260G	6,480	F209280, F209280B	9720	2000	1	6480	0	x		0	3240		CDV2000
12	Wednesday, October 12, 2022	LCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
13	Thursday, October 13, 2022	CTCB5260	10,800	F209280, F209280B	9720	2000	2	7560	0	x		3240	6480		CDV2000
14	Friday, October 14, 2022	LCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
15	Saturday, October 15, 2022	LCB5260G	9,720	F209280, F209280B	9720	2000	1	9720	0	x		0	0		CDV2000
16	Sunday, October 16, 2022	RCB5260G	6,480	F209280, F209280B	9720	2000	1	6480	0	x		0	3240		CDV2000
17	Monday, October 17, 2022	RCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480	6480	CDV2000
18	Tuesday, October 18, 2022	CTCB5260	6,480	F209280, F209280B	9720	2000	1	6480	0	x		0	0		CDV2000
19	Wednesday, October 19, 2022	RCB5260G	6,480	F209280, F209280B	9720	2000	1	6480	0	x		0	3240		CDV2000
20	Thursday, October 20, 2022	RCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
21	Friday, October 21, 2022	CTCB5260	9,720	F209280, F209280B	9720	2000	1	9720	0	x		0	0		CDV2000
22	Saturday, October 22, 2022	RCB5260G	10,260	F209280, F209280B	9720	2000	2	7020	0	x		3240	6480		CDV2000
23	Sunday, October 23, 2022	CTCB5260	10,800	F209280, F209280B	9720	2000	2	7560	0	x		3240	6480	6480	CDV2000

Figure 25: Figure to show the developed sheet to calculate the number of batches for the viaflex line

The line viaflo is the one must be filled before the symphony line other than that it is similar to the glass line in sense there are not any special requirements. One issue that appeared here was the filling date, since the worker copy the data from another sheet to paste here in the table, we noticed that the pasted values are dates with timings, Therefore the mixing calculations were wrong because the timing is not the same. So we had to use a dummy column in all the sheets to convert the input of the filling date column to only date and remove the timing.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	VFO														
2	FILLING DATE	CODE	QUANTITY	FORMULA	CAPACITY	VOLUME	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF	x	FULL BATCH	LAST BATCH	REMAIN CAPACITY	MIX	OPG1
3	Saturday, October 1, 2022	LCE2324G	18,720	F1000AB	17280	1000	2	15840	0	x		2880	14400	14400	VF01000
4	Saturday, October 1, 2022	LCE2324G	18,720	F1000AB	17280	1000	1	4320	0	x		0	12960		VF01000
5	Tuesday, October 4, 2022	LCE2324G	18,720	F1000AB	17280	1000	2	15840	0	x		2880	14400		VF01000
6	Wednesday, October 5, 2022	LCE2324G	28,800	F1000AB	17280	1000	2	17280	0	x		11520	5760		VF01000
7	Thursday, October 6, 2022	LCE2324G	18,720	F1000AB	17280	1000	2	15840	0	x		2880	14400		VF01000
8	Friday, October 7, 2022	LCE2324G	28,800	F1000AB	17280	1000	2	17280	0	x		11520	5760		VF01000
9	Saturday, October 8, 2022	LCE2324G	28,800	F1000AB	17280	1000	2	17280	0	x		11520	5760	5760	VF01000
10	Saturday, October 8, 2022	LCE2324G	18,720	F1000AB	17280	1000	1	12960	0	x		0	4320		VF01000
11	Sunday, October 9, 2022	LCE2324G	28,800	F1000AB	17280	1000	2	17280	0	x		11520	5760		VF01000
12	Monday, October 10, 2022	LCE2324G	18,720	F1000AB	17280	1000	2	15840	0	x		2880	14400		VF01000
13	Tuesday, October 11, 2022	LCE0063G	18,720	F100040	23040	500	1	18720	0	x		0	4320		VF00500
14	Tuesday, October 11, 2022	LCE0064G	28,800	F100040	17280	1000	2	17280	0	x		11520	5760		VF01000
15	Thursday, October 13, 2022	LCE1324G	28,800	F1000B7S	17280	1000	2	17280	0	x		11520	5760		VF01000
16	Saturday, October 15, 2022	LCE0063G	18,720	F100040	23040	500	1	18720	0	x		0	4320		VF00500
17	Saturday, October 15, 2022	LCE0064G	28,800	F100040	17280	1000	2	17280	0	x		11520	5760		VF01000
18	Saturday, October 15, 2022	LCE0063G	18,720	F100040	23040	500	1	18720	0	x		0	4320		VF00500
19	Monday, October 17, 2022	LCE2324G	18,720	F1000AB	17280	1000	2	15840	0	x		2880	14400		VF01000
20	Tuesday, October 18, 2022	LCE0064G	28,800	F100040	17280	1000	2	17280	0	x		11520	5760		VF01000
21	Wednesday, October 19, 2022	LCE0063G	28,800	F100040	23040	500	2	23040	0	x		5760	17280		VF00500
22	Thursday, October 20, 2022	LCE2324G	18,720	F1000AB	17280	1000	2	15840	0	x		2880	14400		VF01000
23	Saturday, October 22, 2022	LCE1324G	18,720	F1000B7S	17280	1000	2	15840	0	x		2880	14400		VF01000
24	Saturday, October 22, 2022	LCE0063G	18,720	F100040	23040	500	1	18720	0	x		0	4320		VF00500

Figure 26: Figure to show the developed sheet to calculate the number of batches for the viaflo line

Both machine number 5 and 13 works together and they name that cell as line 5-13, the constraint about this line is that if the volume of product is 1000 ml it must takes into account that the tank must be neutralized. Basically, it means the tank will not be fully

utilized to fulfil the order amount in the first batch so the capacity is restricted to 13272 bags. However this restriction is only in the first batch of the 1000 ml in the day while the rest batches will have the full capacity of 16590 bags.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	5&13														
2	FILLING DATE	CODE	QUANTITY	FORMUL	CAPACIT	VOLUM	TOTAL NUMBER OF BATCHES	First Batch	NUMBER OF		FULL BATCH	LAST BATCH	REMAIN CAPACIT	MIX	OPG1_B
3	Thursday, October 27, 2022	13974E5GR	14220	F1000E5	13272	1000	2	10902	0	X	0	3318	13272		EM01000
4	Thursday, October 27, 2022	14329B7GR	14220	F1000B7S	13272	1000	2	10902	0	X	0	3318	13272		EM01000
5	Friday, October 28, 2022	1A81KB7GR	26544	F1000B7S	13272	1000	2	9954	1	X	16590	0	0		EM01000
6	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	13272	1000	1	6636	0	X	0	0	9954	6636	EM01000
7	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	0	13272	0	X	0	0	3318	3318	EM01000
8	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	1	3318	0	X	0	0	13272	6636	EM01000
9	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	0	13272	0	X	0	0	6636	6636	EM01000
10	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	0	13272	0	X	0	0	0		EM01000
11	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	1	6636	0	X	0	0	9954	6636	EM01000
12	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	0	13272	0	X	0	0	3318	3318	EM01000
13	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	1	3318	0	X	0	0	13272	6636	EM01000
14	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	0	13272	0	X	0	0	6636	6636	EM01000
15	Thursday, October 27, 2022	1A81NB7GR	6636	F1000B7S	16590	1000	0	13272	0	X	0	0	0		EM01000
16	Friday, October 28, 2022	14327B7GR	13272	F1000B7S	13272	1000	1	13272	0	X	0	0	3318	3318	TW01000
17	Friday, October 28, 2022	1432AB7GR	23226	F1000B7S	16590	1000	2	16590	0	X	0	3318	13272		TW01000
18	Saturday, October 29, 2022	1A81NB7GR	6636	F1000B7S	13272	1000	1	6636	0	X	0	0	9954		EM01000
19	Saturday, October 29, 2022	13974E5GR	6636	F1000E5	13272	1000	1	6636	0	X	0	0	9954		EM01000
20	Monday, October 31, 2022	14329B7GR	14220	F1000B7S	13272	1000	2	10902	0	X	0	3318	13272		EM01000
21	Tuesday, November 1, 2022	1A81KB7GR	6636	F1000B7S	13272	1000	1	6636	0	X	0	0	9954		EM01000
22	Wednesday, November 2, 2022	14327B7GR	13272	F1000B7S	13272	1000	1	13272	0	X	0	0	3318		TW01000
23	Thursday, November 3, 2022	1432AB7GR	23226	F1000B7S	13272	1000	2	13272	0	X	0	9954	6636		TW01000
24	Friday, November 4, 2022	1A81NB7GR	26544	F1000B7S	13272	1000	2	9954	1	X	16590	0	0		EM01000

Figure 27: Figure to show the developed sheet to calculate the number of batches for the 5-13 line

Finally, the last line 7-8 also works as a cell and it shares some products with the pervious line 5-13. The 2000 ml bags can be produced on both lines 7-8 and 5-13 however, the capacity of both lines is different the capacity of 2000 ml products on line 7-8 is 10368 bags while on the line it is 8316 bags. This is the only unique condition on that line that we had to deal with while working on it.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	7&8														
2	FILLING DATE	CODE	QUANTITY	FORMULA	CAPACITY	VOLUME	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF	x	FULL BATCH	LAST BATCH	REMAIN CAPACIT	MIX	OPG1_BF
3	Saturday, October 1, 2022	AECCB7127S	7488	F1000B7S	6912	3000	2	6336	0	x		1152	5760		CF03000
4	Monday, October 3, 2022	AECCB7117S	4608	F100001	6912	3000	1	4608	0	x		0	2304		CF03000
5	Monday, October 3, 2022	AECCB7127S	20736	F1000B7S	6912	3000	4	5760	2	x	6912	1152	5760	5760	CF03000
6	Monday, October 3, 2022	BLCCB7127S	8064	F1000B7S	6912	3000	1	2304	0	x		0	0		CF03000
7	Tuesday, October 4, 2022	AECCB7127S	3456	F1000B7S	6912	3000	1	3456	0	x		0	3456	3456	CF03000
8	Tuesday, October 4, 2022	BMCCB7127S	12672	F1000B7S	6912	3000	2	6912	0	x		2304	4608	4608	CF03000
9	Tuesday, October 4, 2022	QCCB7750S	5760	F1000B7S	6912	3000	1	1152	0	x		0	5760		CF03000
10	Wednesday, October 5, 2022	AECCB7119S	6048	F100001	4032	5000	2	4032	0	x		2016	2016		CF05000
11	Wednesday, October 5, 2022	BLCCB7129S	4320	F1000B7S	4032	5000	2	3456	0	x		864	3168		CF05000
12	Thursday, October 6, 2022	LCCB7749S	6912	F1000B7S	4032	5000	2	4032	0	x		2880	1152	1152	CF05000
13	Thursday, October 6, 2022	LCCB7749S	17280	F1000B7S	4032	5000	5	3168	3	x	4032	864	3168		CF05000
14	Friday, October 7, 2022	AECCB7129S	17,280	F1000B7S	4032	5000	5	4032	3	x	4032	1152	2880		CF05000
15	Saturday, October 8, 2022	QCCB7750S	17,280	F1000B7S	6912	3000	3	6912	1	x	6912	3456	3456		CF03000
16	Sunday, October 9, 2022	AECCB7119S	20736	F100001	4032	5000	6	3744	4	x	4032	864	3168		CF05000
17	Monday, October 10, 2022	LCCB7749S	8064	F1000B7S	4032	5000	3	3168	1	x	4032	864	3168		CF05000
18	Tuesday, October 11, 2022	QCCB7750S	3456	F1000B7S	6912	3000	1	3456	0	x	3456	0	3456		CF03000
19	Wednesday, October 12, 2022	AECCB7119S	12672	F100001	4032	5000	4	3744	2	x	4032	864	3168		CF05000
20	Thursday, October 13, 2022	AECCB7127S	6048	F1000B7S	6912	3000	1	6048	0	x	6048	0	864		CF03000
21	Friday, October 14, 2022	BLCCB7127S	4320	F1000B7S	6912	3000	1	4320	0	x	4320	0	2592		CF03000
22	Saturday, October 15, 2022	AECCB7127S	6912	F1000B7S	6912	3000	1	6912	0	x	6912	0	0		CF03000
23	Sunday, October 16, 2022	BMCCB7127S	4320	F1000B7S	6912	3000	1	4320	0	x	4320	0	2592		CF03000
24	Monday, October 17, 2022	LCCB7749S	6912	F1000B7S	4032	5000	2	4032	0	x	4032	2880	1152		CF05000

Figure 28: Figure to show the developed sheet to calculate the number of batches for the 7-8 line

After finishing all the lines and having several meetings with the stakeholders to make sure everything is working fine and doing the job that was required and use some data to run in the system to make sure the calculations were right and all the special conditions for each line have been respected. Then we thought about how that there is a sheet for the database, there should be another sheet where it is easier to have an overview over the whole lines. So, we needed to develop a power query It enables us to create a query once and reuse it with a straightforward refresh. It has a decent amount of power. Millions of rows may be imported and cleaned by power query into the data model for further analysis. The user interface is clear and well-designed, making it simple to learn. Compared to other Excel features like formulae or VBA, it has a remarkably low learning curve, so it will be easier than other tools to edit on it in the future in case of adding or removing any data.

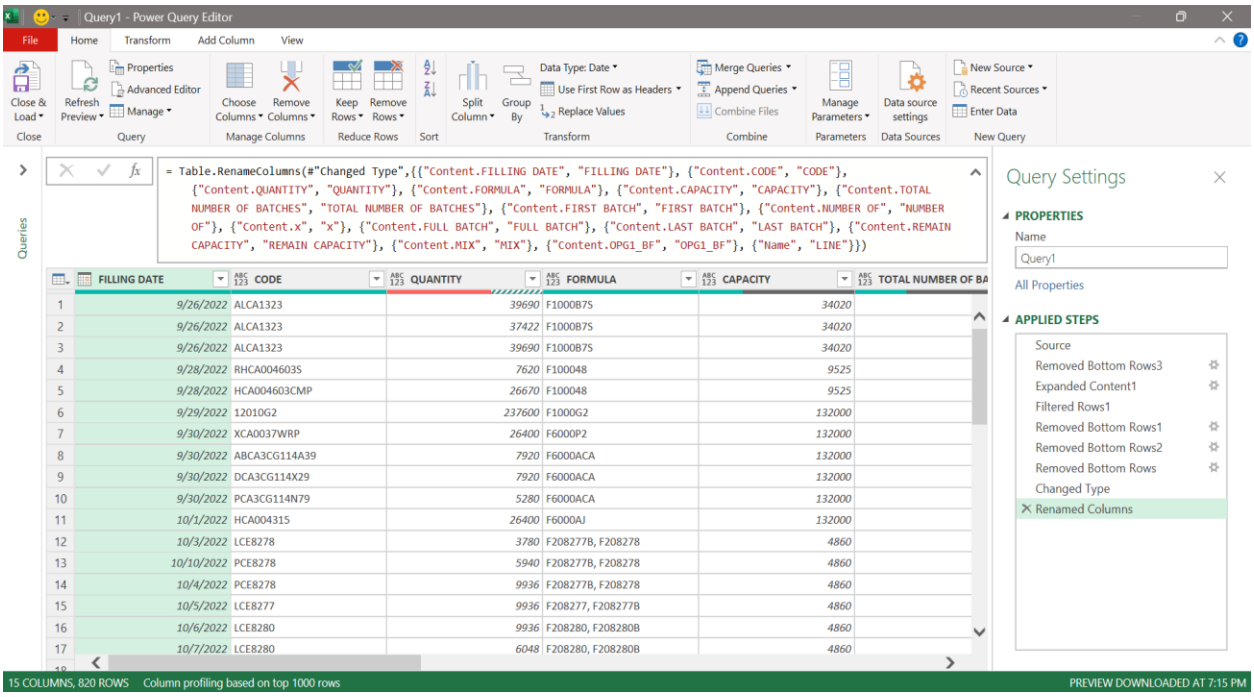

Figure 29: Figure to show the developed power query

The output of this power query loads in a sheet under the name summary where the worker can have an overview of the whole daily production and he can filter the results to display a specific thing.

	A	B	C	D	F	G	H	I	J	K	M	N	O
1	FILLING DATE	CODE	QUANTITY	FORMULA	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF	x	FULL BATCH	LAST BATCH	MIX	OPG1_BF	LINE
2	9/26/2022	RHCA004693S	15875	F6000AL	2	9525	0	x		6350	0	FD01000	GL
3	9/26/2022	RHCA004313S	22225	F6000AJ	3	9525	1	x	9525	3175	0	FD01000	GL
4	9/26/2022	HCA004315	26400	F6000AJ	1	26400	0	x		0	0	FD00100	GL
5	9/28/2022	RHCA004603S	7620	F100048	1	7620	0	x		0	1905	FD01000	GL
6	9/28/2022	HCA004603CMP	26670	F100048	3	9525	1	x	9525	5715	0	FD01000	GL
7	9/29/2022	12010G2	237600	F1000G2	2	132000	0	x		105600	0	FL00100	GL
8	9/30/2022	XCA0037WRP	26400	F6000P2	1	26400	0	x		0	0	FD00100	GL
9	9/30/2022	ABCA3CG114A39	7920	F6000ACA	1	7920	0	x		0	7920	FD00100	GL
10	9/30/2022	DCA3CG114X29	7920	F6000ACA	0	0	0	x		0	5280	FD00100	GL
11	9/30/2022	PCA3CG114N79	5280	F6000ACA	0	0	0	x		0	0	FD00100	GL
12	10/1/2022	HCA004315	26400	F6000AJ	1	26400	0	x		0		FD00100	GL
13	8/2/2022	PCE8278	9936	F208277B, F208278	3	3726	1	x	9525	1242	0	PH05000	SY
14	8/3/2022	PCE8278	9720	F208277B, F208278	2	4860	1	x	9525	0	0	PH05000	SY
15	8/4/2022	LCE8280	9936	F208280, F208280B	3	2673	1	x	9525	2403	0	PH05000	SY
16	8/5/2022	LCE8280	6696	F208280, F208280B	2	2673	0	x		4023	0	PH05000	SY
17	8/22/2022	PCE8277	9936	F208277, F208277B	3	2673	1	x	9525	2403	0	PH05000	SY
18	8/23/2022	LCE8278	4968	F208277B, F208278	2	2673	0	x		2295	0	PH05000	SY
19	8/23/2022	LCE8282	4968	F208280B, F208282	2	2673	0	x		2295	0	PH05000	SY
20	8/24/2022	LCE8281	9936	F208280B, F208281	3	2673	1	x	9525	2403	0	PH05000	SY
21	8/25/2022	LCE8281	9936	F208280B, F208281	3	2673	1	x	9525	2403	0	PH05000	SY
22	8/26/2022	LCE8277	9936	F208277, F208277B	3	2673	1	x	9525	2403	0	PH05000	SY
23	8/28/2022	LCE8280	3240	F208280, F208280B	1	3240	0	x		0	0	PH05000	SY
24	8/29/2022	LCE8280	9936	F208280, F208280B	3	2673	1	x	9525	2403	0	PH05000	SY
25	8/30/2022	LCE8280	9936	F208280, F208280B	3	2673	1	x	9525	2403	0	PH05000	SY
26	8/31/2022	LCE8280	9936	F208280, F208280B	3	2673	1	x	9525	2403		PH05000	SY

Figure 30:Figure to show the output of the power query

For further analysis to get more useful information from the data we decided to include some graphs to help represent these insights.

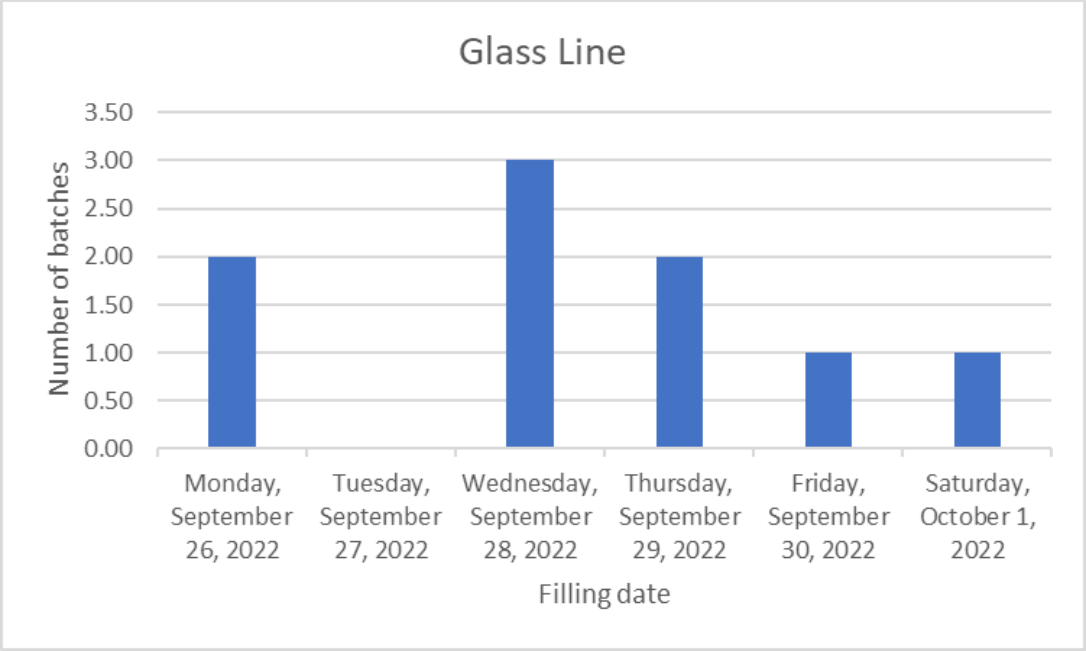

Figure 31: Figure to show the number of batches each day for the glass line

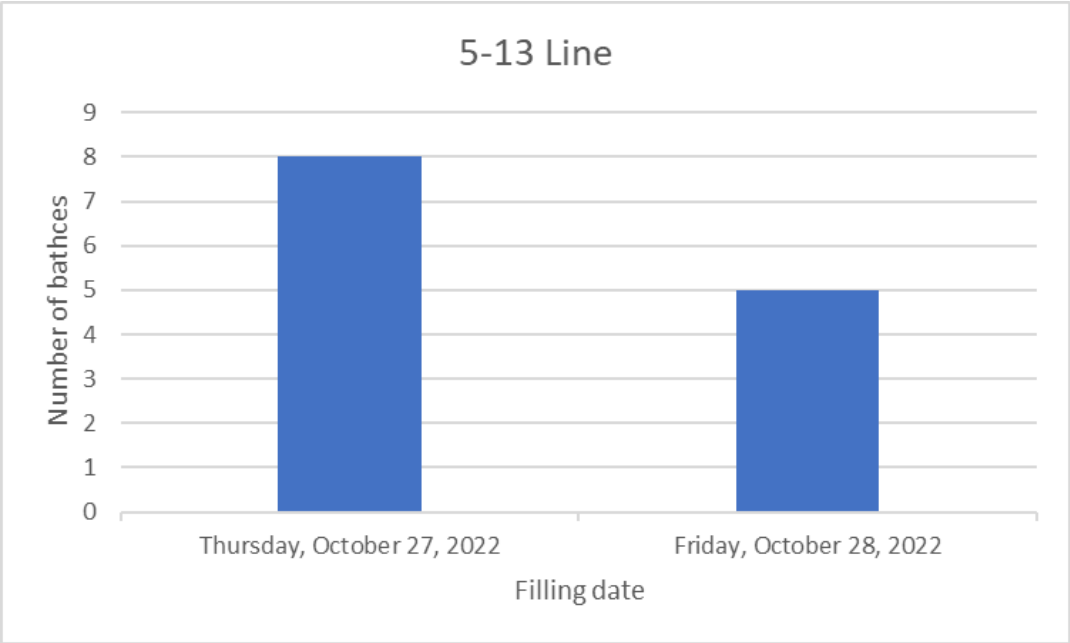

Figure 32: Figure to show the number of batches each day for the 5-13 line

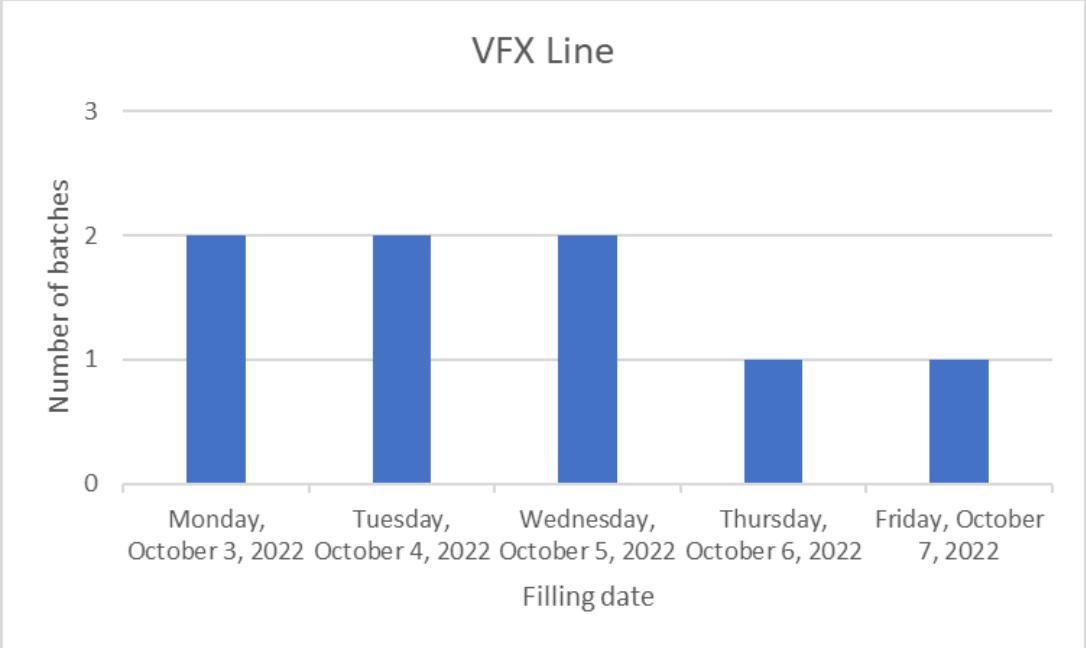

Figure 33: Figure to show the number of batches each day for the viaflex line

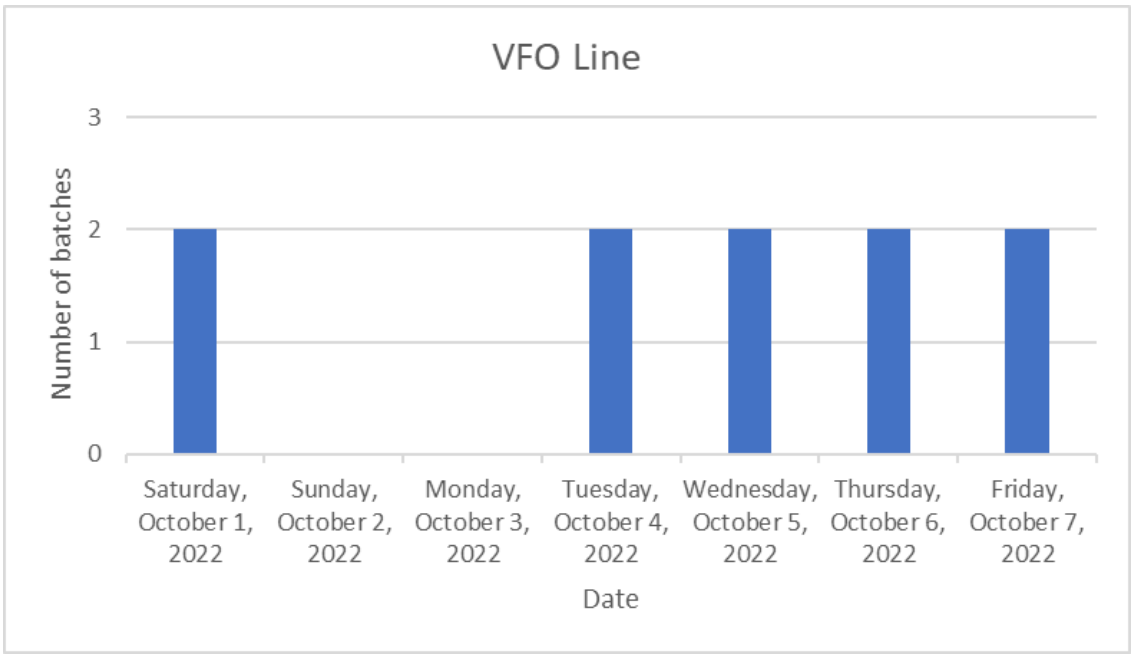

Figure 34: Figure to show the number of batches each day for the viaflo line

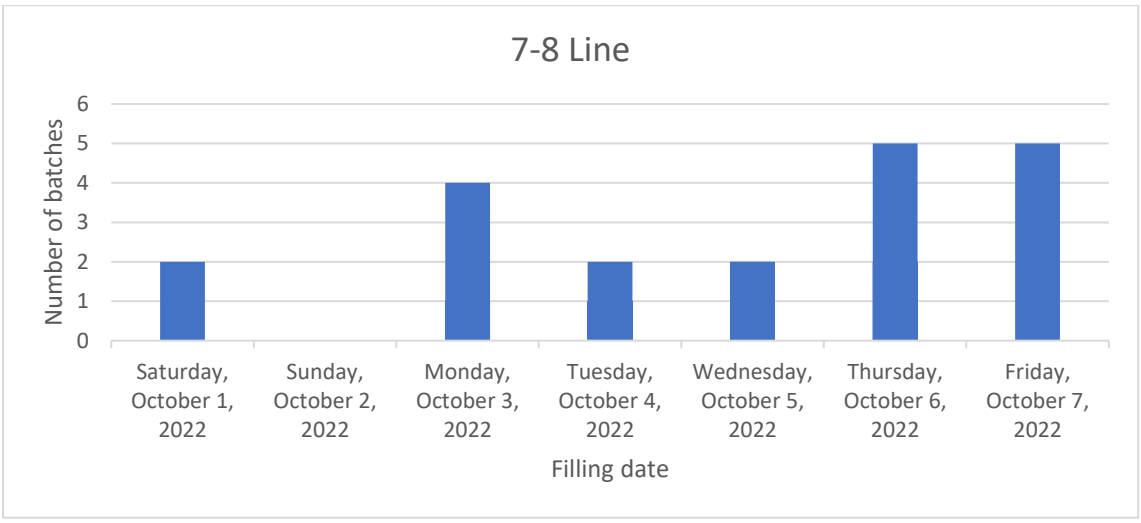

Figure 35: Figure to show the number of batches each day for the 7-8 line

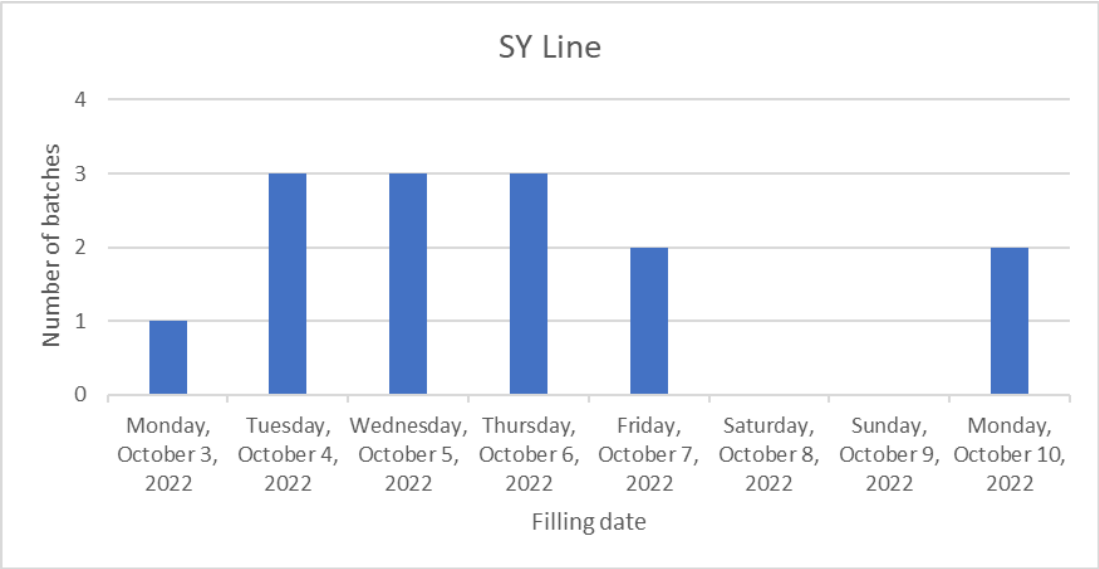

Figure 36: Figure to show the number of batches each day for the symphony line

With these graphs we can see the number of batches daily for each line, that will help the production department to level the production. The importance of levelized manufacturing it is that enhances the likelihood that the company will be able to meet specific client requirements and deliver on time for big orders. Level production assists in preventing production capacity from being completely or overbooked, in contrast to the just-in-time approach of satisfying client orders once they have been reserved.

All these activities and procedures is to improve and standardize the production plan of the company and make it doable by any worker and not someone familiar with the numbers and the calculations. However, A plan is a methodical path of action with an anticipated result or results. Depending on the degree of comfort and the sort of business, the plan can be for one week in advance, one month in advance, or even longer. After mapping out the strategy, it will be necessary to make a list of all the activities and actions required to take. Sort them as well, if it is possible, according to importance and how much involvement they will require. Since this is only a prediction and not actual accounting, there is no need to be incredibly precise.

Since the machines can give a report about the actual timing such as when did each batch started and finished and in which batch the machine is currently working on. To take advantage of these information coming out of the machines we thought about comparing

the plan which is the output of the pervious sheets with actual. To get profound understanding of what the department were capable of and were unable to achieve by contrasting the outcomes of their efforts with what they had anticipated. It also explains what they should and shouldn't do. If the majority of their outcomes fall short of their expectations, they can develop a list of potential contributing variables.

To do so we needed to use visual basic for application VBA it is a programming language that runs internally in Microsoft Office and is used to create programmes, it permits users to access features that go beyond those included in MS Office apps. Additionally, users may utilize VBA to adapt software to their own business needs by building user-defined functions, automating computer operations, and more. To do that we had to build a macro -short for macroinstructions- it is simply a string of letters that, when entered, produces a different string of characters as its output, carrying out a certain set of computational operations. There are two ways to create Excel macros, the first method is utilizing the Macro Recorder is the first approach. Once the recorder is turned on, Excel will capture each action the user does and store it as a macro. This macro is stored after the user closes the recorder and may be linked to a button that, when pressed, will repeat the entire procedure. It is not necessary to have any prior understanding of the VBA code to use this pretty easy procedure. Simple procedures will function using this technique.

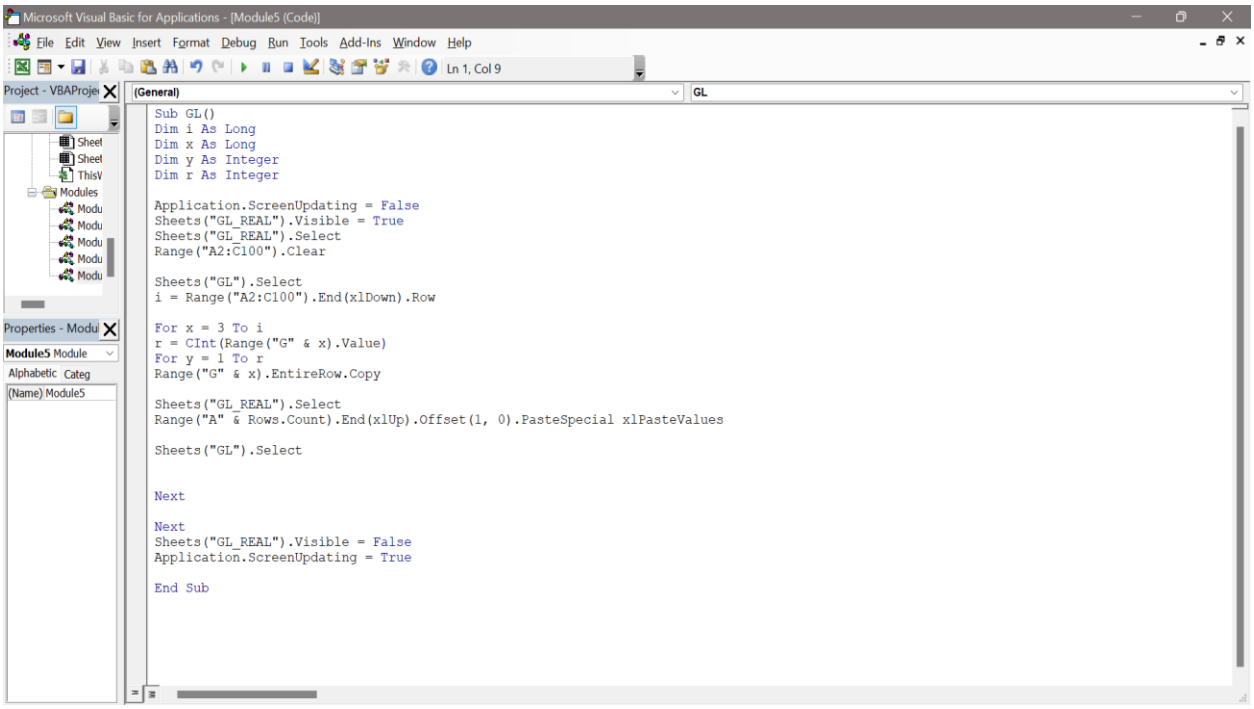

Figure 37: Figure to show the developed code in VBA

we had to come up with a code that shown in the picture above to take the output of the pervious sheets and disaggregate the order, in other words to deal with each batch of the order as it is a separate order. Basically, the code will go for each row copy it and paste it depending on the number of batches

The drawback of the other approach which is that the macro recorder will precisely replicate the user's input and is not highly configurable. Recorder macros also by default utilize absolute reference as opposed to relative referencing. This has the effect of making macros created in this manner exceedingly challenging to utilize with variables and "smart" processes. Excel macros may also be programmed using VBA, which is a more robust way. Therefore, we could not use that way.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	FILLING DATE	CODE	QUANTITY	FORMULA	CAPACITY	VOLUME	TOTAL NUMBER OF BATCHES	FIRST BATCH	NUMBER OF		FULL BATCH	LAST BATCH	REMAIN CAPACITY	MIX	OPG1_BF	REQURIED L
2	Saturday, October 1, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	14400	2880	14400	14400	VF01000	35650
3	Saturday, October 1, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	14400	2880	14400	14400	VF01000	35650
4	Saturday, October 1, 2022	LCE2324G	18720	F1000AB	17280	1000	1	4320	0	x	4320	0	12960	0	VF01000	4650
5	Tuesday, October 4, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	17280	2880	14400	0	VF01000	20150
6	Tuesday, October 4, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	17280	2880	14400	0	VF01000	20150
7	Wednesday, October 5, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	0	VF01000	31000
8	Wednesday, October 5, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	0	VF01000	31000
9	Thursday, October 6, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	17280	2880	14400	0	VF01000	20150
10	Thursday, October 6, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	17280	2880	14400	0	VF01000	20150
11	Friday, October 7, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	0	VF01000	31000
12	Friday, October 7, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	0	VF01000	31000
13	Saturday, October 8, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	5760	VF01000	37200
14	Saturday, October 8, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	5760	VF01000	37200
15	Saturday, October 8, 2022	LCE2324G	18720	F1000AB	17280	1000	1	12960	0	x	12960	0	4320	0	VF01000	13950
16	Sunday, October 9, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	0	VF01000	31000
17	Sunday, October 9, 2022	LCE2324G	28800	F1000AB	17280	1000	2	17280	0	x	17280	11520	5760	0	VF01000	31000
18	Monday, October 10, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	17280	2880	14400	0	VF01000	20150
19	Monday, October 10, 2022	LCE2324G	18720	F1000AB	17280	1000	2	15840	0	x	17280	2880	14400	0	VF01000	20150

Figure 38: Figure to show the output of the VBA code

This the output of the macro, there are 18 rows which means that during that week there are 18 batches to be produced in that line. For each line there will be a specific macro that takes the calculations made in the pervious and the output of these macros will be in different sheet. Since the output sheet will work as a source for other sheet where it will calculate the starting and ending time for each batch, all the macro's output sheets will be hidden as shown also in the code.

	A	B	C	D	E	F	G	H
1	VFO				UPDATE			
2	FILLING DATE	CODE	FORMULA	QUANTITY	batch	MIX	START	END
3	Saturday, October 1, 2022	LCE2324G	F1000AB	18720	15840	0	6:00:00 AM	9:00:00 AM
4	Saturday, October 1, 2022	LCE2324G	F1000AB	2880	2880	14400	9:30:00 AM	2:15:00 PM
5	Saturday, October 1, 2022	LCE2324G	F1000AB	4320	4320	0	2:45:00 PM	6:26:15 PM
6	Tuesday, October 4, 2022	LCE2324G	F1000AB	18720	15840	0	6:00:00 AM	9:00:00 AM
7	Tuesday, October 4, 2022	LCE2324G	F1000AB	2880	2880	0	9:30:00 AM	10:27:00 AM
8	Wednesday, October 5, 2022	LCE2324G	F1000AB	28800	17280	0	6:00:00 AM	10:30:00 AM
9	Wednesday, October 5, 2022	LCE2324G	F1000AB	11520	11520	0	11:00:00 AM	3:24:00 PM
10	Thursday, October 6, 2022	LCE2324G	F1000AB	18720	15840	0	6:00:00 AM	9:00:00 AM
11	Thursday, October 6, 2022	LCE2324G	F1000AB	2880	2880	0	9:30:00 AM	10:27:00 AM
12	Friday, October 7, 2022	LCE2324G	F1000AB	28800	17280	0	6:00:00 AM	10:30:00 AM
13	Friday, October 7, 2022	LCE2324G	F1000AB	11520	11520	0	11:00:00 AM	3:24:00 PM
14	Saturday, October 8, 2022	LCE2324G	F1000AB	28800	17280	0	6:00:00 AM	10:30:00 AM
15	Saturday, October 8, 2022	LCE2324G	F1000AB	11520	11520	5760	11:00:00 AM	5:15:00 PM
16	Saturday, October 8, 2022	LCE2324G	F1000AB	12960	12960	0	5:45:00 PM	10:11:15 PM
17	Sunday, October 9, 2022	LCE2324G	F1000AB	28800	17280	0	6:00:00 AM	10:30:00 AM
18	Sunday, October 9, 2022	LCE2324G	F1000AB	11520	11520	0	11:00:00 AM	1:45:00 PM
19	Monday, October 10, 2022	LCE2324G	F1000AB	18720	15840	0	6:00:00 AM	9:00:00 AM

Figure 39: Figure to show the developed sheet where it compares the planned with the actual

This is the sheet that will show the starting and ending time for each batch during the week so they can compare the department planning with what they are achieving. Every week or with every plan they just need to click on the update button, so the macros run and the calculations also. In this way it now easier to any worker to develop and the daily planning and the task would not require much experience.

Monitoring Of Results

The countermeasures were finished at various project phases and made available to the firm between version 1 and version 2. Version 1 which was planning the daily production plan without calculating the time of each batch and compare it with the actual plan, this phase ended by early June and the company used the file to run it in the real life and challenge the sheets to see if there is going to be any issue. By middle of the month, we had a meeting with the department to discuss the outcome and modified the file to their comments, finally by the end of the month the company approved the file.

The second version which is comparing the planned schedule with the actual one started after the first phase ended. It was delivered by September and the company tried both versions together for two weeks to make sure that both phases are working together as it should be.

Three targets have been set in the beginning of the project. The first one was decreasing if not eliminating the paperwork, for this target we managed to eliminate the paperwork which resulted in a faster and greener process since they were using around 10 pages every time, meanwhile now everything became on Excel sheets which make it also easier to modify.

The other goal was removing the worker from the process in order to make it independent and free him to other tasks that are more meaningful.

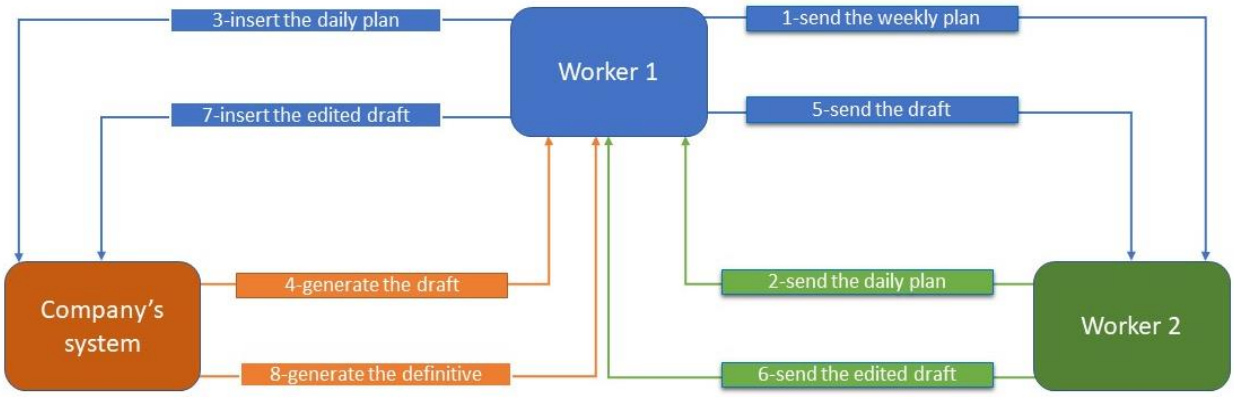

Figure 40: Figure to show how the process used to go

As shown before this how was the process going the aim was to remove worker 2 from this process since he already there because he knows all the constraints of the lines and how the calculation is made.

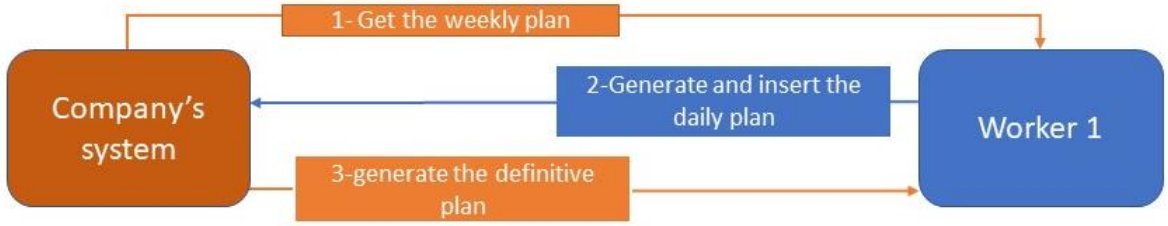

Figure 41: Figure to show how the process is now

As the above figure shows with removing worker 2 the worker one now can do the process by himself using the tool provided, because all the calculation and constraints that he is not aware of are respected already in the excel, then he can put it in the company's system to generate the definitive plan that will be performed.

This also means now that the process is a lot shorter in fact, we measured time required to perform the whole new process for a month and these were the results.

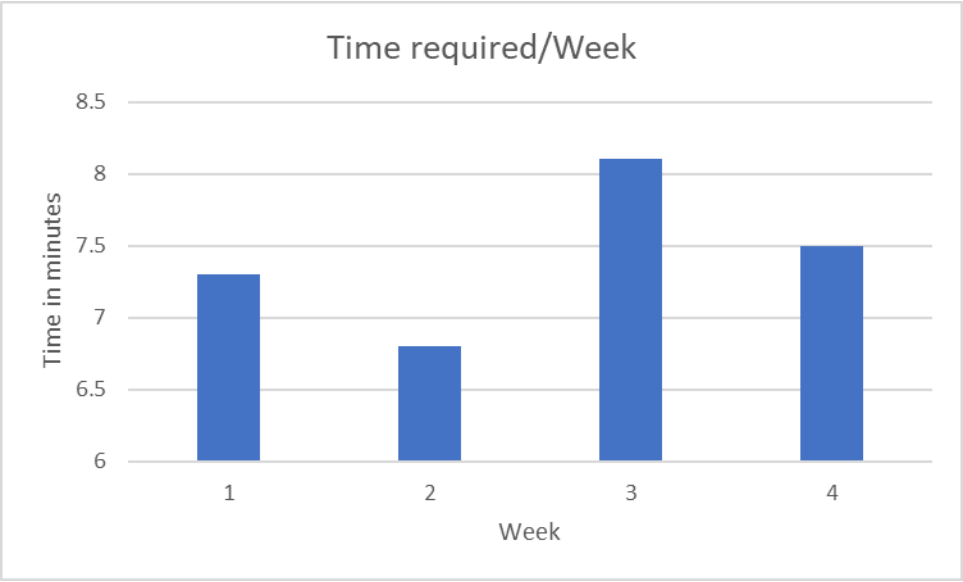

Figure 42: Figure to show the time required to do the process each week after the countermeasures

The maximum was 8.1 minutes while the minimum was 6.8 minutes with an average of 7.4 minutes that is 33.9% decrease of the original average time.

With that result it means also that the worker will save his time that was spent on this process without giving it any value adding so the manager can exploit him somewhere else using the maximum of his expertise.

A survey was produced and given to every member of the production team who had access to the most recent tool in order to better understand the views, attitudes, and adoption of the tool by the team.

In order to give brief insights, the questions were generated utilizing ratings (from 1 to 5 points), open-ended questions, and a public poll. The first three inquiries were utilized to learn more about how the new configurator will affect their job and whether it would actually be helpful. The findings below demonstrate an overall favorable perception of the configurator with outcomes that are above average.

Survey Questions 1 = strongly disagree, 5 = strongly agree	Rating 1-5	Percentage
Are the new tool simple to use and comprehend?	3.9	75%

Do you find the new tool to be time-saving when it comes to the planning process?	4.0	77%
Do you think the new tool makes your job easier?	3.7	70%

Table 4:Table to show the results of the survey

Standardize and Share Success

The Baxter management announced that utilizing the configurator will become normal procedure to that the identical operating method will be followed by all production departments. The configurator will also be used for monitored to assess how well the tool is being used and to identify shortcomings caused by underuse. It is crucial in order to ensure that the production department feels confident using the new tool, all demos and the firm has been given access to well-documented instructions for the new features to continuously enhance their operational procedures. Additionally, the code used to develop and communicate with the configurator has been meticulously tracked to guarantee that the configurator can be enhanced going forward.

The production department now has access to updated capabilities and features on the digital planning configurator, including expanded daily batch calculations, planned vs actual variance, data accessibility and modification, as well as increased tool confidence. The quantitative findings demonstrated a considerable reduction in proposal planning time.

Additionally, the absence of the need for documentation results in a smoother and quicker operation. The survey findings clearly showed that the production department was qualitatively pleased with the improved configurator. The tool was praised for being simple, understandable, and useful for their work, which increased the likelihood that it would be adopted.

As was mentioned throughout the countermeasure implementation, the necessary code language in order to use the VBA were the first significant challenge. Since our team had never worked with these specific languages before, a lot of effort was spent making sure that our coding skills were enough to take on this project.

The fact that the team included two international students added to the linguistic barrier. The problem of some of the Italian workers at Baxter not speaking English was also a problem. As a result, several of the dialogues during our visit to the firm were postponed

to make sure that our corporate instructor was there so that everyone could understand the discussions. Due to this barrier, information requests were delayed many times, and simultaneous communication in both languages with all production teams was necessary.

The time spent at the firm was a rewarding experience with many of valuable lessons learned. The technical information about pharmaceutical plants and how they function, as well as the numerous aspects that affect their operations and planning, was immensely fascinating to study. Working closely with the management group helped me to understand many of the fundamental abilities needed to handle challenging circumstances at work and overcome certain difficulties. In order to advance our understanding of the sector, our staff was actively encouraged to learn from all departments and contacts with diverse service providers.

The language barrier made certain conversations difficult, but generally the experience helped us develop a wide range of technical and soft skills, exposed us to different situations, and tested our talents. Working for the firm was a wonderful joy, and we wish them luck in all of their future commercial endeavors.

Continuous improvement is a crucial component of the A3 technique since it adheres to the lean methodology. By hiring a committed team this project may be made even better, to schedule the order of the orders for example if in a certain day the company going to produce ten orders on the glass line the order of these ten orders can be optimized to reduce the amount of waiting time that is required to sanitize and clean the line between batches.

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Appendix

A3 Framework

A3 No. and Name	Team members (name & role)	Stakeholders (name & role)	Department
Standardise and optimize daily production planning	1. Karim Shams 2. Soroosh Emami 3. 4.	1. Stefano Pettigrosso, Planning supervisor 2. Alex Yevdoveli, Manufacturing manager 3. Alex Furlani, Manufacturing supervisor 4. Catrina	Supply chain Manufacturing IT

Organisation objective

Non value added reduction during planning process

Start date & planned duration

01/04/2022- 5 months

1. Clarify the problem / Problem Background / Current situation

The company is facing a problem with the daily production planning. The repetitive activities makes the process takes more time than it should. The main person involved is Manufacturing and planning supervisor who has non value added activities during manual daily production planning.

3 hours = 7.5% of weekly available time

2. Breakdown the problem

The company has three production plans monthly, weekly and daily. The daily production plan is based on the weekly plan and it's done manually. The worker takes the weekly plan and assign the number of batches and the size of each one, after that another worker check the and confirm the numbers then put the daily production plan into the system and get a draft for it and handled back to the worker who review it and do some changes in it and send back again. Finally the when the second worker get the draft edited by the first worker she puts in the system and get the definitive daily plan.

3. Set the Target

1. Reduce NVA activities for M&P supervisor to reach 2.5% of available time
2. Eliminate the repetitive processes
3. Make the process feasible by anyone without heavy experience

4. Analyse the Root Cause

5. Develop Countermeasures

	Problem	Countermeasure	Impact on target
1	Inefficient reporting system	Export an excel from weekly planning	Eliminating paper sheets
2	Human error	Planning by Excel	Reaching zero error in calculation
3	Verbal communication	Delegating main part of planning task	Eliminating waiting time for M&P supervisor
4	Repetitive tasks	Planning by Excel	Reducing NVA activities

6. Implement Countermeasure

7. Monitor Results & Process

8. Standardise & Share Success

The production department now has access to updated capabilities and features on the digital planning configurator, including expanded daily batch calculations, planned vs actual variance, data accessibility, and modification, as well as increased tool confidence. The quantitative findings demonstrated a considerable reduction in proposal planning time.

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