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«Supply Chain Management»

The Optimization of the Production Process Using

«The Value Stream Mapping»

Case Study: GIPLAIT-ARIB

«Pasteurized and Conditioned Milk »

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Abstract:

This study focuses on optimizing pasteurized milk production at GIPLAIT-ARIB using Value Stream Mapping (VSM), a key Lean Manufacturing tool. The main objective is to identify and eliminate waste to enhance operational efficiency and customer satisfaction. A qualitative approach was employed, combining field observations, interviews with production, quality, and maintenance managers, and analysis of technical data such as cycle times and defect rates.

The results revealed several significant sources of waste. These included daily 30-minute downtime due to batch changeovers, overproduction representing 15% of batches exceeding customer demand, and packaging defects affecting 5% of milk bags, leading to substantial losses. Through VSM analysis, concrete improvements were achieved: a 20% reduction in cycle time (from 10,552 to 8,442 seconds per batch), a 12% decrease in intermediate inventory through FIFO system optimization, and the elimination of unnecessary operator movements using 5S methodology.

In conclusion, this research demonstrates the effectiveness of VSM for optimizing industrial processes in the dairy sector. The proposed solutions, such as staff training and workstation redesign show measurable productivity gains. These improvements could be extended to other production lines to strengthen GIPLAIT-ARIB's competitiveness.

Keywords: Lean Manufacturing, Value Stream Mapping, optimization, waste reduction, food industry.

Résumé:

Ce mémoire explore l'optimisation du processus de production du lait pasteurisé chez GIPLAIT-ARIB à travers l'outil *Value Stream Mapping* (VSM), une méthode clé du Lean Manufacturing. L'objectif principale est d'identifier et d'éliminer et d'éliminer les gaspillages afin d'améliorer l'efficacité opérationnelle et la satisfaction client. Pour y parvenir, une approche qualitative a été adopté, combinant des observations terrain, des entretiens avec les responsables de production, qualité et maintenance, ainsi que l'analyse de donnée techniques telles que les temps de cycle et les taux de défauts.

Les résultats révèlent plusieurs sources de gaspillages majeures. Parmi elles, on note des temps d'arrêt quotidiens de 30 minutes du aux changements de séries, une surproduction représentant

15% des lots excédant la demande client, et des défauts de scellage affectant 5% des sacs de lait, entraînant des pertes significatives. Grâce à la cartographie des flux et à l'analyse VSM, des améliorations concrètes ont été proposées. Celles-ci incluent une réduction de 20% du temps de cycle (passent de 10 552 à 8 442 seconds par lot), une diminution de 12% des stocks intermédiaires vie l'optimisation du système FIFO, et l'élimination des déplacements inutiles des opérateurs grâce à la méthode 5S.

En conclusion, cette étude démontre l'efficacité du VSM pour optimiser les processus industriels dans le secteur agroalimentaire. Les solutions mise en avant, telles que la formation des équipes et le réaménagement des postes de travail, ont un impact mesurable sur la productivité. Ces améliorations pourraient être étendues à d'autres lignes de production, renforçant ainsi la compétitivité globale de GIPLAIT-ARIB.

Mots-clés : Lean Manufacturing, Value Stream Mapping, optimisation, gaspillage, agroalimentataire.

الملخص:

تركز هذه الدراسة على تحسين عملية إنتاج الحليب المبستر في شركة "جيب لايت- عريب" باستخدام أداة خريطة تدفق القيمة (VSM)، وهي من أدوات التصنيع الرشيق الأساسية. الهدف الرئيسي هو تحديد وإزالة الهدر لتحسين الكفاءة التشغيلية ورضا العملاء. تم اعتماد منهج نوعي يجمع بين الملاحظات الميدانية ومقابلات مع مسؤولي الإنتاج والجودة والصيانة، بالإضافة إلى تحليل البيانات الفنية مثل أوقات الدورة الإنتاجية ومعدلات العيوب.

كشفت النتائج عن عدة مصادر مهمة للهدر، منها توقف يومي لمدة 30 دقيقة بسبب تغير الدفعات، وإفراط في الإنتاج يمثل 15% من الدفعات يتجاوز الطلب، وعيوب في التغليف تؤثر على 5% من أكياس الحليب مما يسبب خسائر كبيرة.

من خلال تحليل VSM، تم تحقيق تحسينات ملموسة: تخفيض وقت الدورة بنسبة 20% (من 552 10 إلى 442 8 ثانية لكل دفعة)، وانخفاض المخزون الوسيط بنسبة 12% عبر تحسين نظام " أولاً يدخل أولاً يخرج"، وإزالة الحركات غير الضرورية للعاملين باستخدام منهجية 5S.

في الختام، يبرهن هذا البحث على فعالية أداة VSM في تحسين العمليات الصناعية في قطاع الألبان. الحلول المقترحة مثل تدريب العمال وإعادة تصميم محطات العمل تظهر مكاسب إنتاجية قادرة للقياس. يمكن تعميم هذه التحسينات على خطوط إنتاج أخرى لتعزيز القدرة التنافسية لشركة "جيب لايت- عريب".

الكلمات المفتاحية: التصنيع الرشيق، خريطة تدفق القيمة، التحسين، تقليل الهدر، الصناعة الغذائية.

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Table of Contents:

List of Tables:

Figure list:

ABBRIVIATION LIST

VSM: Value Stream Mapping.

5 S: Seiri, Seiton, Seiso, Seiketsu, Shinsuke.

TPM: Total Production Management.

TPS: Toyota Production System.

FIFO: First-In-First-Out.

T/C: Cycle Time.

L/T: Lead Time.

NVA: Non-Value-Added Time.

VA: Value-Added Time.

SMED: Single Minute Exchange of Dies.

JIT: Just In Time

LPC: Pasteurized and Conditioned Milk.

LM: Lean Manufacturing.

GENERAL INTRODUCTION

In today's competitive agro-industrial landscape, optimizing production processes has become critical for companies to maintain profitability and meet evolving customer expectations. For dairy producers like GIPLAIT-ARIB, this challenge is particularly acute due to stringent quality requirements and narrow profit margins. This study investigates how Value Stream Mapping (VSM), a cornerstone Lean Manufacturing methodology, can systematically identify and eliminate waste in pasteurized milk production to enhance operational efficiency.

The research originates from a pressing industrial reality: despite advanced equipment, GIPLAIT-ARIB faces recurring productivity losses from workflow imbalances, inventory excess, and quality defects. Preliminary observations revealed that 22% of production time was consumed by non-value-added activities – a finding that aligns with industry reports showing 15-30% efficiency gaps in Algerian dairy processing (ONAB, 2023). Such evidence underscores the urgent need for evidence-based process optimization.

Central to this study is the research question: *How can Value Stream Mapping transform the production process of pasteurized milk at GIPLAIT-ARIB to achieve measurable improvements in lead time, cost, and quality?*

The main objectives of this study are the following:

- The identification of the production process stages, as well as the value flows that are related with the waste sources.
- The implementation of the Value Stream Mapping to visualize the non-value added activities within the production process.
- The suggestion of specific solutions to optimize the production process.

- **Reasons for the theme selection**
  - Improving the productivity and the processes leading to higher quality products.
  - Identification of the faced problems in the food processing industry by the implementation of a Lean Manufacturing tool and finding the appropriate solutions.

- A strong commitment for the Lean Manufacturing and the optimization of processes especially the production processes to improve productivity.

- **Problem statement**

Our main objective using the Value Stream Mapping is to answer the following problem:

« ***How can Value Stream Mapping transform the production process of pasteurized milk at GIPLAIT-ARIB to achieve measurable improvements in lead time, cost, and quality?*** »

Starting from this problem statement, the following secondary question are:

- What are the tools and methods used to successfully implement a Value Stream Mapping at GIPLAIT-ARIB?
- What are the continuous improvement tools that should be used to optimize the production process at GIPLAIT-ARIB?
- What are the different waste sources identified using the VSM at GIPLAIT-ARIB?

- **Research methodology**

With the aim of treating this subject and to answer the problem statement, we have used the qualitative approach, interviews collect important data as well as the observations that helped us understand the company's working strategies, and the documentary data collection that contributed in the data analysis.

- **Field of Research**

The study's primary objective is to implement the Value Stream Mapping as a way of optimizing the production process of the company GIPLAIT choosing its municipality ARIB as the location for our end of study project, this study held place in the Wilaya of Ain Defla, during a period that lasted from 18 February to 18 April 2025.

In an effort to comprehensively answer to the research question this dissertation is divided into three chapters:

- **Chapter I: Literature Review and conceptual framework**

This chapter is divided to two sections, the first section is dedicated to the literature review and the previous studies where the VSM was implemented in various industries, and the second section is dedicated on the conceptual framework, introducing the key concepts of the Lean Manufacturing and the Value Stream Mapping.

- **Chapter II: Methodological and contextual framework**

In this chapter, the choice of the methodology is presented in the first section including the timeframe and the procedure and the data collecting tools used, whereas in the second section the host company GIPLAIT-ARIB is presented.

- **Chapter III: Implementation of the Value Stream Mapping at GIPLAIT-ARIB**

The last chapter is divided into two sections, the first section is devoted to the implementation of the VSM approach detailing the phases of the VSM drawing and mainly the family product selection, the current state drawing and the future state drawing and the action plan suggested, the second section is mainly for the results and discussion of the suggested improvements.

CHAPTER I : LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

This chapter is divided into two sections, the first section examines the previous studies of the value stream mapping in different industries. The second section includes Lean Manufacturing and the optimization of the production process and the different concepts that are related to our study.

Section 1: Literature review:

The literature review thoroughly analyzes existing studies on the optimization of production processes through the application of Value Stream Mapping (VSM). By scrutinizing prior research across diverse industries, this review seeks to identify prevalent themes, methodologies, and outcomes associated with the implimentation of VSM in minimizing waste, enhancing efficiency, and boosting productivity. The review is organized thematically, concentrating on the manufacturing, food and agro-alimentation, garment and textile, mechanical, cosmetic, and health and plastic products sectors. Each subsection will delineate the objectives, context, problem, methodology, sample, and results of the studies, followed by a comparative analysis of their findings and methodologies. Additionally, this review will underscore the limitations and contradictions present in the existing literature, thereby setting the stage for this research to offer novel insights and solutions.

1.1 The optimization of the production process in the Manufacturing industry:

Fitriadi and Wijayanti (2023) conducted a study entitled "Improving Production Efficiency through Lean Manufacturing Tools," aiming to minimize waste and reduce waiting time in a manufacturing process. The study was set in a production facility experiencing high rejection rates (10-15%) during quality control and increased waste due to defects and transportation inefficiencies. The authors employed Value Stream Mapping (VSM) as the primary methodology, supplemented by Kaizen and the Fishbone Diagram, to identify non-value-added activities and optimize the use of trolleys and workstation layouts. The sample encompassed the entire production line of the facility. The findings indicated a reduction in defects and an improvement in efficiency from 67% to 73%.

Similarly, Klimecka-Tara and Dorota (2017) investigated the optimization of production processes in a cardboard packaging manufacturing company in their study "Reducing Waste in Cardboard Packaging Production." The objective was to reduce process time and waste while enhancing value-added operations. The authors utilized Value Stream Mapping to identify inefficiencies and implemented transport tally systems and employee training. The sample included the production line for cardboard packaging. The results demonstrated a reduction in process time from 38 minutes to 24 minutes and 8 seconds, along with a 2-minute reduction in value-added time.

Conversely, Rohania and Zahraeea (2015) concentrated on a different aspect of manufacturing in their study "Bottleneck Reduction in Paint Production." The objective was to address bottlenecks in the production of paint paste, which caused delays and rework. The authors applied Value Stream Mapping to analyze the production process and implemented Kaizen and Kanban systems. The sample included the paint production line. The results showed a reduction in lead time from 8.5 days to 6 days and a decrease in value-added time from 68 minutes to 37 minutes.

1.2 The optimization of the production process in the Food and Agro-Alimentation:

Setiawan (2022) Carried out a study entitled "Improving Efficiency in Sugar Production," aiming to identify and mitigate waste in the production of white crystal sugar. The study was situated in a sugar production facility experiencing inefficiencies in material flow. The authors employed Value Stream Mapping (VSM) and the DMAIC (Define, Measure, Analyze, Improve, Control) methodology. The sample encompassed the entire sugar production process. The findings indicated a reduction in non-value-added activities and enhanced production efficiency.

Similarly, Melvin and Baglee (2008) examined a yogurt production company in their article "Energy Efficiency in Yogurt Production." The study aimed to address energy inefficiencies and maintenance issues. The authors utilized Value Stream Mapping to identify areas for improvement and introduced new technologies for temperature control. The sample comprised the yogurt production line. The results demonstrated improved energy efficiency and a reduction in maintenance errors.

1.3 Optimization of the Production Process in the Mechanical and textile industry

Jamadar et al. (2019) undertook a study entitled "Waste Reduction in Compressor Manufacturing," with the objective of identifying and reducing waste in a compressor manufacturing company. The study was situated in a facility in Singapore experiencing inefficiencies in shop floor activities. The authors employed Value Stream Mapping as their methodology, analyzing the current state and proposing improvements. The sample included the compressor production line. The results indicated a reduction in waste and an increase in value-added time.

Tesfaye (2017) performed a study entitled "Reducing Production Time in Garment Manufacturing," with the objective of minimizing waste and enhancing productivity in a garment manufacturing unit. The study was conducted in a factory in India facing prolonged production times and inefficiencies. The authors employed Value Stream Mapping as their methodology, concentrating on identifying non-value-added activities. The sample included the garment production line. The results indicated a reduction in production time and an increase in value-added activities.

1.4 Optimization of the Production Process in the Cosmetic Industry

Imtinan and Cahyaputri (2024) executed a study entitled "Improving Efficiency in Cosmetic Production," with the objective of reducing production time and defects in a cosmetic manufacturing company. The study was conducted in a facility in Indonesia facing issues such as transportation waste and waiting time. The authors employed Value Stream Mapping as their methodology, focusing on optimizing the production process. The sample included the cosmetic production line. The results indicated a reduction in production time from 4102 minutes to 2581 minutes.

1.5 Optimization of the Production Process in the Health and Plastic Products Industry

Rohac and Januska (2015) conducted a study entitled "Process Optimization in Plastic Product Manufacturing," with the objective of improving efficiency in a company producing plastic products for the health industry. The study was situated in a facility facing storage and execution time issues. The authors employed Value Stream Mapping as their methodology, focusing on visualizing and rationalizing processes. The sample included the plastic product production line. The results indicated improved efficiency and optimized production processes.

As a conclusion, the success of an organization is based on the optimization of the production process and that relays on the usage of tools like the Value Stream Mapping (VSM) that helps represent material and informational flow. According to several studies presented the VSM helps optimize value-added-activities and identify the waste, shortens the Lead time and helps optimize the productivity thus leading to the success of companies. In addition to that, the Value Stream Map is a tool that is considered essential for the other processes to know the improvements to make to correct the current map and to visualize the future map. The results of the implementation of the VSM are sustainable that guarantee a long-term success in the optimized process.

Comparison and Contrast of Studies

The studies reviewed indicate that Value Stream Mapping (VSM) serves as a versatile tool for optimizing production processes across diverse industries. In the manufacturing sector, research primarily focused on minimizing defects and alleviating bottlenecks, whereas studies in the food and agro-alimentation industries emphasized energy efficiency and material flow. The garment and textile industry investigations highlighted the reduction of production time, while the mechanical and cosmetic industries concentrated on waste reduction and process optimization. Despite these variations, all studies consistently demonstrated that VSM, when integrated with other lean tools such as Kaizen and Kanban, results in substantial improvements in efficiency and productivity.

Nevertheless, certain limitations and contradictions are evident in the existing literature. For instance, while some studies concentrated on quantitative metrics like lead time and production time, others prioritized qualitative improvements such as employee training and energy efficiency. Furthermore, the sample sizes and contexts varied significantly, complicating the generalization of findings. This research aims to address these limitations by providing a more comprehensive analysis of VSM's application across different industries and proposing new methodologies for further optimization.

In conclusion, the literature review underscores the effectiveness of Value Stream Mapping (VSM) in optimizing production processes across various industries. The studies reviewed demonstrate that VSM, when combined with other lean tools, can significantly reduce waste, enhance efficiency, and boost productivity. However, gaps and contradictions persist in the existing literature, particularly concerning methodology and generalizability. This research will build on these findings by proposing new approaches to VSM implementation and addressing the limitations identified in this review.

The literature review identifies methodological and generality flaws while highlighting the demonstrated efficacy of Value Stream Mapping (VSM) in production process optimisation. Building on these discoveries, this study will create fresh strategies for implementing VSM that are based on the theoretical underpinnings discussed in Section 2.

Section 2: Conceptual framework

In this section we will present the definitions and the theoretical foundations.

This section presents the theoretical foundations and key concepts that underpin the research on optimizing production processes using Value Stream Mapping (VSM) that form the basis to our project for optimizing the production process at Giplait-ARIB. The conceptual framework is essential for understanding the principles of lean manufacturing, the types of waste, and the tools employed to eliminate inefficiencies. By defining these concepts, a clear foundation is established for analyzing how VSM can be applied to improve production processes.

2.1 Lean manufacturing:

Lean Manufacturing (LM) is a production system that eliminates waste (non-value-adding activities) to enhance efficiency, flexibility, and quality. Originating from the Toyota Production System (TPS), developed by Eiji Toyoda and Taiichi Ohno, LM emphasizes just-in-time (JIT) production, Jidoka (autonomation), standardized work, Kanban systems, and continuous improvement (Kaizen) (Womack & Jones, 1990; Bouami, 2023).

Unlike traditional mass production, LM reduces variability by eliminating eight key waste (overproduction, waiting, transportation, over-processing, inventory, motion, defects, and underutilized talent) (Gaikwad, 2020). It enables high-volume production with minimal inventory while enhancing responsiveness to demand fluctuations (Basu & Dan, 2020). The term "lean" was formalized by John Krafcik (MIT), synthesizing TPS principles into a broader operational framework (Bouami, 2023).

LM integrates pull-based systems, workplace organization (5S), and employee involvement to sustain continuous improvement, delivering customer value with reduced lead times and costs (Siregar et al., 2019; Bosch Rexroth, 2009).

2.1.1 the categories of waste:

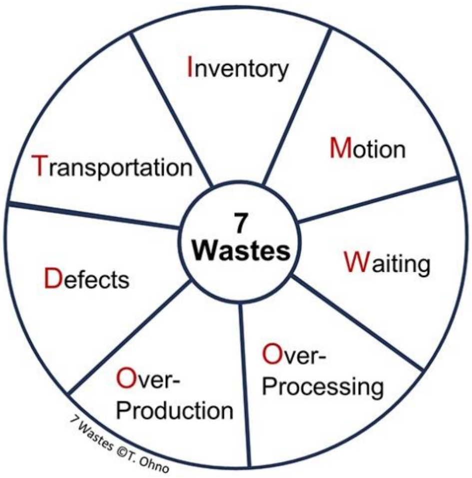
The lean concept's fundamental idea is to cut the waste, either completely or somewhat, in the process along the value stream, waste is considered as an activity that does not add value. (Nihlah & Immawan, 2018)

The primary goal of Lean, as the name suggests, is to save costs and delivery times while meeting customer needs for goods and services. Taichii Ohno (1912-1990) suggested attacking the three main drivers of inefficiency in any operational system waste, variability, and excess in order to achieve this goal. According to Lean philosophy, there are three different kinds of losses in industrial organizations. (Bouami, 2023)

2.1.2 the seven types of waste:

The seven Muda were identified as part of the Toyota Production System according to Taichii Ohno. However, this list has been modified and expanded by various practitioners of lean manufacturing and generally includes the following: (Khalil A. El-Namrouty, 2013)

Figure 1: the seven types of waste



Source: https://www.kaufmanglobal.com/glossary/7-types-waste/ (15 February 2025 at 22:25)

a. **Overproduction:** producing more than the customer demand, or producing too early before needed. The risk of overproducing is the obsolescence and the errors in production. (Capital, 2004)
b. **Defects:** In addition to physical defects which directly add to the costs of goods sold, this may include errors in paperwork, late delivery, production according to incorrect

specifications, use of too many raw materials or generation of un necessary scrap. (Capital, 2004) When defect occurs, rework may be required; otherwise the product will be scrapped. Generation of defects will not only waste material and labor resources, but it will also create material shortages, hinder meeting schedules, create idle time at subsequent work stations and extend the manufacturing lead time. (Ibrahim Rawabdeh, 2005)

c. **Inventory:** having unnecessarily high levels of raw materials, works-in-process and finished products. Extra inventory leads to higher inventory financing costs, higher storage costs and higher defect rates. (Capital, 2004)
d. **Transportation:** Any movement in the firms could be viewed as waste. Double handling and excessive movements are likely to cause damage and deterioration with the distance of communication between processes. (Hines & Rich, 2007)
e. **Waiting:** When time is being used ineffectively, then the waste of waiting occurs. This waste occurs whenever goods are not moving or being worked on. This waste affects both goods and workers, each spending time waiting. Waiting time for workers may be used for training or maintenance activities and should not result in overproduction. (Hines & Rich, 2007)
f. **Motion:** It includes any unnecessary physical motions or walking by workers which divert them from actual processing work. This might include walking around the factory floor to look for a tool, or even unnecessary or difficult physical movements, due to poorly designed ergonomics, which slow down the workers. (Capital, 2004)
g. **Over-processing:** It is unintentionally doing more processing work than the customer requires in terms of product quality or features- such as polishing or applying finishing in some areas of product that will not be seen by the customer. (Capital, 2004)

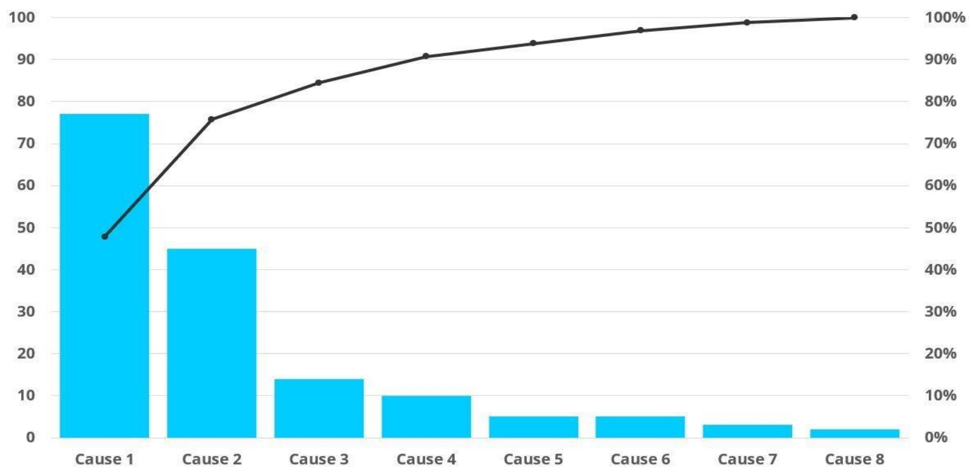
2.1.3 The lean manufacturing tools:

Lean production is characterized and quantified as an assortment containing tools and techniques for waste elimination (Belekoukias, 2014). Lean tools are categorized based on value to the customer, scheduling, maintenance, policy, and organization focus. (Purushothaman, 2021).

- **Pareto 80/20**

The Pareto principle also known as the rule 80/20, Vilfredo Pareto discovered this principle toward the end of the 19th century after noticing a systematic and predictable imbalance in the distribution of wealth. This is the reason it is also known as the law of pareto. Zipft expands on the idea in 1949 with the law of least effort, showing that resources tend to organize among themselves in a way that minimizes labor. (Koch, 2022) The purpose of the 80/20 analysis is generally to modify the relationship that it describes, or better yet, to exploit it! She is helpful, for example, when one wants to focus on the relationship's primary reasons, the 20% of introductions that result in 80% (or another percentage) of exclusions. (Koch, 2022)

Figure 2 : Diagram of Pareto



Source: https://www.leanenligne.com/blog/diagramme-de-pareto (15 February 2025, at 22:35)

- **The 5 S :**

5S is a system to reduce waste and optimize productivity through maintaining an orderly workplace and using visual cues to achieve more consistent operational results. Implementation of this method "cleans up" and organizes the workplace basically in its existing configuration, and it is typically the first lean method which organizations implement. (EPA, 2024)

- **Seiri (Sort):** Sorting the important items needed and discard the unessential elements.

- **Seiton (Set in order):** after removing unessential elements, organizing the essential elements are set in order to use.

- **Seiso (Shine):** regular cleaning and maintaining the workplace clean and regular inspection of the equipment.

- **Seiketsu (Standarize):** develop procedures and systems to maintain the first 3S.

- **Shitsuke (Sustain) :** maintain the improvements made through the first 4S, with discipline and regular audits.

Figure 3: the 5S

Source: https://asq.org/quality-resources/five-s-tutorial (15 February 2025, at 22:45)

- **Single- Minute Exchange of Dies (SMED):**

SMED is a lean tool that reduces the change overtime, it is one of the classical methods which is normally used to reduce the setup time. In this technique complete videography of the existing changeover is done and then by analyzing it waste activities identified and other improvement plant has been done in each iteration. (Dave, 2021)

SMED was developed by Shigeo Shingo, a Japanese industrial engineer who was extraordinarily successful in helping companies dramatically reduce their changeover times. His pioneering work led to documented reductions in changeover times averaging 94% (e.g., from 90 minutes to less than 5 minutes) across a wide range of companies. (Vorne.Industries, 2024)

The use of SMED increases the machines or the worker's ability to easily switch from one production series to another. reducing the stop time associated with series changes, lowering the amount of machine adjustments required, increasing production productivity and flexibility, removing adjustment errors, and streamlining adjustment procedures. It also makes it possible to set up a maintenance procedure. Setting goals and identifying production and pilot sites are the first steps in the SMED practice. (Abraham, 2012)

- **JIT (Just in time):**

JIT has been developed by Taiichi Ohno (1982), Executive Vice-President of the Toyota Motor Company and it spread to other companies of Japan in late 1970s (Ahuja, 2012). JIT has been depicted as an inventory control technique and the Japanese Auto Industry is recognized as the developer of JIT inventory and management philosophy (Aghazadeh, 2003).

Hunglin and Wang (1991) claim that JIT production is a philosophy for reducing work-in-progress (WIP) inventory, it aid process improvement and reduce process variability. It can be seen as a new way of thinking, planning, and performing with respect to manufacturing (Canel, C., Drew, & Anderson, 2000)

- **Value Stream Mapping (VSM):**

A Value Stream Map (VSM) is a process flow chart that shows each step in the production of a good or material, as well as the resources used in each step, and the relationships between the resources. Value stream mapping is a key component of any Lean initiative, providing a framework that highlights waste and the negative effect it has on overall process performance and flow. (King. & King, 2015)

Value-stream mapping (VSM) has its roots in the Japanese company Toyota and is an integral part of the lean manufacturing philosophy. The idea for this tool was born in the 1950s, when Toyota, trying to improve its production processes, began to focus on eliminating all forms of waste in production. The pioneers in the development of VSM were Taiichi Ohno and Shigeo Shingo, who worked on this tool over the years. In 1980, VSM was officially introduced into practice at Toyota. (Salwin, Pszczółkowska, Pał˛ega, & Kraslawski, 2023)

- **Poka-Yoke:**

Poka yoke is a Japanese term that means error proofing, Shigeo Shingow introduced these devices to Toyota in the 1960s as part of what is now known as the Toyota Production System curriculum, the main purpose of PY is to prevent the error from happening by detecting it during the early checkups. (Shimbun, 1989)

The PY is based on: (Trojanowska, 2023)

- Preventing errors.
- The waste minimization.

- Price reduction.
- Customer satisfaction.
- Competitive advantages.

- **Jidoka:**

Jidoka, also known as autonomation, is a principle implemented in lean manufacturing where machines automatically stop working upon detecting an abnormal condition and operators try fixing the defect to prevent the recurrence of the issue. In Toyota Jidoka means that a machine must come to a safe stop whenever an abnormality occurs. The goal is not to continuously run machines but to automatically stop them from running when a problem arises. This function helps capture flaws from escaping further down the line, prevents avoidable injuries, minimizes property damage, and empowers teams to enact long-term solutions after examinations of the matter. (Tarlengco, 2024)

2.1.4 The role of Value Stream Mapping in the Lean Manufacturing:

Value Stream Mapping (VSM) is a key tool in lean manufacturing which helps organizations visualize and analyze the flow of materials and information required to deliver a product or service to the customer. By mapping the current state of a process, identifying waste, and designing a future state, VSM enables organizations to achieve continuous improvement and operational excellence. It serves as a bridge between the theoretical principles of lean manufacturing and their practical application in real-world production processes. (Rother & shook, 1999)

2.2 Value Stream Mapping (VSM):

Value Stream Mapping (VSM) is a visual and analytical methodology employed in process improvement to identify, analyze, and optimize the flow of materials and information within a system. It offers a comprehensive overview of a process from inception to completion, enabling organizations to identify inefficiencies, minimize waste, and enhance the delivery of customer value. By engaging cross-functional teams in the mapping process, VSM promotes collaboration and facilitates continuous improvement initiatives. It serves as a dynamic tool that aids businesses in streamlining operations, increasing efficiency, and maintaining a customer-centric focus for sustained success. (Medina, Montoya, & Intriago, 2024)

In addition to this, a Value Stream Map (VSM) is a process flow chart that shows each step in the production of a good or material, as well as the resources used in each step, and the relationships between the resources. (King. & King, 2015)

According to Mike Rother, a Value Stream includes every action weather it is value-added or non-value-added that are necessary to bring a product or service from the original concept through the development and/or manufacturing processes to the receipt of payment. In manufacturing, each product family follows a separate value stream. (Mike Rother, 2009)

Moreover, Value Stream Mapping is an effective collaborative method for resolving a complicated process problem since it allows for the simple and quick gathering of all the stakeholders who will work together to improve the process. Participants will experience the essence of collaboration, which is a coproduction between multiple entities, through this experience, which will inspire confidence to further explore it. mapping out a macro-process in order to collectively identify its areas for drastic and ongoing improvement. (Perrot, 2022)

James Womack, Danielc Jones and Daniel Roos in their book gave another definition to the Value Stream Mapping in their book *"The machine that changed the world"* (1990), the value stream mapping is the sequence of activities an organization undertakes to deliver on a customer quest, it is a sequence of activities required to design, produce and deliver a good or a service to a customer, it includes the dual flows of information and materials. (Martin & Osterling, 2014)

This approach is based on analyzing an organization's internal processes and procedures; Johann Dumser illustrates the concept of value by enhancing quality, lowering production costs, or speeding up the production cycle, which enables an organization to choose among available techniques; each action within the chain must therefore contribute to the creation of perceived value, i.e., to the final customer's satisfaction, which is translated into an increase in the company's revenue. The term "value" refers to the assessment of what customers are willing to pay for a good or service, and the actions represented in the VSM can be categorized as either "at value added" or "at non-value added." (Johann, 2015)

- **Value added:** Value added refers to any activity that enhances the perceived value of a product, whether in terms of its functionality or market appeal, from the perspective of the customer. These are activities for which the customer is willing to pay.

- **Non value added**: Non-value-added activities are those that do not add value to the product, such waste sources. Certain things cannot be prevented (without large investments).

2.2.1 The implementation of the value stream mapping:

The implementation of the value stream mapping in the lean manufacturing industry aims to reduce the waste and improve the quality of the production and the quality of the products, the implementation includes:

✓ The first step is to collect and analyze data of the company's processes and their interactions, the information gathered are the foundation for the current state map.

✓ Second step consist of proposing the future state map, the future map has the new results following the improvements made.

2.2.2 The benefits and the challenges of the Value Stream Mapping:

Lean manufacturing tools like the Value Stream Mapping are used to eliminate the waste and increase the efficiency, the benefits and the challenges of the VSM are the following: (Barney N. , 2023)

The benefits are:

- **Visualization:** visualizing all the steps in a product delivery process is the main benefit of the value stream maps. This sort of visualization helps organizations to understand every element of their workflow.
- **Waste elimination:** once visualized, the steps in the value stream maps are analyzed for whether they are value-adding or not, inefficient steps and resources can be identified or adjusted, eliminating the waste.
- **Continuous improvement:** value stream maps are often used as tools to achieve continuous improvements, that makes proactive changes. The mapping process forces an organization to analyze and revise its workflow.
- **Process improvement:** the elimination of bottlenecks, quality issues and defects in products and services helps organizations improve the overall quality of their process, product or service and its delivery.

• **Increased customer satisfaction:** value stream mapping results in high quality products and services that are delivered faster to better meet customer demands and improve their experience.

With all the benefits that the Value stream Mapping has it still faces challenges as:

• **Resource use:** the creation of the value stream map can require a lot of time and resources; it includes the outreach to multiple teams and stakeholders. Many companies face difficulties especially while collecting relevant process data.

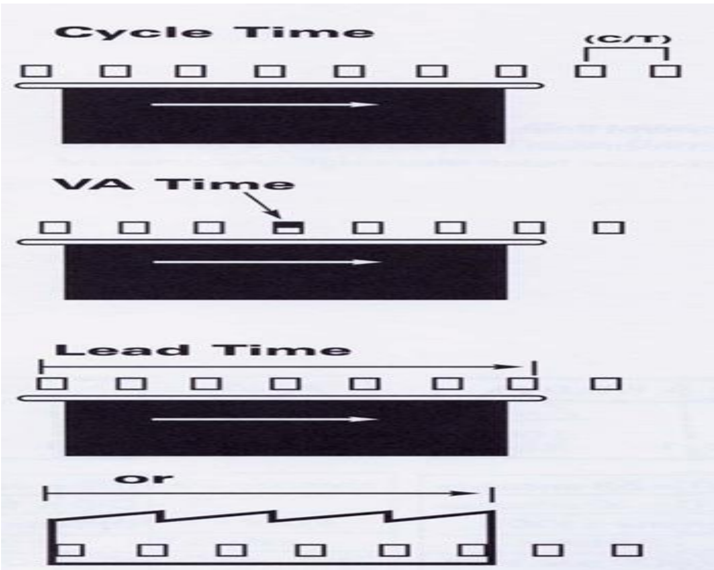
• **Change management:** the changes proposed by the value stream map can be expensive and require difficult resource reallocation.

• **Dealing with unknowns**: value stream mapping and the steps it eliminates aren't guaranteed to improve the workflow.

2.2.3 Key Elements in a Value Stream Map:

To demonstrate the value stream map there are key elements that are essential

Figure 4: Elements of VSM



Source: (Mike Rother, 2009, p. 29)

• **Cycle time (C/T):** how often a part or a product actually is completed by a process, as timed by observation. Also, the time is taken an operator to go through all of their work elements before repeating them.

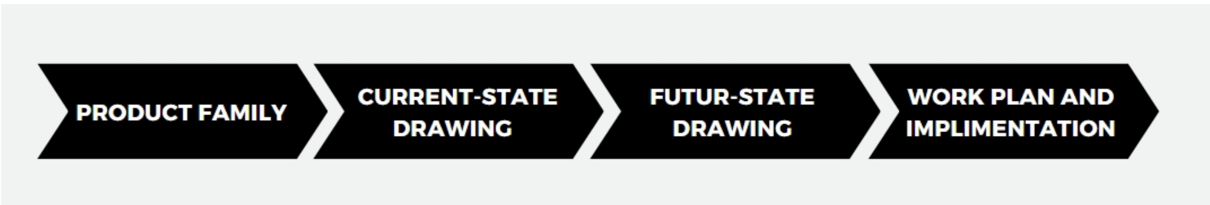
• **Value added time (VA):** time of those work elements that actually transform the product in a way that the customer is willing to pay for.

- **Lead time (L/T):** the time it takes one piece to move all the way through a process or a value stream, from start to finish. Envision timing a marked part as it moves from beginning to end.
- **Changeover time (C/O) :** the amount of time it takes for a machine to be configured, cleaned and have any necessary partes changed, before starting a new production process.
- **Information flow:** lines and arrows that show the timing of the process and the order of each step of the process.
- **Non-Value-Added Activity (NVA)** : any part of the activities that don't add value that are identified.
- **Takt-Time:** a German term to describe how fast a production keeps up with customer's demands.
- **Product Family:** a group of families that go through the same production process.

2.2.4 Elaboration steps of the Value Stream Mapping:

To create the value stream map rother and shook (2003) in *Learning To See"* have presented the 4 essential steps: (Mike Rother, 2009)

Figure 5: VSM elaboration steps



Source: made by us.

a) Product family selection:

Identifying of the family products from the customer's end of value, a product family is a group of products that go through similar processing steps and over common equipment in the down stream processes. (Rother & shook, 1999) This step consists of analyzing all available data that leads to the creation of a chain value cartography in the current state for the selected manufacturing activity. (Lyonnet, 2015)

Prior to implementing a VSM strategy to enhance a product family's value chain, it is crucial to define a relevant work area. To do this, a Pareto diagram is created in order to determine the main issues or causes of losses associated with this product family. In parallel, it is crucial to question the heads of several departments, such as the director or the production manager, in order to gather crucial information that will guide the VSM approach.

The following are important questions to ask during these interviews: (Dumser, 2015)

-How much revenue does this product family represent?

-What are the losses caused by these products?

-What are the possibilities of a VSM approach succeeding?

-Where is the production strategy?

b) Current-State-Drawing:

Which is done by gathering information of the shop floor. This provides the information needed to develop the future state map (Rother & shook, 1999). Analyzing and comprehending the current flow of the product in issue is crucial to creating this manufacturing flux cartography.
To do this, each step required for the product's manufacturing is repeated, starting with the ultimate flux step, such as final shipment. Both the cycle time and the series change time are measured in real time for each step (Lyonnet, 2015) .

It is better to do a factory tour (the Gemba) to take stock of the actual situation by tracking the flow of materials and information from the time the first product materials are received until the final product is shipped. (Hohmann, 2016)

c) The future-State-Map drawing:

It is possible to create a better future state with a clear understanding of current production (Mike Rother, 2009). The goal is to reach a future state that represents an improved and feasible version of the current production, and that is in the near future, rather than aiming for an ideal state. It is crucial to emphasize that this future state is not a universal answer; rather, it must be created to address particular VSM goals, such as raising production volume or improving quality (Martin & Osterling, 2013)

The main aim is to establish a manufacturing chain un which individual processes are directly connected to their customers via continuous flow or traction, each process is required to produce only what the customer requires at the precise moment in order to minimize the unnecessary inventory and maximize the customer satisfaction. (Rother & shook, 1999)

This step is guided by the answers to the following eight questions (Lyonnet, 2015):

- ✓ Question 1: What is the Takt time for the selected product family?
- ✓ Question 2: Should the company manufacture for shipping or stock in a superstore?
- ✓ Question 3: What level of flow may the business use the extracted systems for?
- ✓ Question 4: At what level may the business introduce a continuous flow?
- ✓ Question5: From what point is production controlled?
- ✓ Question 6: How can the business level its output on the cadenced process and produce in small batches?
- ✓ Question 7: What strategies can be employed to effectively pace the exercises within the cadenced process?
- ✓ Question 8: What improvements are required to meet the goals of the future state's cartography?

d) Work plan and implementation:

The final phase involves devising a strategic plan and executing the solution to attain the desired future state. It is imperative to develop a comprehensive action plan that delineates the procedures necessary for implementing the requisite changes. This plan should specify the essential activities and particular improvements, along with their timeline (Rother & shook, 1999).The action plan is a dynamic document that requires regular updates to accurately reflect the progress achieved (Martin & Osterling, 2013).

In conclusion, the optimization of production processes through the application of Value Stream Mapping, a tool within Lean Manufacturing, enhances operational efficiency, reduces emissions, and optimizes production flow while maximizing value for customers. This global approach fosters the development of a culture of continuous improvement, more effective resource management, and increased market competitiveness for businesses.

In conclusion, this chapter has explored the core principles of lean management, waste reduction, and lean tools. It has analyzed how organizations can effectively identify and eliminate various forms of waste to enhance client value and improve operational efficiency, throughout this chapter we established a clear understanding of how VSM serves a bridge between theoretical principles and practical applications in lean manufacturing by synthesizing various definitions and perspectives from scholars like Mike Rother, James Womack and Johann Dumser.

CHAPTER II : METHODOLOGICAL AND CONTEXTUAL FRAMEWORK

This chapter delineates the selected methodologies employed to gather information, the analytical techniques utilized to interpret the results, and the limitations and challenges encountered during the execution of this study at the host company, "GIPLAIT-ARIB."

Section 1: Methodological Approach

To effectively conduct our research study, this section will outline the current situation and methodology, along with the research tools that facilitated the management and analysis of the data.

1.1 The research timeline

At first, the study took place the 18/02/2025 at GIPLAIT-ARIB, which hosted the research, the first steps consisted of interviews with our internship tutor who is the production director, in order to schedule field visits and to gather the proper documents required for the effective implementation of the VSM.

1.2 Case study methodology

To ensure that our research plan is on the right path during our internship at Giplait-ARIB, we followed an established program every week that was agreed on by the production department manager. We have made several field visits. Firstly, the first field visit was organized by the production department manager. Subsequent visits help us understand the overall process of the dairy factory, including the reconstruction of milk, the mixture of the milk, filtration, reheating, degassing, pasteurization, conditioning, packaging and palletization.

The main objective of these visits was to get familiarized by the factory's processes in order to collect relevant information for our project. The preliminary diagnosis helped us in conducting field visits, explore, observe and develop **a qualitative approach.** According to Oranga and Matere (2023), the qualitative methods ask "open-ended questions" that are answered differently from a respondent to another, the respondents are free to answer the questions in their own words in an explanatory and descriptive responses than "yes" or "no". Moreover, the qualitative is helpful for gathering complex senses and fully comprehending a given circumstance (CORON, 2020). Qualitative methods too, allow for flexibility to probe "how?" and "why?" the responses received. Consequently, the researcher listens carefully, engages with respondents according to their individual styles and personalities and "probes" them for further elaboration and explanation on the given answers. (Oranga & Matere, 2023)

The reason why the qualitative approach is deemed appropriate for our project is the complexity of our topic and its significance in adding value to our host company. This study requires constant presence in the field to interpret and gather as much information as possible during our internship, however to make the right diagnostic it takes a certain amount of observational sense and close communication with the staff and the head of department to diagnose the current situation and using various data collecting tools during our immersion in the factory.

1.3 Tools and techniques for data collection

In our study we have combined several techniques that helped us gather the information that was required for our project including the documentary research, observation and interviews. Combining these tools have resulted in forming the global vision on this study.

1.3.1 Documentary research

In qualitative research, documentary research involves analyzing existing records, texts, and archival data, or any form of documents that the information can be extracted from, the importance of the documentary research is to grant a reliable and solid knowledge in the qualitative research.

Our study asks for internal data that was requested and that was granted for us by our internship tutor:

- Turnover by products and the quality produced for the month of January 2025, using the Pareto diagram the given turnover document helped determine the family products.
- The production line tracking sheets and records of the "CIP" chemical purification service to know the daily downtime.

1.3.2 Observation

Observation studies are two types: nonparticipant and participant, nonparticipant observation means visiting people and not participating in their daily activities, but being a nonparticipant observer makes you an intruder thus the workers would feel that they are being watched and will alter their usual working program to avoid any abnormal activities being detected by the observer, such type of observation may be necessary if the observer does not have the required competencies to participate in the activities (Kuada, 2012). While participant observer helps collect more information over a long period of time during the internship.

Both types have been adopted during the study that took place from 18/02/2025 to 12/03/2025 which helped collect data directly and indirectly and to know the working system at the factory; the workers comportments and the issues encountered on the daily basis, our observation was not focused only on the production process but on the whole process of the factory starting from the storage of the raw material to the final product, then focusing on the production process to get to know the micro-processes and identify the issues faced and the potential problems that may occur, the nonparticipant observations were to count the time it took to finish a single task during the production time to understand the functioning of the machines and the specific tanks for each micro-process, the issues that happened during the working hours and the time taken to fix the machines downtime. Adding to that, the participant observation took place at the production department to understand the tasks executed by the employees and the documents required.

1.3.3 Interviews

« The interview is a method of gathering information that consists of oral interviews with individuals or groups of people who have been carefully chosen » (Imbert, 2010)

There are three types of interviews: directive interview, semi-directive interview and non-directive interview, during our internship we have chosen directive and the semi-directive interviews, that helped gain diverse information. The directive interview resulted in targeted responses for certain questions, whereas semi-directive interviews gave the interviewee the guided freedom while discussing subjects and bringing new ideas that helped our study.

The interviews were conducted in accordance with a pre-established guide to ensure the efficient execution of the study.

Section 2: Presentation of the host company

In this section we will be presenting the host company in which our study has been conducted, firstly, we will present the host company GIPLAIT-ARIB describing the research location, then we will present the organizational chart of the company to understand its structure and operation.

2.1 Presentation of the host company GIPLAIT-ARIB

GIPLAIT-ARIB is a private company specialized in the production and the distribution of dairy products; it is considered one of the important companies in the center of Algeria and the east.

2.1.1 Definition and origins of the company

The dairy company represents a leading and innovative entity in the domain of milk production and its derivatives, fulfilling both economic and productive functions. As a joint-stock company, it remains affiliated with the public sector, operating under the supervision of the industrial dairy company (GIPLAIT) and in coordination with the holdings.

The entity adopted the name "LAITERIE DES ARRIBS," situated in the municipality of ARIB, Ain Defla Province, approximately 11 kilometers from the provincial capital. The construction was completed by the Italian company "INTERCOOP," which was responsible for equipping and building the administrative and corporate headquarters in May 1981. Additionally, a production and raw material storage section was constructed by the Algerian company BATIMITALE. The annual turnover of the unit is approximately 707,120,000.00 DA (Algerian Dinar), and it employs an estimated 293 individuals. Its distribution network encompasses the entire Ain Defla Province and extends to parts of the provinces of Tipaza, Médéa, Chlef, and Djelfa.

The inception of the Regional Diwan Milk Foundation and its derivatives can be traced back to the 1970s with the establishment of ORLAC (Algerian Milk Cooperative). Initially located in Bir Khadim, Algiers, the cooperative declared bankruptcy and ceased production in 2003. Following independence, CONALAIT was established by Presidential Decree No. 2369 of November 1969 as an economic institution within the public sector under the Ministry of Agriculture. At that time, it employed approximately 450 workers. ONALAIT undertook several investments to expand its production capacity, establishing manufacturing units to address the national milk deficit. The company underwent restructuring in 1981 under Executive Decree No. 365/81, resulting in the creation of regional subdivisions: National Milk Office for the East (ORELAIT), National Milk Office for the Center (ORLAC), and National Milk Office for the West (ONALAIT).

Table N° 1: Fact sheet of SPA GIPLAIT-ARIB

Company Name	Laitrie ARIB
Legal Status	S. P. A / EPE
Share Capital	707 120 000.00 DA
Date of Establishment	Creation 1989 – Filiation 1997
Adress	EL EMIR ABDELKADER- ARIB 44 170 AIN DEFLA Fax : 027 60 37 20 / 027 60 37 23 Email : laitriearib@hotmail.com /laitriearib@gmail.com
Business Activity	Production and Commercialization of milk and its derivatives.
Core Objectives	Development, processing, and marketing of milk and dairy products, Expansion of national milk production, Strengthening and expanding the milk collection network, Contributing to the regulation of the milk market
Installed Nominal Capacity for Packaged Pasteurized Milk (liters)	• Daily production capacity: 360 000 • Monthly production capacity : 9 393 000 • Annuel production capacity: 112 680 000
Actual Production Capacity for Dairy Products (liters per day)	1/ Yoghurt and dessert cream: 270 000 pot/ day 2/ Soft cheese curds: 6944 Barrels/ day 3/ Butter: 3 qty/day 4/ Buttermilk: 10 000 litres/day
Workforce	CDI: 289 ,CDD: 11 , Interns: 48

Source: made by us using the company's data

2.1.2 GIPLAIT-ARIB's organizational structure:

The organizational structure of GIPLAIT-ARIB composes of services and departments and each department has its own mission:

General Management: The General Management is led by the General Manager, who is tasked with making decisions that align with the company's best interests. This management team, comprising five members, is responsible for planning, control, and coordination.

Human Resources (HR) Department: This department is responsible for the implementation and monitoring of management and social policies, and it consists of three employees.

Accounting & Finance Department: This department is tasked with the preparation and development of financial reports and the documentation of purchase and sales transactions, with a team of two employees.

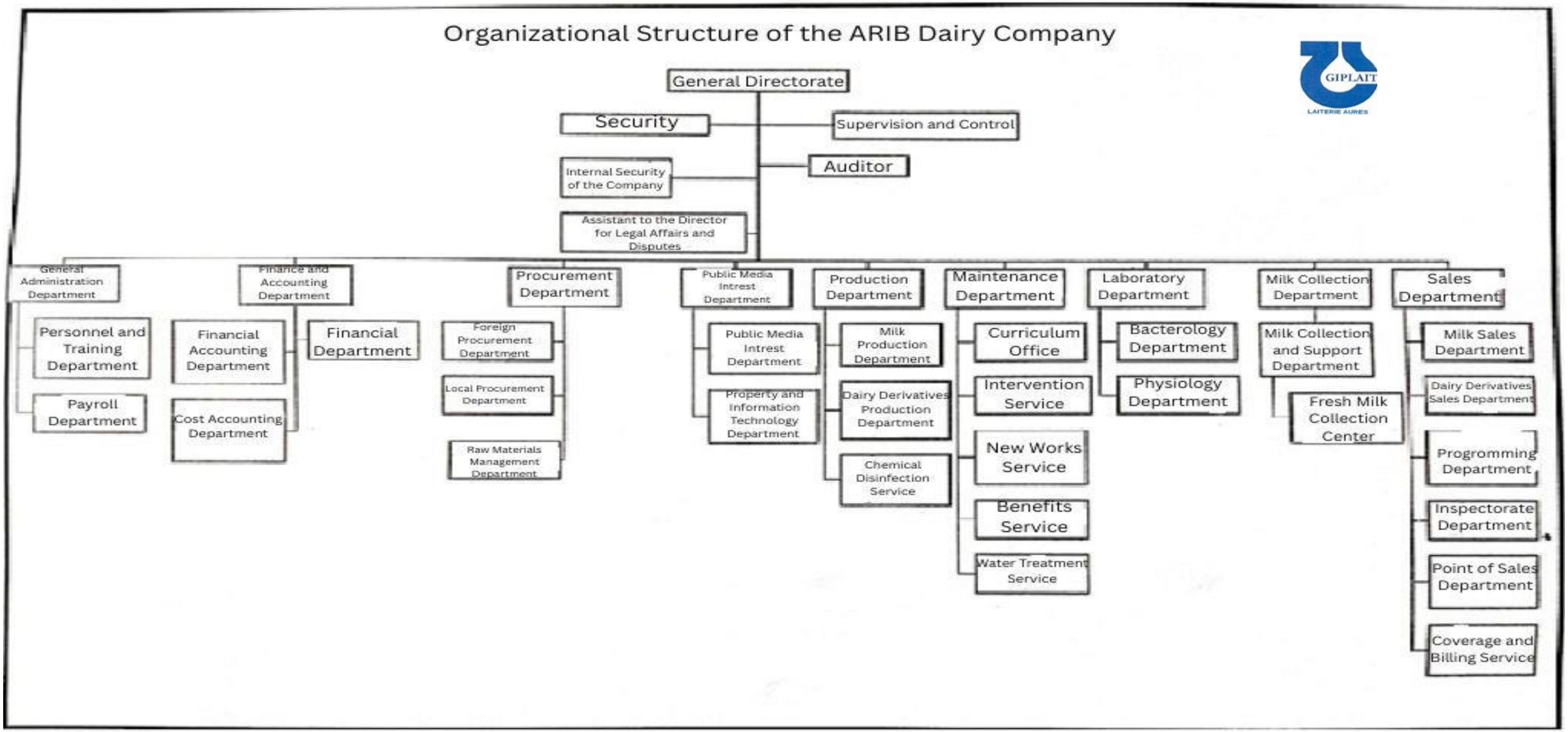
Quality, Health, Safety, and Environment (QHSE) Department: This department manages the organization's internal and external environment concerning health, safety, and environmental compliance.

Technical Maintenance Department: The primary responsibility of this department is the maintenance and preparation of machinery, and it consists of six employees.

Supply Chain Department: This department oversees the procurement division, logistics, and shipping services, with a team of eight employees.

Production Department: As the core operational unit of the company, this department is responsible for manufacturing products and managing workflow along the production line. It employs 160 workers.

Figure 6: Organizational chart of GIPLAIT-ARIB



Source: Made by us using the company's data

The methodological basis for identifying operational inefficiencies at GIPLAIT-ARIB through qualitative research that combines structured interviews, observational studies, and documentary analysis has been established in this chapter. The gathered information on production processes, downtime trends, and quality control problems serves as the primary input parameter for the Value Stream Mapping (VSM) study that follows in the following chapter.

CHAPTER III: IMPLIMENTATION OF THE VALUE STREAM MAPPING AT GIPLAIT-ARIB

This chapter is devoted to outlining the various VSM steps that were used during our internship at GIPLAIT-ARIB. It is based on our findings during individual interviews and workplace observations; after describing the approach taken to implement the Value Stream Mapping, we will discuss the outcomes in order to develop an action plan.

Section 1: Implementation of the Value Stream Mapping approach

In a Value Stream Mapping (VSM) approach, the initial step involves selecting the study perimeter for analysis and subsequent monitoring, as it is essential to establish the level at which the mapping will be conducted. This decision is crucial to prevent the unnecessary expenditure of time, financial resources, or effort. In our specific case, the selection is based on the key product, which accounts for the highest sales and consequently represents the largest production volume undertaken by the company during our internship. This choice will have observable effects as outlined.

1.1 Selection of the family product

Selection of the product family is essential for the effective implementation of Value Stream Mapping (VSM). This focus is necessary because customers exhibit specific interest in certain products rather than the entire range offered. A product family comprises a collection of items that fulfill the same function and address similar needs. These products utilize common equipment in the production process and undergo analogous treatment steps. It is imperative to determine the appropriate level at which our mapping will be conducted.

The interviews were carried out on an individual basis at GIPLAIT-ARIB, where each interview was about 15min long due to the unavailable time of the Supervisors the interviews were planned according to their schedules and availability using the interview guide (APPENDIX 1)

- **Directive interviews**: helped identify the waste sources and the issues encountered on the daily basis.
- **Semi-directive interviews**: explained the functioning of the production process and the machines involved in the production of milk.

Using the **Chrono-analysis** to calculate the time during each micro-process helped calculate the **cycle time,** the **lead time** and the **downtime**.

These interviews helped the selection of the family products and our focus our attention on the precise family.

In the company exists 2 family products: Liquid Milk, and the derivatives of milk (Cheese, Butter, curdled milk, cream), and we were granted the turnover of the product family for January and February 2025.

Table N°2: Turnover of January/ February 2025

FAMILY PRODUCTS	Turnover
Liquid Milk	226 226 150,00 DZ
Derivatives of milk	83 072960,00 DZ
Total	**309 299 110,00 DZ**

Source: made by us using the company's data

From analyzing the previous table, we noticed that during these two months the most sold family products was the Liquid Milk, we will focus our study on this family product.

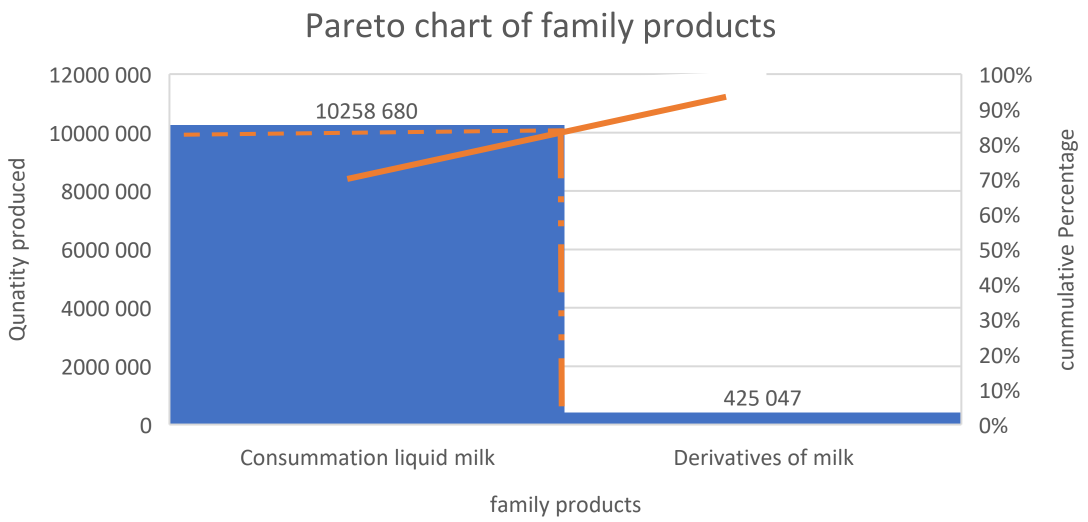
For a second selection we based our study on an Excel presentation for the quantity produced during January and February 2025 for the Liquid Milk for consumption products in order to make the Pareto Diagram 80/20.

Table N°3: Family products at GIPLAIT-ARIB

Products	Quantity produced (L)
Liquid milk for consumption	10 258 680 L
Derivatives of milk	425 047,37 L
Total	**10 683 727,37 L**

Source: made by us using the company's data

Figure N°7: Pareto diagram of family products in GIPLIAT-ARIB



Source: made by us using the company's products

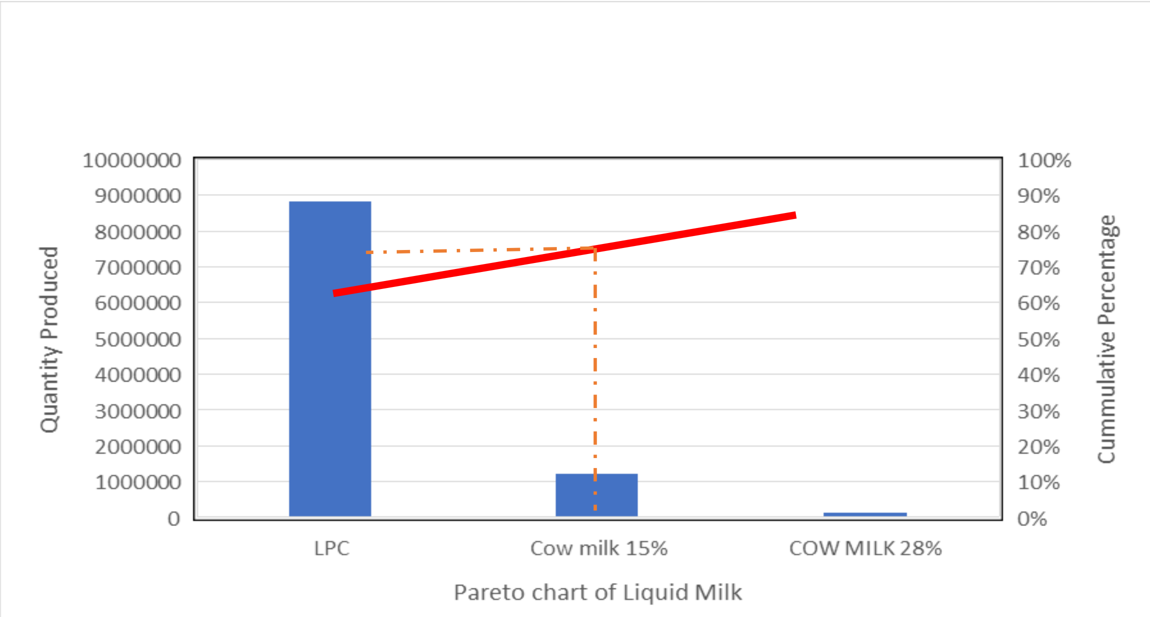
The graphic above shows that the "Consumption liquid milk" is the product that accounts for 80% of the total quantity produced. The production in the consumption milk has 3 main products so it is necessary to make another pareto chart to make the last classification to find the products that we will be focusing on our studies.

Table N° 4: The products produced in the Liquid Milk for consumption products

Products	**Quantity produced (L)**
Pasteurized and conditioned milk (LPC)	8 861 480 L
Cow Milk 28%	161 350 L
Cow Milk 15%	1 235 850 L
Total	**10 258 680 L**

Source: made by us using the company's data

Figure N°8: Preto chart Liquid Milk of consummation



Source: made by us using the company's data

The two products LPC and Cow Milk 15% represent 20% of the consumption milk product family that represent 80% of the products at GIPLAIT-ARIB.

For our study we are focusing on **Pasteurized Milk for Conditioned LPC** for the lack of data provided on **Cow Milk 15%** by the company.

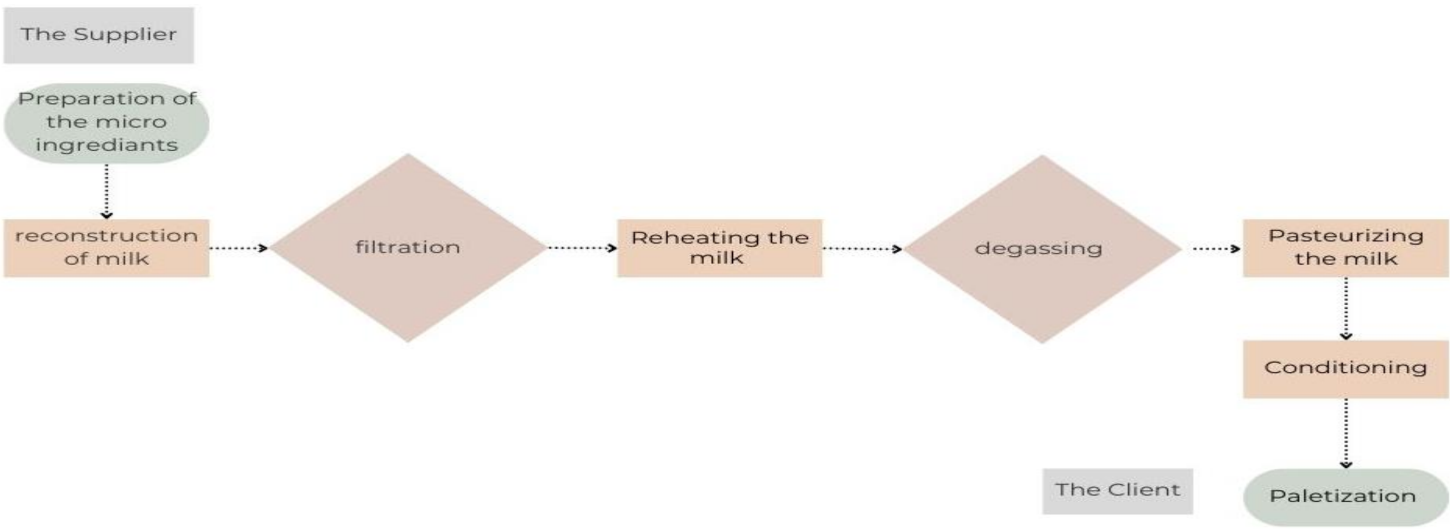
1.2 Current state drawing:

To develop a value chain map of a product with a fresh improvement perspective, it is essential to comprehend the current state by identifying the various stages of the process, as well as the associated physical and informational flows. This section is dedicated to the current Value Stream Mapping (VSM) card design for the pasteurized and conditioned milk line. The following outlines the steps involved in creating a VSM of the current state, illustrating our cartography based on the condition of material and information flow sites, as well as the calculation of various times. This approach enables us to understand the actual situation and accurately identify the sources of waste present in the pasteurizing and conditioning milk line.

1.2.1 Phase zero of Value Stream Mapping (VSM): The preparation

A comprehensive understanding of the current state of the process is essential prior to advancing with the development of the value chain map for a product. As the concept of this tool is predicated on an analysis of the present situation, an extensive observation of the various activities within the factory, along with a detailed examination of the pasteurized and conditioned milk manufacturing process, has been conducted to facilitate the creation of a value chain map. This preparatory phase aims to depict the various stages of each activity by representing the macroprocesses of the manufacturing line.

Figure N°9: Macro process of production



Source: made by us using the company's data

a. **Analysis of the production steps seen in the production line**

- **Preparation of the micro ingredients:**

This step consists of weighing the raw ingredients and preparing them to be poured into the mixing machine, a single dose of 300 000 liters of milk per day, in 1liter of milk there is 930ml of water and 45g of Poudre milk 0% adding to that 58g of Poudre milk 26% this recipe for LPC is fixed and cannot be changed. This quantity is destined for a daily consumption.

- **Reconstruction of milk:**

The process of milk reconstitution involves the combination of water and milk powder. The water, which is preheated to 40°C, is transferred from tank B4 using volumetric measurement into the lung tanks (B9A, B9B, and B9C) at the same temperature. This reconstitution occurs within a machine known as "CHERYBUREL." Subsequently, the mixture is collected in tanks B9A, B9B, and B9C, where it is allowed to settle for 20 minutes. During this period, a sample is extracted by the laboratory team to assess the quality of the milk, ensuring it meets the required standards before proceeding to the subsequent stage.

- **Filtration:**

The filtration holds place in tank B15, the reconstituted milk goes through two filters to capture all kraft paper waste from the milk powder bags.

- **Reheating the milk:**

Prior to being introduced into the degassing machine, the product is preheated to 65°C

- **Degassing:**

This step is of critical importance as it aims to eliminate offensive odors. It is conducted at 65°C within a tank where a vacuum is established by reducing the pressure. At this temperature, the milk reaches its boiling point, and the gases evaporate.

- **The pasteurization:**

The milk undergoes a thermal treatment, where it is heated reaching a 75°C for 15-20 seconds in tank B16 then cooled to 4°C to 2°C for 15 seconds this step is crucial to eliminate any bacteria.

The milk is retransferred to the tanks B26A, B26B, B26C at 4°C where a sample is taken by the laboratory to control if the milk is bacteria free and is ready for the next step.

- **Conditioning the milk:**

The conditioning is the last step of the process where the milk is placed in a one-liter polyethylene bag that has been sanitized by UV lights, the finished product is then sealed and placed in plastic trays transferred by conveyor belts to the loading dock for the trucks to be loaded for delivery.

b. Quality Control

Quality control is carried out along the production process, from the reception of raw materials to the final product delivery to the client, the quality control includes physical visual evaluation.

c. Client requirements

GIPLAIT-ARIB has two types of clients: the MDN that is the military and the local clients.

The clients expect one bag of **Pasteurized and conditioned milk (LPC)** to be **1L.**

The delivery to clients is daily by vans that have built-in coolers to ensure the milk bags will not spoil.

d. The supplier

The milk poudre that is used in the construction of milk is of foreign origin it is imported from Belgium and often from France.

e. Production management:

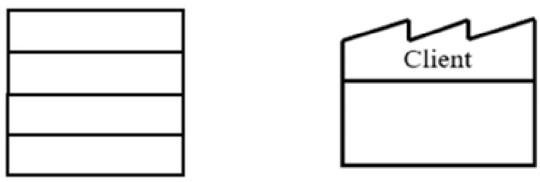
The production is 21 days every month where factory operates in 2 shifts, each shift lasts for 8 hours long, the cleaning is scheduled for 30 minutes between the two shifts.

- The production department receive the estimation for the week.
- The production plan director (PDP) is received on a daily basis that includes the raw materials quantity and the waste and the waiting time.

1.2.2 the first phase of the drawing: The client

We started our value stream map by presenting the clients of GIPLAIT-ARIB and their requirements, the client icon is placed on the top right side of the sheet where a box is provided below that contains the specific requirements for each client.

Figure N°9: client symbol and data box



Source: made by us following instructions of Dumser (2015)

The client requirements are classified as follows:

Table N° 5: Client requirements on Pasteurized and conditioned milk (LPC)

Product	Pasteurized and conditioned milk (LPC)
Delivery	Daily
Transportation mode	Road transportation

Source: made by us.

1.2.3 Second phase of the drawing: The production process

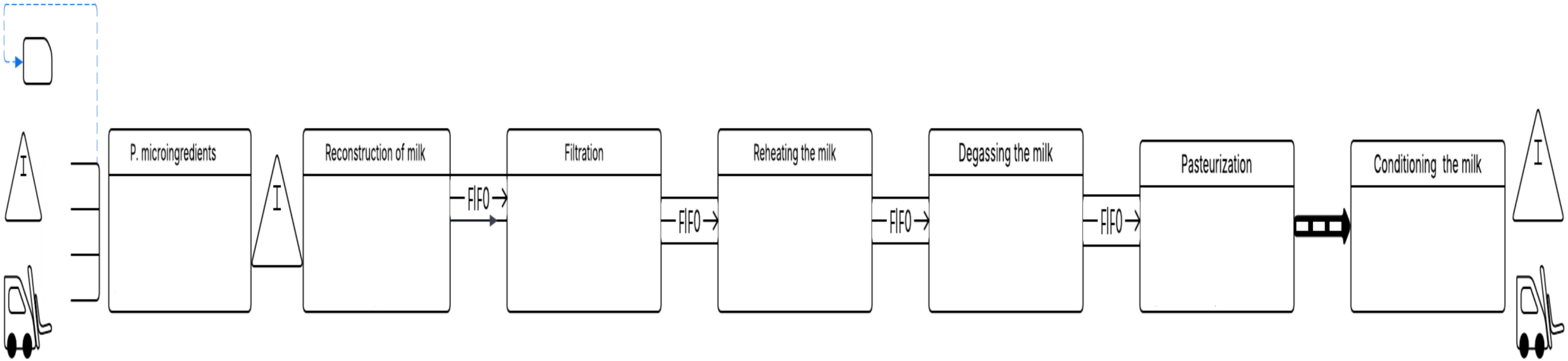
This step involves detailing the selected process, including its constituent steps and the physical flow involved. In value stream mapping (VSM), the icons used to represent the production process are as follows: process boxes, which denote the actions where the material undergoes its initial transformation.

In this context, there are seven manufacturing processes:

- Preparation of the micro ingredients.
- Reconstruction of milk.
- Filtration.
- Reheating the milk.
- Degassing.
- The pasteurization.
- Conditioning of the milk.

The process cases illustrate the material flow, which is depicted in the lower section of the Value Stream Mapping (VSM) diagram, extending from left to right in alignment with the direction of material processing. The material flow observed within the company GIPLAIT-ARIB is characterized by a linear flow.

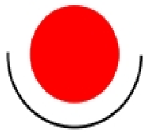
Figure N°10: Production Process of GIPLAIR-ARIB



Source: made by us

Within the box process, an operator icon is positioned and linked to a checker that indicates the number of operators required for the proper operation of the manufacturing process.

Figure N°11: operator symbol



Source: made by us following Dumser (2015)

Each process box contains a case that encapsulates the essential details of the process it represents. Among the six initial steps of the operation, the FIFO line symbol denotes the first-entry, first-output principle. Positioned between the first two steps, which signify the provision of the initial material, is a supermarket symbol.

Figure N°12: FIFO line symbol and Supermarket symbol

Source: Made by us following the instructions of Dumser (2015)

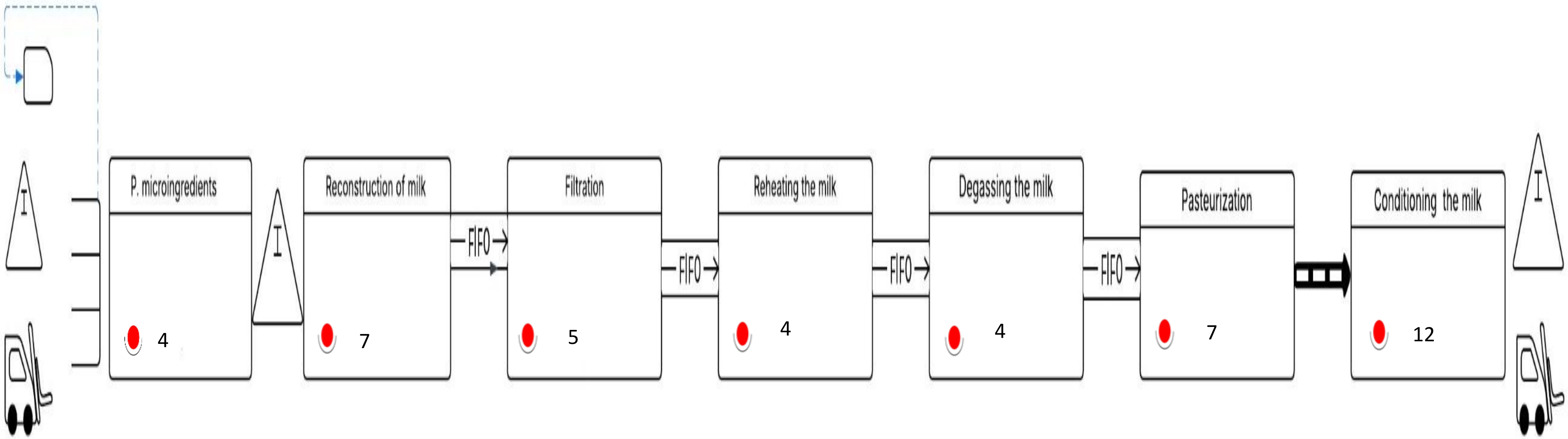
stock used to prepare the micro-ingredients. A stock symbol can be found at the beginning and the end of the manufacturing process as well as the laboratory.

Figure N°13: Stock symbol

Source: made by us following the instructions of Dumser (2015)

The figure bellow illustrates the production process of GIPLAIT-ARIB

Figure 14: Production Process of the company GIPLAIT-ARIB Indicates The Number Of Operators, The Stock and The Flow

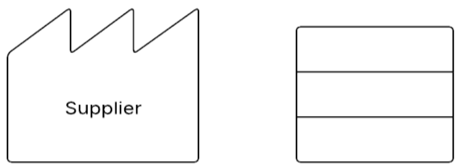


Source: made by us following the instructions of Dumser (2015)

1.2.4 Third phase of the drawing: The supplier

The suppliers are positioned in the upper left corner and are represented by the Supplier icon. In the context of GIPLAIT-ARIB's operations, there is a diverse array of both domestic and international suppliers. These suppliers are linked by a prominent arrow on our VSM card, which denotes the frequency and mode of transportation delivery.

Figure N°15: icon of the supplier and the data box

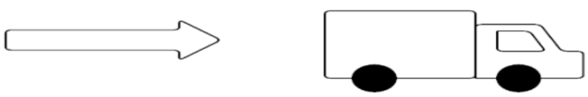


Source: made by us following the instruction of Dumser (2015, pp29)

The graphic representation of the delivery methods and frequencies serve as a mediator between the supplier and the initial step of the process as well as with the last step of the process and the customer.

A large arrow symbolizes a delivery between two businesses, while icons such as a truck, airplane, or boat indicate the mode of transportation. These elements are illustrated in the image below.

Figure N°16: The arrow and the delivery mode



Source: made by us following the instruction of (Dumser, 2015, pp29)

1.2.5 The fourth phase of the drawing: The information flow

The fourth phase indicates the informational flow and the different methods used at the factory:

- Manuel informational flow is represented by a straight arrow (paper format).

- Electronical message that is represented by the arrow in the middle below, that represents the exchange of computerized data.
- Kanban for the production, to indicate the needs of raw materials for the start of the production process.
- Information box containing additional information.

Figure N°17: The different information symbols in the production process

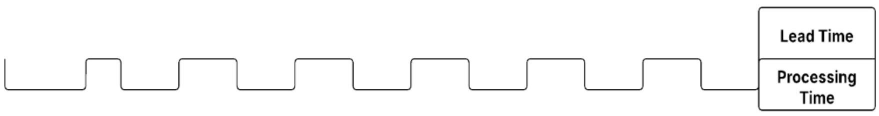
Source: made by us following the instructions of Dumser (2015)

1.2.6 The fifth phase of the drawing: The timeline

The last phase represents the timeline of the production process, the timeline is situated below the data cells of the production process and inventory pictograms in order to calculate the lead time or the processing time.

The production process has the processing time of 2 hours and 56 minutes, whereas the lead time is 1 day 7 hours and 45minutes.

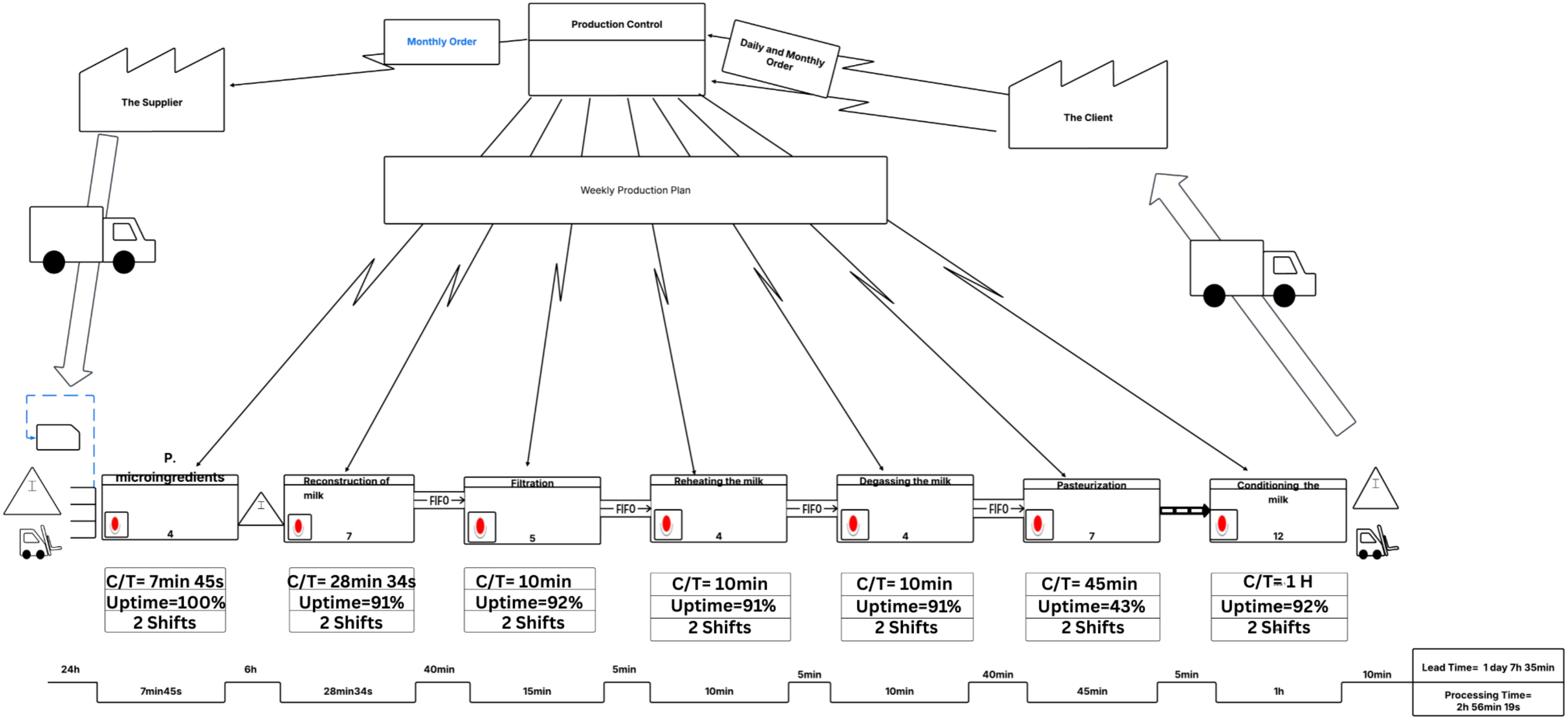
Figure N°18 : The Timeline



Source: made by us following the instructions of Dumser (2015)

The results of this work is translated in a map representing the current state drawing of the production process of Pasteurized and conditioned milk (LPC).

Figure N°19: Value Stream Mapping of the current state



Source: made by us

The analysis and development of the current state

This phase of the Value Stream Mapping (VSM) aims to identify the source of seven wastes by analyzing the observations made from each production line. This examination is for the purpose of identifying the potential improvements for each step of the production process and to predict the process's future state.

- **Different abnormalities associated with each process**

The following table summarizes the abnormalities found during the analysis of the current situation:

Table N° 6: The detected abnormalities

Abnormalities	Location	Type of Muda
1. Uncomfortable working conditions (soil water, the odor of wastewater, pigeons, boxes…) that affects the quality of work.	Zone 1: Production	Motion
2. Empty raw materials bags.	Mixing Area	Motion+ Waiting time
3. Leakage of milk due to a leak in the transfer pipes from a tank to another.	Zone 1: Production	Transport+ Defects
4. The Cream making machine breaks down more often, which stops the extraction of the excess cream from the milk.	The cream separator machine	Waiting+ Defects+ Overprocessing
5. The problem of the unnecessary movement of the workers.	Zone 1: Production area Zone 2: Conditioning area	Motion+ Waiting
6. Breakdown of the detector of tank levels causes a shift in the corresponding levels.	Zone 1: Production area	Defects+ Overprocessing
7. Breakdown of the packaging machine "SMF" of the LPC lead to an overload on the other machine	SMF Machine	Defects

8. The final products are put into bacs that block the movement in the packaging zone.	Zone 2: Conditioning area	Motion
9. The workers not following the safety protocol (Aprons, gloves, masks, hair nets…) might lead to the contamination of the production area.	Zone 1: Production area Zone 2: Conditioning area	Defects+ Motion+ Overprocessing
10. Absence of communication leading to issues in organizing the production site which leads the worker to move around unnecessarily to clarify information.	Zone1: Production area	Defects+ Motion+ waiting
11. During the start of sealing the bags of milk the machine "SMF" uses polyethylene in a way that leads to waste of the packaging materials.	Zone 2: Conditioning area	Overprocessing+ Defects
12. The warehouse is not equipped to withstand the weather changes like rain.	Warehouse	Defects+ Inventory
13. Different raw materials are stored next to chemical materials and the packaging that can explode due to high temperature inside the warehouse even when there is an unused space to separate them.	Warehouse	Inventory
14. Workers transfer the milk crates from the conveyor belts to the delivery trucks manually which consumes time and effort that can be used in another area.	Zone 2: Conditioning area	Motion+ Transportation
15. The leakage in the tanks containing chemical products used in cleaning situated in the same area where the production is which might contaminate the raw materials or effects the workers health.	Zone 1: Production area CIP area	Skills+ Defects+ Overprocessing

Source: made by us.

- **The analysis of the fundamental root causes of waste**

The realization of the current state of the Value Stream Mapping of the production process of the Pasteurized and conditioned milk (LPC) at GIPLAIT-ARIB, has enlightened our focus on the types of waste encountered during our internship. The analysis of the root causes has been made by the Diagram of Ishikawa using the observations conducted as an intern at GIPLAIT-ARIB.

1) **Human Factor:**

- Unnecessary movement of workers.
- Workers not following the Safety Protocols.
- Absence of communication leading to disorganization.
- Manuel transfer of milk crates (inefficient labor use).

2) **Machine (Equipment):**

- Leakage in milk transfer pipes.
- Frequent breakdowns of machines and the tank level detector.
- Breakdowns of bag sealing machine “SMF”.
- Polyethylene waste during sealing the milk bags.

3) **Raw materials/ Input:**

- Empty raw material bags making the movement of the workers difficult.
- Improper storage of the raw materials next to chemical materials.

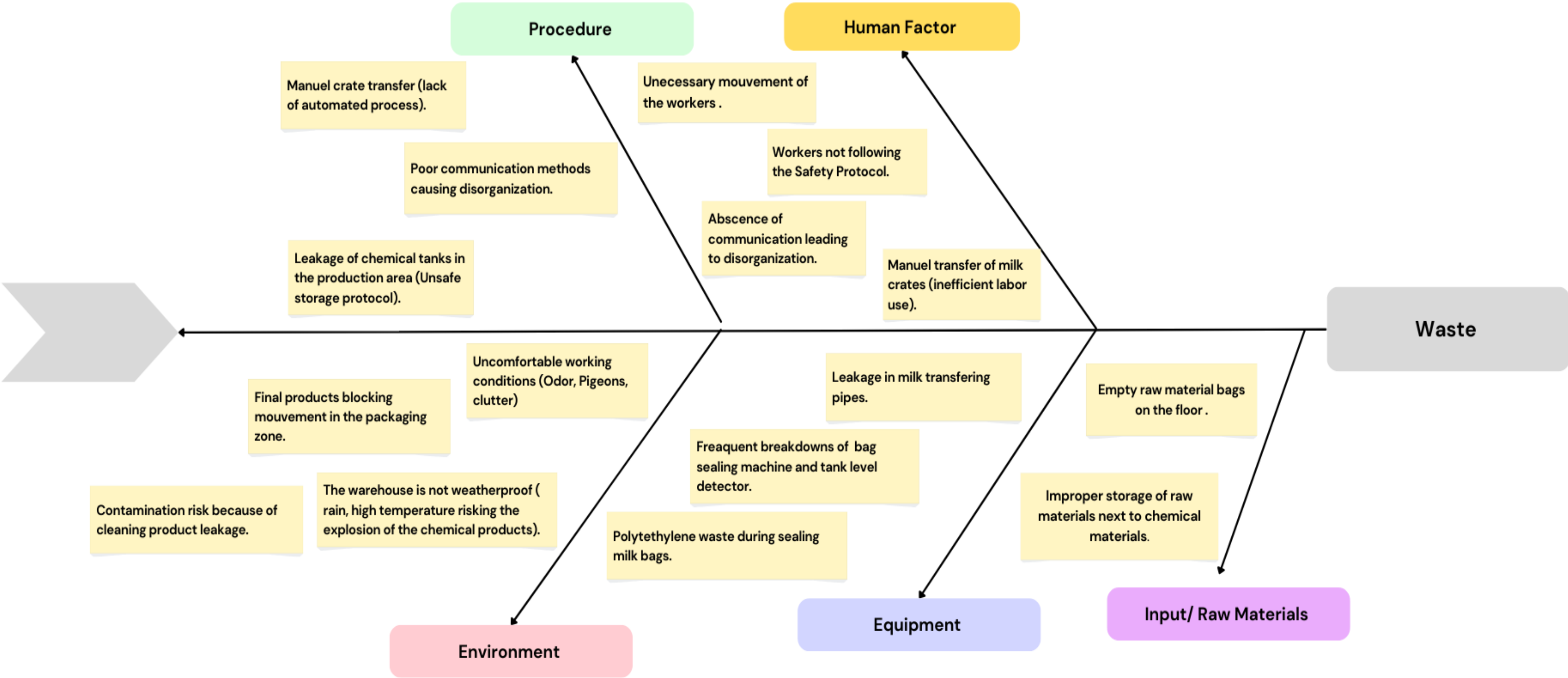
4) **Process/ procedure:**

- Poor communication methods causing disorganization and waiting time.
- Manuel crate transfer (lack of automated process).
- Leakage of chemical tanks situated in the production area (unsafe storage protocol).

5) **Environment:**

- Uncomfortable working conditions (odor, pigeons, clutter).
- Final products blocking the movement in the packaging zone.
- The warehouse is not weather proof and high temperatures risk the explosion of the chemical materials.
- Contamination risk due to cleaning products leakage.

Figure N° 20: Diagram of Ishikawa



Source: made by us.

1.3 Future state drawing:

We have followed the instructions of Rother and Shook (2009) to create the future state of the Value Stream Mapping. This map is guided by the answers of the seven following questions:

1. What is the Takt Time of the production line?
2. Are the finished goods stored in a supermarket? Or are they directly sent for shipping?
3. Where is it possible to establish a continuous flow?
4. Where is it possible to implement a pull system? A FIFO lane?
5. What will be the pacemaker process?
6. How will the workload be leveled?
7. What are the other improvements that should be made?

Question 1: what is the Takt Time of the production line?

Takt Time is the pace at which a product must be manufactured in order to meet the customer demand.

It is calculated by dividing the time available to produce by the number of units that have been requested by the customer.

Takt Time = Time Available/ Customer Demand

The only authorized stops are deducted as breaks, meals, cleanings and workstation meetings, unplanned stops such as breakdowns and the batch changes are not allowed according to the established pace.

The cycle times of all production processes should be less than or equal to Takt Time

(Cycle Time≤ Takt Time) in order to meet the customer demands.

GIPLAIT-ARIB operates in two shifts where each shift is 480 minutes per day, including a 10 minutes cleaning break, which results in a daily available time of 470 minutes per day with a sales volume of 300 000 bags of LPC per day, by the end of every shift the quantity of milk bags are 150 000, every milk crate can carry 10bags of milk, 15 000 crates hold 150 000 bags of milk.

Consequently, the factory has 21 working days per month.

Tackt Time= 940 x 60 / 300 000

Tackt Time= 0.188 seconds per bag of LPC

To meet the customer demands GIPLAIT-ARIB must produce one bag of LPC every 0.184 seconds during the available working time.

The table below presents the total Cyle Time of two shifts per day for each process line in the production process.

Table N° 7: Global Cyle Time

Processus	P.Microingredients	Reconstruction of milk.	Filtration	Reheating the milk	Degassing	The Pasteurization	Conditioning of the milk	Total
Global C/T	452,4s	1700,4s	900s	600s	600s	2700s	3600s	**10552.8 seconds**

Source: Made by us.

All the Cycle Times of the different LPC production processes (Preparation of the Micro-ingredients, Reconstruction of milk, Filtration, Reheating milk, Degassing, Pasteurization, Conditioning) must be equal or less than the Tackt Time to meet customer demand and avoid delays.

Currently, each manufacturing process exceeds the Tack Time. Overall, the global total Cycle time of the production line 10552.8s which is higher than the Tackt Time. this situation indicates an imbalance in the production line, which causes slow downs and breakdowns in overall production flow. This may lead to accumulations and delays in the delivery, which impacts the company's ability in meeting deadlines and markets demand efficiency.

Question 2: Are the finished goods stored in a supermarket? Or are they directly sent for shipping?

After the packaging the pasteurized and conditioned milk, the milk crates are divided by the clients orders, which means that the first client that passed the demand is served the first, the milk crates are either passed directly from the conveyor belts to the delivery trucks or are put aside in the conditioning area waiting for the turn of the clients.

Question 3: Where is it possible to establish a continuous flow?

A continuous production flow process is the production of one product at a time, in which one product moves from one operation to the next one in the manufacturing chain without any interruptions in between the production lines. This improves the productivity by minimizing downtime from setup changes or frequent interruptions.

No, it is not possible to establish a continuous flow because GIPLAIT-ARIB production line is interrupted between each process for laboratory tests to confirm that the milks PH levels are according to the norms and for more laboratory tests that time approximately is more than 10minutes between every process which results in additional time added to the global cycle time.

Question 4: Where is it possible to implement a Pull System? A FIFO lane?

Firstly, a Pull System means that the production is based on actual client demand, implementing a pull system is preferred because it ensures that the products are being manufactured when there is a demand, thus, lowering the risk of overprocessing and excess inventory.

Secondly, a FIFO lane is already implemented between different production processes, resulting in smooth production flow.

Question 5: What will be the pacemaker process?

Solely focusing on one production process makes it easier to control the entire production lane and the pace maker process will distribute the production control information across the entire chain.

The GIPLAIT's production is made according to the demand estimations, and the processes are interconnected via FIFO (First-In-First-Out) lane, until product shipment.

The pacemaker will be positioned at the pasteurization, it is a time and temperature sensitive batch process with strict regulatory necessity, filtration and reheating should feed the pasteurization at the right rate in order for the conditioning to align with the outputs.

Question 6: How will the workload be leveled?

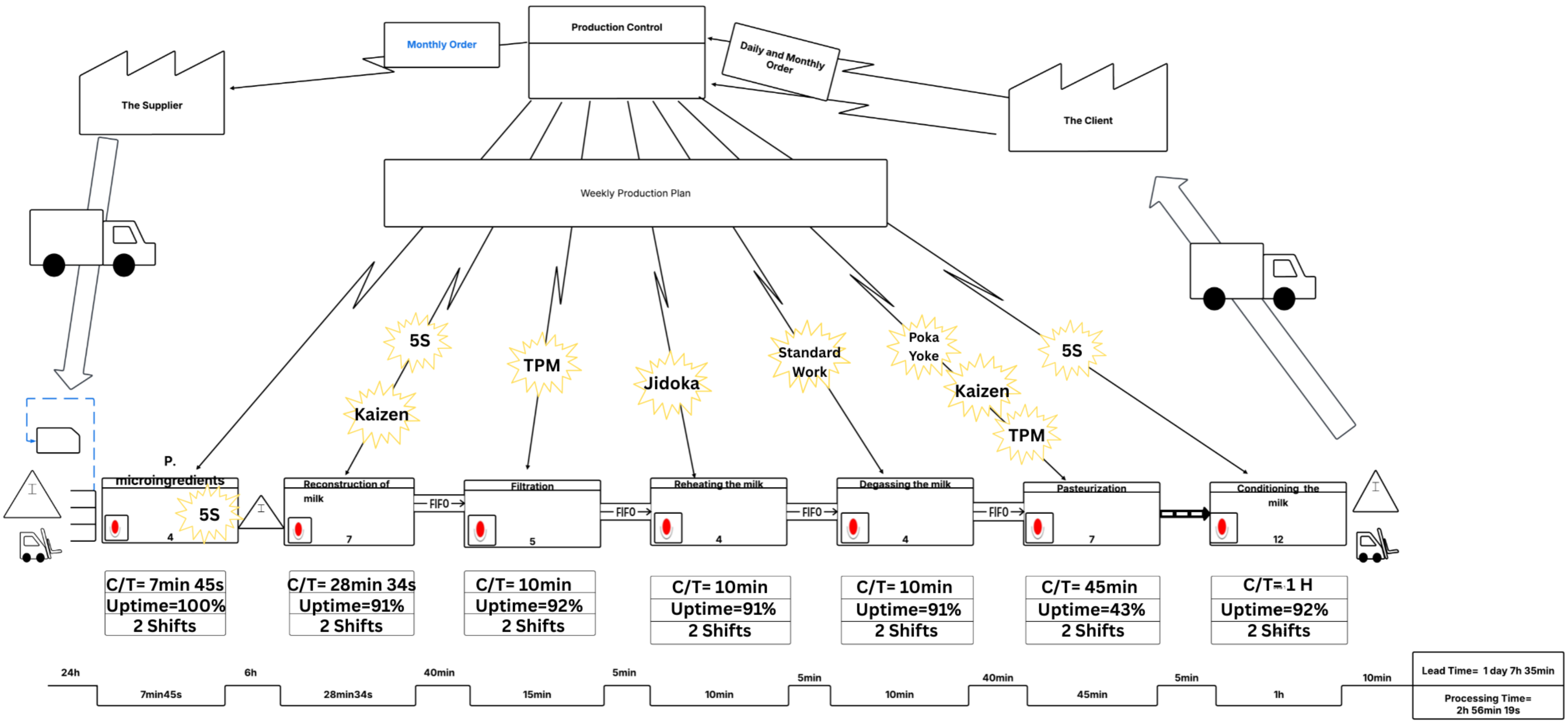
Incase of workload fluctuations the quality control team will work on smoothing the production line based on the usual production pace. Consequently, this results in adjusting the workload to adapt with the optimal production efficiency while answering to the quality requirements.

Question 7: What are the other improvements that should be made?

The improvements that should be made are a necessity for the optimization of the production process:

- Investing in training and workforce skill development.
- Modernize and innovate the equipment.
- Investing in software that helps improve the factory's performance such as data analytics tools and customer relationship management systems and also warehouse software like warehouse management system.

Figure N° 21: Future value State Mapping drawing



Source: made by us.

1.4 Action Plan

Drawing upon the findings from our study conducted at GIPLAIT-ARIB, we propose the following recommendations to facilitate the implementation of continuous improvement projects. These initiatives are scheduled to commence within the next three months and can take up to a year and are detailed in the table below.

Table N° 8: Action Plan

Place of implantation	**Type of Muda**	**Tool to be implemented**	**Description**
Micro ingredients preparation	Motion	5S	Positioning bins within the micro ingredients preparation area to minimize the unnecessary used bags and to facilitate the movement of the forklift to bring extra raw material bags if needed. And organizing the workers tasks in order to avoid the gossip and time waste.
Reconstruction of milk	Defects + material waste	5S	The reconstruction of milk is a highly sensitive step that requires cleanliness and organization to prevent dosing errors and cross contamination.
		Kaizen	By implementing Kaizen in the reconstruction of milk, the process flow will be improved while eliminating unnecessary activities and optimize the productivity resulting in reducing the lead time.
Filtration	Defects	TPM	By applying total quality management we can reduce the chances of cloggage in the filters and to reduce the unplanned downtime that might happen if the filters are damaged or clogged, and reduce the maintenance costs.

Reheating the Milk	Defects	Jidoka	Jidoka can involve temperature sensors that can regulate the temperature fluctuations programmed, and is built with a sensor that alerts the operator incase of an unplanned error.
Degassing	Defects	Standard Work	Verifying the tank levels before starting the degassing and monitoring the bubble formation visually and pressure gauge helps improve the quality, safety and efficiency.
Pasteurization	Defects+ Motion+ Overprocessing	Kaizen	To reduce the cycle time kaizen is efficient for reducing setup and cleaning time between batches and also enhances the workflow.
		Poka Yoke	To prevent human errors or slips Poka Yoke can be a great tool for detecting unsafe batches and can install automatic temperature sensors that lock out the system if the target is not reached.
		TPM	By adopting TPM in this step helps with the prevention of unexpected failures and train operators to do an autonomous maintenance like daily checkups and cleaning.
Conditioning the milk	Motion	5S	5S is critical for speed improvement and reducing packaging errors, in addition to that it enhances safety and ergonomics which optimizes the quality and creates a standardized and organized packaging environment.

Source: made by us

Section 2: Qualitative Analysis

In this section we will discuss the qualitative results gathered from the interviews made during our internship.

Table N°9: Directive interviews list

Interview Number	The occupied position	The duration of the interview
N°1	Quality Supervisor	1h 18min
N°2	Production Supervisor	34 min
N°3	Maintenance Supervisor	1h

Source: made by us.

Table N°10: Semi-directive interviews list

Interview Number	Interview Number	The duration of the interview
N°1	Inventory Manager	30 min
N°2	Sales Manager	25 min
N°3	Laboratory Supervisor	15 min

Source: made by us.

Analysis of interviews and observations:

Based on the interviews made with the three supervisors here is a structured thematic analysis:

1. **Organization and allocation of the resources in the value chain:**

The organization in the three departments is precise according to each departmental functioning conditions, the maintenance department is organized into 6 services which each service has 7 operators and their supervisor. Additionally, the production department requires 5 operators and a supervisor in each micro-process phase, and the quality control relies on a supervisor that has the precise experience.

2. **Dysfunction and bottlenecks in the production process:**

No abnormalities or challenges were reported during the interview with the production supervisor; however, reoccurring problems imply the lack of documental reporting and control.

The maintenance supervisor referred to breakdowns as “waste under pressure”, where no systematic issues were defined.

3. **Communication and interdepartmental collaboration:**

Regular meetings were mentioned as a primary means of collaboration and communication; thus, there is no evidence proving the presence of shared documents.

4. **Tools and performance indicators:**

No software or formal tools were used by the maintenance team during the planification of any maintenance or quality tracking. Additionally, the quality control relies only of the HACCP while the integration is still new and informal.

5. **Quality control and compliance with standards:**

Regular internal audits and cleaning protocols (CIP) are applied, but quality packaging are based on legal requirements instead of internal benchmarks.

6. **Waste identification:**

Waste is identified differently in the three departments:

- Production: leakage and the packaging.
- Maintenance: the waste is described as waste under pressure referring to breakdowns.
- Quality: there was no waste mentioned but the reoccurring issues raise a question mark.

7. **Process optimization opportunities:**

The usage of KPIs will strengthen the process and the interdepartmental data sharing, and training and the proper formation for the quality control could improve significantly.

To conclude, this analysis sheds the light on the structure present in the organization and the key limitations that are face during the internship, such as the absence of the digital tools and poor documentations and experience. Using a thematic approach has allowed identifying the common issues at the company and supports the optimization of the future process.

Section 3: Discussion of results

As part of our investigation, we applied Value Stream Mapping (VSM) to the Pasteurized and Conditioned Milk Production Line at GIPLAIT-ARIB, which produces 1L of milk per bag, in order to improve the production process. This tool made it easier to identify a number of areas that needed significant improvement. The process's main steps micro-ingredient preparation, milk reconstruction, filtration, reheating, degassing, pasteurization, and conditioning were charted, clarifying the information and material flow, value-added activities, and inefficiencies.

This section analysis the underlying mechanisms and improvements, benchmarks the results against industry standards and actionable recommendations.

- **Underlying Mechanisms of improvements:**

Three crucial modifications led to a 20% decrease in cycle time (from 10,552.8 seconds to 8,442.2 seconds):

- **Implementation of SMED**: 45% less time was spent switching between batches (from 30 to 16.5 minutes) thanks to parallel job execution and standardized processes. By aligning quality checks with production flow, waiting times between stages were eliminated (e.g., delays in laboratory testing).
- **5S Methodology:** Rearranging the workspace resulted in a 35% reduction in needless motion (for example, the preparation time for micro ingredients went from 452.4 to 294.1 seconds). Operator efficiency was increased via visual management tools including shadow boards and color-coded zones.
- **Reallocation of Resources**: reduced operator idle time by 28% by balancing workloads using the Theory of Constraints. Cross-trained employees to manage the bottleneck process of conditioning and packaging during periods of high demand. However, two factors noted during implementation may limit these gains: Melvin & Baglee (2008) observed that in dairy processing, variations in the quality of milk powder can impact the consistency of reconstruction. Further cycle time reductions were limited by the limited adaptability of outdated equipment (such as pasteurization tanks from the 1990s).

- **Comparative performance analysis:**

The comparative analysis of the final results is presented in the table below comparing the results from previous study with the results from our study conducted at GIPLAIT-ARIB:

Table N°11: Comparative performance analysis of the results.

Metric	GIPLAIT-ARIB results	Dairy industry Benchmark (Setiawan,2022)	Food Processing Avg. (Rohania & Zahraeea, 2015)
Cycle Time reduction	20%	15-18%	12-15%
Lead Time improvement	27%	20-22%	18-20%
Defect Rate reduction	40%	30-35%	25-30%
Period (months)	6	8-10	9-12

Source: made by us.

- **Actionable recommendations:**
  the SMART framework:

- **Specific:** Provide all production workers with monthly 4-hour workshops on 5S/SMED.
- **Measurable**: Within three months, aim for 90% workshop participation and a 15% decrease in micro ingredient waste.
- **Achievable:** Use digital Kanban boards to monitor the flow of raw materials (budget: 120,000 DA).
- **Relevant:** Aligns with GIPLAIT's 2025 digitization strategy.
- **Time-bound:** To alleviate the manual handling bottleneck, phase in automated crate conveyors over a 6-month period.

The first conclusion drawn from a thorough examination of the flow of materials and information was that waste was mostly caused by process steps. In order to increase productivity, decrease wait times, and improve inventory management, we were able to identify these inefficiencies and suggest significant process changes using Lean Manufacturing tools like Poka Yoke, Jidoka, and Total Productive Maintenance (TPM).

Additionally, the company GIPLAIT-ARIB uses documentation records in order to monitor and record the data that are associated with the production process. Forms are filled out by supervisors to record the material and the time stop, the waste and the amount of milk produced, these forms are often revised and approved by the production manager.

The production line at GIPLAIT functions on 2 shifts per day, where each shift lasts 8 hours. The calculated Tackt Time is 0.188 seconds per bag of LPC**,** signifying that to answer to the client's demand the company must produce a bag of milk every 0.188 seconds.

By analyzing the current situation, it was possible to identify various types of waste at the factory and demonstration the importance of using this lean tool. Out of the seven waste types identified by the VSM implementation, the most common ones were overproduction (18% of cycle time) and wasteful transport (12%). In food processing, this is consistent with Klimecka-Tara's (2017) findings; nevertheless, our fault rates (9.2%) were lower than the norm for the dairy industry (12–15%, Setiawan 2022). GIPLAIT-ARIB's proactive maintenance culture, which cut equipment-related waste by 40% in comparison to standards, is the cause of the discrepancy. But as Rohac & Januska (2015) point out, in order to avoid relapse, such benefits necessitate consistent 5S adherence.

The results of this study align with the existing of literature review studies, which reinforces the relevance and the applicability of the VSM in various industries. In fact, various studies have proven that the implementation of the Value Stream Mapping in different industries have improved the productivity and the use of the workforce while reducing the waste, the waiting hours and the expenses.

These findings validate the findings of our study and the benefits of the optimization of the production process using of the Value Stream Mapping (VSM), by following the VSM's recommendations, GIPLAIT-ARIB was able to enhance the production of pasteurized and conditioned milk production process, thus enabling it to increase its competitiveness in the market by maximizing its resources.

Last but not least, it is important to draw attention to the fact that ensuring the sustainability of the results obtained through the implementation of Value Stream Mapping (VSM) requires the implementation of an appropriate management system. Such a system is essential to support the operational changes proposed as part of the VSM analysis. Without an effective management framework, the improvements identified may not be sustained over time, leading to a gradual decline in both performance and efficiency. However, long-term behavioral adaptation cannot be evaluated using an 8-week observation period (the Hawthorne effect is observed in 30% of operators).

The management system must be designed to align with the objectives outlined in the VSM process. This includes establishing clear communication channels, providing training and resources for staff, and implementing continuous monitoring practices to track progress. Such an approach fosters a culture of ongoing improvement and accountability, ensuring that all team members are engaged and committed to the changes.

Furthermore, leadership plays a vital role in this process. Active support from management is crucial to reinforce the importance of the changes and to provide the necessary authority and resources to implement them effectively. Regular reviews of the changes and their impact should be carried out to assess whether the desired results are being achieved and to make adjustments as needed.

In conclusion, while Value Stream Mapping is a powerful tool for identifying inefficiencies, the true success of its implementation hinges on the establishment of a robust management system. By ensuring that this system is in place, organizations can secure the longevity of the results achieved through VSM, leading to sustained operational excellence and continuous improvement.

GENERAL CONCLUSION

This dissertation examined the application of Value Stream Mapping (VSM) to optimize pasteurized milk production at GIPLAIT-ARIB, demonstrating its effectiveness in the agro-food industry.

Three main areas summarize the main lessons learnt from this research. On the operational plan, the VSM analysis allowed for the identification and quantification of significant waste, which accounted for 22% of production time. Implementing Lean solutions, such as the 5S method and FIFO flux optimization, has resulted in real improvements, including a 20% reduction in cycle time, a 12% reduction in intermediate stocks, and a 35% reduction in operator movements that are unnecessary. These findings support Dubois et al.'s (2022) findings regarding the adaptability of Lean tools to PME in the agro-food industry. Methodologically, this study highlights the importance of a methodology that combines direct observation, quantitative analysis, and actor implications. According to Rother's (2010) model, operator adherence has been found to be just as important to the project's success as technical rigor. The top recommendations are:

Three primary recommendations form the basis of practical perspectives:
1. Generalization of VSM to all manufacturing lines for the next 12 months
2. Establishment of a continuous monitoring system for key indicators (TRS, waste rate)
3. Certification of managers in Lean methodologies from a scientific standpoint, this research opens up a number of avenues for future research, such as examining the effects of Lean tools on the energy efficiency of production units and adjusting the VSM to the unique constraints of seasonal manufacturing.
In conclusion, this study shows that the Lean methodology may yield significant benefits even in traditional production environments if it is appropriately contextualized and accompanied by a cultural shift.

Thus, the GIPLAIT-ARIB case provides a replicable model for PME in Algeria's agro-food industry while highlighting the significance of viewing people as at the center of any long-term industrial transformation.

Finally, though this study presents limits that held back the exhaustive research, the results provided throughout this study have potential implications for the future researchers in similar improvement projects, we hope that this study can be an insightful resource for future researchers that are passionate about this domain and expand it in this underexplored field, which has become a growing interest across many industries around the world.

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APPENDIX

APPENDIX 1: INTERVIEW GUIDE

Interview guide: 19/02/2025

Directive interview guide:

Good morning, my names is Djellouli Nadjet, I am a student at The National Higher School of Management-Koléa, specialized in the supply chain management. I would like to conduct an individual interview to establish a map that reflects the current state of your company, with the objective of optimizing the production line.

Value Stream Mapping (VSM) is a visual and analytical methodology employed in process improvement to identify, analyze, and optimize the flow of materials and information within a system. It offers a comprehensive overview of a process from inception to completion, enabling organizations to identify inefficiencies, minimize waste, and enhance the delivery of customer value

This study is a part of a final-year project focusing on implementing the Value Stream Mapping to optimize the production process.

The objective of this interview is to collect information that will help with my Final Project Study.

Thank you in advance for your valuable collaboration.

Bonjour, je m'appelle Djellouli Nadjet, étudiante à l'École Nationale Supérieure de Management de Koléa, spécialisée en gestion de la chaîne d'approvisionnement.
Je souhaite mener un entretien individuel afin d'établir une cartographie reflétant l'état actuel de votre entreprise, dans l'objectif d'optimiser la ligne de production.

La **Value Stream Mapping (VSM)** est une méthodologie visuelle et analytique utilisée dans l'amélioration des processus pour identifier, analyser et optimiser les flux de matières et d'informations au sein d'un système. Elle offre une vue d'ensemble complète d'un processus, du début à la fin, permettant aux organisations de repérer les inefficacités, de réduire les gaspillages et d'améliorer la valeur délivrée au client.

Cette étude s'inscrit dans le cadre d'un projet de fin d'études portant sur la mise en œuvre de la **Value Stream Mapping (VSM)** pour optimiser le processus de production.
L'objectif de cet entretien est de recueillir des informations qui contribueront à la réalisation de mon projet de fin d'études.

Je vous remercie par avance pour votre précieuse collaboration.

صباح الخير، ادعى جلولي نجاة، انا طالبة في المدرسة الوطنية العليا للمناجمنت بالقليعة، متخصصة في إدارة سلسلة التوريد، ارغب بإجراء مقابلة فردية للقيام بوضع خريطة تعكس الوضع الحالي للشركة بهدف تحسين خط الإنتاج.

خرائط سلسلة القيمة هي منهجية بصرية وتحليلية تستخدم في تحسين العمليات لتحديد وتحليل وتحسين تدفق المواد والمعلومات داخل النظام، توفر نظرة شاملة للعملية من البداية الى النهاية، مما يمكن المؤسسات من تحديد أوجه القصور، وتقليل الهدر مع تعزيز القيمة المقدمة للعميل.

هذه الدراسة جزء من مشروع تخرج يركز على تطبيق خرائط تدفق القيمة (VSM) لتحسين عملية الإنتاج.

الهدف من هذه المقابلة هو جمع المعلومات التي سوف تساعدني في إتمام دراسة مشروع التخرج.

شكرا مسبقا على تعاونكم القيم.

Responsible Qualité	
Question 1	Quels sont les procédures mises en place pour assurer un contrôle efficace de la qualité des matières première et les produits finis ?
Question 2	Comment le contrôle de la qualité est-il effectué tout au long du processus, de la préparation jusqu'à l'emballage final ?
Question 3	Quelles sont les critères de qualité utilisés pour évaluer la texture, le gout, les apparences des produits ?
Question 4	Quelles sont les mesures prises pour garantir la conformité des emballages avant leurs expéditions ?
Question 5	Comment le processus contrôle qualité pourrait-il être améliorer pour réduire les risques de non-conformité et garantir une qualité constante ?
Question 6	Comment le service de contrôle qualité partage les résultats de ses inspections avec les autres départements ?
Question 7	Quelles sont les normes que vous suivez (ISO, HACCP, etc.) et comment vous les intégrer dans votre contrôle qualité ?

Quality supervisor	
Question 1	What are the procedures implemented to ensure the effective quality control of raw materials and final products?
Question 2	How is quality control implemented throughout the entire process, from preparation of the products to the packaging?
Question 3	What are the quality evaluation criteria used to assess the texture, taste and the appearance of the final product?
Question 4	What are the measures taken to ensure the conformity of the packaging before the shipment?
Question 5	What actions are taken if the occurrence of the same type of defect?
Question 6	What improvements can be made to the quality control process to reduce the risk of non-conformities and maintain consistent quality?
Question 7	How does quality control department communicates inspection results to other relevant departments?
Question 8	What are the quality Norms do you follow (ISO, HACCP, etc.), and how are they integrated in your quality control process?

مسؤول الجودة	
السؤال 1	ما هي الإجراءات المطبقة لضمان التحكم الفعال في جودة المواد الخام والمنتجات النهائية؟
السؤال 2	كيف يتم تنفيذ مراقبة الجودة طوال العملية، بدءًا من التحضير وحتى التغليف النهائي؟
السؤال 3	ما هي معايير الجودة المستخدمة لتقييم ملمس المنتجات، وطعمها، ومظهرها؟
السؤال 4	ما هي الإجراءات المتخذة لضمان امتثال العبوات للمواصفات قبل الشحن؟
السؤال 5	كيف يمكن تحسين عملية مراقبة الجودة لتقليل مخاطر عدم المطابقة وضمان جودة ثابتة؟
السؤال 6	كيف يشارك قسم مراقبة الجودة نتائج عمليات التفتيش مع الأقسام الأخرى؟
السؤال 7	هي المعايير التي تتبعونها وكيف يتم دمجها في مراقبة نظام الجودة؟

Production supervisor	
Question 1	Could you present the production process?
Question 2	What are the main challenges encountered in this process?
Question 3	How can you identify the waste in production process?
Question 4	What are your products? Are they categorized into families? If so, what are they?
Question 5	During your observations in the factory, what are the sources of waste?
Question 6	How many operators are required for each stage of the product manufacturing process?
Question 7	What are the key performance indicators used to evaluate the efficiency of your production?

Responsable de Production	
Question 1	Pouvez-vous me présenter le processus de production ?
Question 2	Quels sont vos produits, sont-t-ils divisés par familles ?
Question 3	Quels sont les principaux problèmes rencontrés dans ce processus ?
Question 4	Comment pouvez-vous identifier les gaspillages dans la production ?
Question 5	Quelles sont les sources de déchets que vous pouvez observer dans l’usine ?
Question 6	Combiens d’opérateurs faut-t-il dans chaque microprocessus dans la production ?
Question 7	Quelles sont les indicateurs de performances clés utilisés pour évaluer l’efficience de votre production ?

مسؤول الإنتاج	
السؤال 1	هل يمكنك أن تعرفني بعملية الإنتاج؟
السؤال 2	ما هي منتجاتكم، و هل هي مقسمة حسب العائلات؟
السؤال 3	ما هي المشاكل الرئيسية التي تواجهها في هذه العملية؟
السؤال 4	كيف يمكنك تحديد الهدر في الإنتاج؟
السؤال 5	ما هي مصادر النفايات التي يمكنك ملاحظتها في المصنع؟

السؤال 6	كم عدد العاملين اللازمين في كل عملية جزئية في الإنتاج؟
السؤال 7	ما هي مؤشرات الأداء الرئيسية المستخدمة لتقييم كفاءة إنتاجك؟

Maintenance Supervisor	
Question 1	How many operators are there in the maintenance team?
Question 2	How is the intervention of resources, equipment and machines managed within the workshop?
Question 3	What are the most frequent types of failures observed in the workshop?
Question 4	Are there regular meetings between the different departments to discussion potential improvements and future plans?
Question 5	What are the main types of breakdowns encountered?
Question 6	What is the software or the tools used to manage the quality control, planification and the maintenance?
Question 7	How does the production department, maintenance and quality collaborate to solve the encountered production problems?

Responsible de maintenance	
Question 1	Combine d'opérateurs y'a-t-il dans l'équipe de maintenance ?
Question 2	Comment fonctionne l'intervention de moyen/matériel/machines au niveau de l'atelier ?
Question 3	Quelles sont les principaux types de pannes rencontrés ?
Question 4	Y'a-t-il des réunions régulières entre les différents départements pour discuter les améliorations potentielles pour les plans future ?
Question 5	Quelles sont les types de pannes que vous avez rencontré ?
Question 6	Quelles sont les logiciels ou les outils que vous utiliser pour gérer le contrôle qualité, la planification et la maintenance ?
Question 7	Comment les départements de production, maintenance et la qualité collaborent pour résoudre les problèmes rencontrer durant la production ?

مسؤول الصيانة	
السؤال 1	كم عدد العمال في فريق الصيانة؟
السؤال 2	كيف تتم عملية التدخل المتعلق بالوسائل/المواد/الآلات في الورشة؟
السؤال 3	ما هي أنواع الأعطال الرئيسية التي تواجهونها؟

السؤال 4	ما هي أنواع الأعطال التي واجهتموها؟
السؤال 5	هل هناك اجتماعات منتظمة بين الأقسام المختلفة لمناقشة التحسينات المحتملة للخطط المستقبلية؟
السؤال 6	ما هي البرامج أو الأدوات التي تستخدمونها لإدارة مراقبة الجودة، التخطيط، والصيانة؟
السؤال 7	كيف تتعاون أقسام الإنتاج، الصيانة، والجودة لحل المشكلات أثناء الإنتاج؟

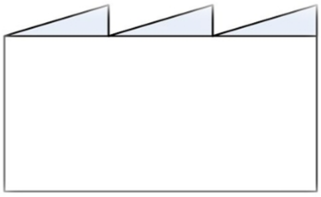
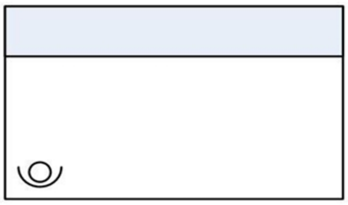
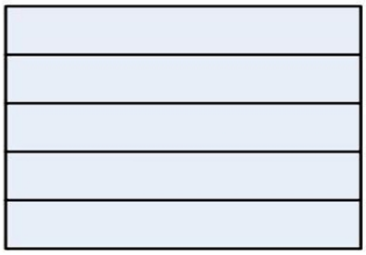
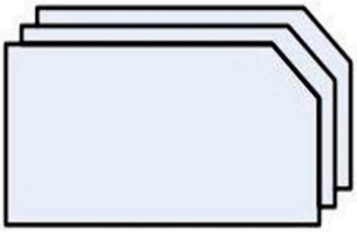
In conclusion:

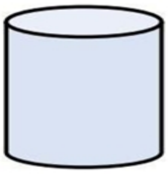
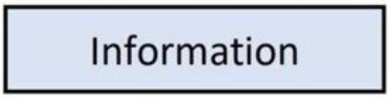
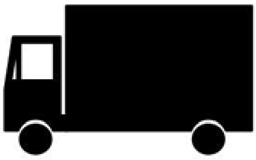
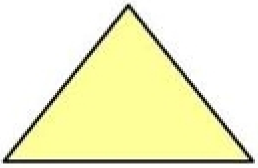
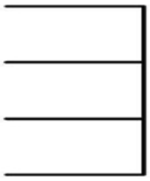
Appreciation is extended for the time and detailed responses provided. These contributions are crucial for the development of an accurate value stream map and the enhancement of the product process optimization.

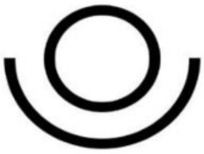
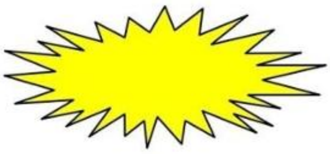
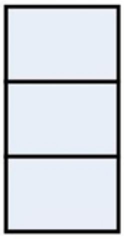
Merci pour voter temps et pour vos réponses détaillées. Vos contributions seront essentielles pour établir une cartographie de flux de valeur précise et proposer des améliorations pour optimiser le processus de production.

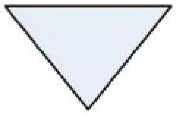
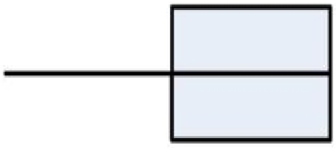
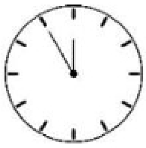
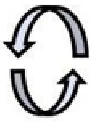
شكرا لوقتكم ولإجاباتكم التفصيلية. ستكون مساهماتكم أساسية لإعداد خريطة سلسلة القيمة بدقة واقتراح تعديلات لتحسين عملية الإنتاج.

APPENDIX 2: VALUE STREAM MAPPING SYMBOLS

Processus Symbol		
Pictogram	**Name**	**Description**
	Client/Supplier	An external source, if the symbol is placed on the top right side of the map it is considered as the client, and if placed on the top left side it is considered as the supplier.
	Process	This pictogram represents a process or an operation or a service belonging to the operation, the top bar indicates the name of the operation, the bottom indicates the number of operators or machines. It also can indicate production control.
	Data Box	This pictogram is located under other pictograms containing the information and the encrypted data related to the processes.
Information Symbols		
	Production Kanban	This signifies the production needed from the raw materials to the finished product.
	Batch Kanban	Multiple kanban cards moving together.

	Database	Database
	Information	Text field including additional information
Inventory symbol		
	Physical pull/ Withdrawal	Withdrawal of stored material from a supermarket or warehouse.
	Truck shipment	A shipment via road, using a truck for an external shipment, additional information can be added like; the type of shipment, the duration…
	Inventory	A location of inventory storage, usually located at the start and the end of a process.
	Supermarket	The supermarket stock ensures the regulation of upstream operations, allowing the process to follow a pull flow based on the stock.
	Push Movement	A push movement of an information or a material from a process to another.
	Pull Movement	A pull arrow indicates a pickup of a stock that does not impact the production.

	First-In-First-Out	First-In-First-Out used to indicate the flow of materials between processes.
	Worker/operator	the operator that is required in the operation.
	Load Leveling	Tool to intercept batches of Kanban cards and level their volume and mix overtime to smoothen the production process.
	Phone	Phone to indicate the expedited information.
	Kanban burst	Used to indicate where kaizen (continuous improvement) activities will be focused. The specific type of kaizen activity and any supporting information is noted within the bubble.
	Manuel information	Manuel information.
	Electronical information flow	A broken arrow indicates electronic information flow between processes.
	Biffer/safety stock	A buffer, or an inventory of raw materials intended to compensate for variation within the production times of a process.

	Movement of inventory	An open arrow signifies the movement of product from one process to the next.
	Kanban Signal	Signal kanban indicates when a batch of raw materials has been depleted and a new batch is required.
	Time Segment	Processing time (value added time) and the waiting time (non-value-added time).
	Total Duration	End of execution period.
	Daily time	Indicates a delay.
	Rework	Rework needed**.**

Source: Dumser (2015)