Continuous Improvement in Discrete Production: A Kaizen Approach to Labelling Lines in a Logistic Center

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Master's Dissertation

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Abstract

This dissertation delineates a consultancy project in a logistics center of a supermarket chain which engaged the services of the Kaizen Institute. This logistics center is unique in that it receives products from suppliers, representing the supermarket's own brand, lacking the required legal information on their packaging that must be provided in Portuguese on every product sold in supermarkets. Consequently, before these products can be dispatched to the stores, they must go through labeling lines where this information is affixed.

COVID-19 posed significant challenges to global supply chains, and the subsequent war in Ukraine contributed to an inflationary trend, reducing the purchasing power of most of the population. This situation led to increased sales of own-brand products, which are generally cheaper, and consequently, the logistics center of the company began to pay closer attention to its labeling lines.

The project's intervention program comprised an initial phase of analysis and characterization of the initial state, sparking the identification of opportunities for improvement, and the subsequent ideation, testing, and implementation of solutions.

The endeavor was centered around three key aspects: task balancing and the introduction of new layouts, thus restructuring workstations with a focus on enhancing productivity through more efficient resource allocation; the establishment of work standards to ensure minimal variability between operators and ensuring all tasks are executed in the most productive manner; and a commitment to improving the ergonomics of the actions performed by the operators.

The project aimed to increase the productivity of the labeling lines. The achieved productivity increase was 28%, comparing equivalent periods.

Melhoria Contínua em Produção Discreta: Uma Abordagem Kaizen para Linhas de Etiquetagem num Centro Logístico

Resumo

A presente dissertação descreve um projeto de consultoria num centro logístico de uma cadeia de supermercados que recorreu aos serviços do *Kaizen Institute*. Este centro logístico tem a particularidade de receber produtos de fornecedores, que correspondem aos produtos de marca própria, sem as informações legais, em português, necessárias na sua embalagem, que todos os produtos vendidos em supermercados têm de conter. Assim, antes de poderem ser enviados para as lojas estes produtos têm de passar por linhas de etiquetagem, nas quais lhes são coladas estas informações.

Tanto a COVID-19, que colocou desafios significativos às cadeias de abastecimento a nível mundial, como a posterior guerra na Ucrânia contribuíram para uma tendência inflacionista, que diminuiu o poder de compra da maioria da população. Isto levou a um aumento da venda de produtos de marca própria, por terem um preço mais baixo, na maioria dos casos e, consequentemente, numa maior atenção dada pelo centro logístico às suas linhas de etiquetagem.

O programa de intervenção do projeto compreendeu como primeira fase a análise e caracterização do estado inicial, desencadeando a identificação de oportunidades de melhoria e a respetiva idealização, teste e implementação de soluções.

A atuação neste desafio focou-se em três pontos cruciais: o balanceamento das tarefas e implementação de novos layouts, reestruturando-se assim os postos de trabalho com vista ao aumento da produtividade, ao alocar-se os recursos de forma mais eficiente; a criação de standards de trabalho, de modo a garantir uma baixa variabilidade entre operadoras e que todas executam as tarefas da forma mais produtiva e o foco em melhorar a ergonomia das ações realizadas pelas operadoras.

O projeto visava o aumento de produtividade das linhas de etiquetagem. O aumento de produtividade alcançado foi de 28%, comparando-se períodos homólogos.

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Chapter 1 Introduction

The project described in this Master's thesis, undertaken as part of the Master's in Industrial Engineering and Management program at the Faculty of Engineering of the University of Porto, was carried out under the guidance of the Kaizen Institute Western Europe. The methodologies of the Kaizen Institute were applied within a company that is a benchmark in the retail market.

Kaizen methodologies were applied in the logistics center of the company, located in Portugal, specifically in the labelling lines of both the dry goods warehouse and the fresh and frozen products warehouse. These represent some of the few discrete production processes within a logistics center.

1.1 Company

The company is a retail sector enterprise originally established in a foreign country but has been established in the Portuguese market for about 30 years. The scope of this project is within the labelling lines of the company's logistics center.

The logistical center of this supermarket chain possesses a unique characteristic compared to others, due to its unique interaction with foreign suppliers, most of whom originate from the supermarket chain's home country. These suppliers predominantly provide the supermarket's own-brand products. However, a significant hurdle is that many of these products arrive without information on components, ingredients, or customer support translated into Portuguese. It is important to note that this information is legally mandated to be present and easily accessible to customers on the supermarket shelves, posing a distinct challenge for the supermarket chain.

Consequently, there is a necessity to append this information to the packaging of each product arriving at the logistic hub before they can be distributed to stores. To facilitate this, the company has a production line that prints and affixes labels containing the necessary information onto each product.

1.2 Project’s Motivation

Primarily due to high inflation rates, consumers tend to favour cheaper products, which, in most supermarkets, are the own-brand products.

According to the most recent data from Nielsen IQ's Scantrend, there is a growth in private label distribution. Between March 27th and April 23rd of 2023, volume sales in the mass consumption market grew 14.1% compared to the corresponding period of last year, amounting to 3.883 billion euros. During this period, distribution own-brands accounted for 44% of total sales (Amaral and Fonseca, 2023).

This trend also had an impact on the company's sales, thereby instigating an enhancement in the output of labelled products from their labelling lines to keep pace with the increased store demand. As a result, the development of this improvement project within the labelling lines emerged as a pivotal requirement for the company.

1.3 Project Objectives

This study is focused on increasing the productivity of the labelling lines. This aim of productivity increase was quantified via an indicator representing the number of labelled products per work hour. The baseline for this indicator was established by recording the number of labelled products over a span of seven working days, subsequent to the start of the project, and by scrutinizing the records of the operators' work hours during that same time interval.

Due to confidentiality restrictions, the baseline value cannot be disclosed. The target value is a 33% increase in comparison to the established baseline productivity level.

To attain the set project goal, the Kaizen problem-solving methodology was adopted.

The foundation of this productivity surge largely lies in a thorough analysis and change of the labelling lines' layout, increased line flow efficiency, operation improvements with an emphasis on standardization, ergonomic improvement in tasks performed, and the establishment of team meeting routines for reviewing indicators and discussing issues and improvements.

1.4 Project Methodology

The methodology employed in this project is predicated on the areas and time segments illustrated in the Gantt chart of Figure 1. The initiation of the project consisted of defining the scope and objective. Simultaneously, the initial situation was mapped out and issues as well as potential opportunities for improvement were pinpointed via brainstorming sessions and *Gemba* observations. In parallel, tasks time measurements were conducted for the Dry Team.

Following this, tasks time measurements for the Fresh and Frozen Team were executed, the new layout for the Dry Team was proposed and implemented, and the practice of Daily Kaizen meetings was introduced.

Subsequent steps included the development of work standards, and the implementation of the new line design and the Daily Kaizen meetings within the Fresh and Frozen Team.

In the final stages, the 5S protocol was done across both teams, and a tool was designed to assist the management team in adjusting capacity to match the increasing demand load.

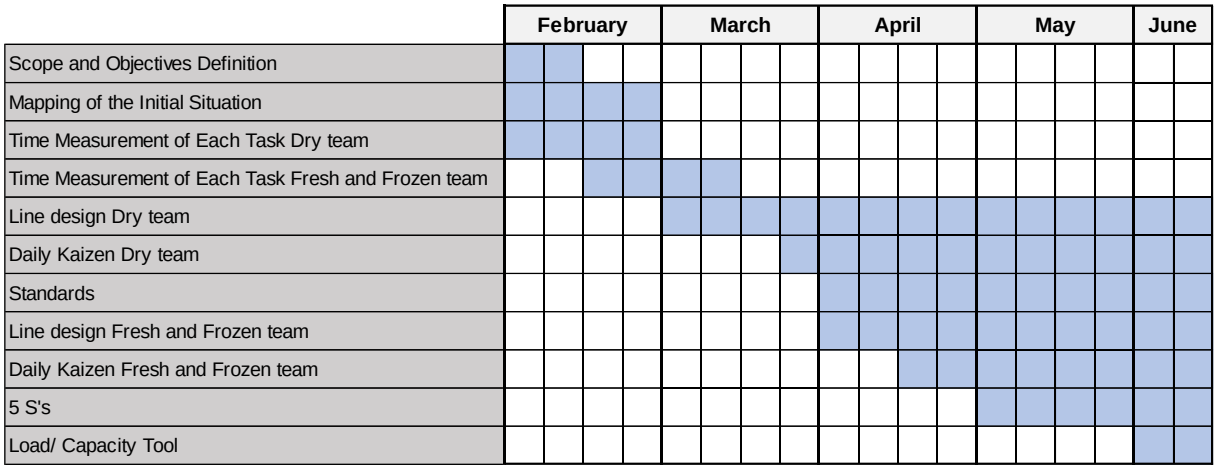

Figure 1 - Gantt chart of the project methodology.

1.5 Document Structure

This thesis unfolds over five main chapters, according to the following structure:

- Chapter 1 provided the project's context, introduced the company, established a broad context for the work undertaken, outlined the project's objectives, and explained the methodology.
- Chapter 2 delivers a brief overview of the literature review.
- Chapter 3 delineates the initial situation, ranging from the line layouts to the tasks undertaken by the operators, in addition to the primary problems and opportunities for improvement that were identified.
- Chapter 4 describes the design of solutions and the implementation thereof.
- Chapter 5 comprises a description of the results obtained, as well as suggesting potential future directions for the project.

Chapter 2 Literature Review

2.1 Kaizen Philosophy

The Kaizen philosophy is a continuous improvement approach that emphasizes the importance of making small, incremental changes to processes and systems in order to achieve greater efficiency and effectiveness over time.

The term Kaizen, which has gained significant prevalence in Western discourse, has its etymological roots in the combination of two Japanese lexemes: Kai, indicating “change”, and Zen, referring to “for the better”. The term refers to an enhancement towards a greater condition and corresponds with the scope of continuous improvement, encompassing everyone, on a daily basis, and across all domains (Palmer, 2001).

The period following World War II was characterized by efforts towards rebuilding and recovery in several nations, Japan being one of them. Following the cessation of hostilities, Japan encountered notable economic obstacles, such as elevated inflation rates and a shortage of resources.

Within this particular framework, the Japanese government instituted a sequence of economic strategies with the goal of fostering industrialization and growth driven by exports. The formulation of this approach involved a crucial element, namely, the establishment and advancement of the automotive sector. This was perceived as a means of enhancing the outflow of goods and services and generating income in foreign currencies.

Toyota was among the corporations that emerged within this particular context. Prior to the war, Toyota had been engaged in the production of automobiles for the domestic market in Japan. The company's production and export activities experienced significant expansion solely during the post-war era (Ashmore, 2001).

The success of Toyota during this particular period played a pivotal role in the widespread acceptance and implementation of the philosophy of continuous improvement, which is now commonly referred to as the Kaizen philosophy. This philosophical approach prioritizes the significance of novelty and constant improvement across all facets of the organization's activities, encompassing both production and management.

The Toyota Production System (TPS) was developed by Toyota under the guidance of Taiichi Ohno. This manufacturing system was designed to prioritize the reduction of waste and the enhancement of efficiency. According to Ohno and Bodek (2019), the key elements of the TPS included:

- The Just-in-time (JIT) production strategy. It was implemented with the goal of minimizing inventory levels and lowering expenses. The concept of just-in-time requires that within a flow process, the components required for assembly are delivered to the assembly line just at the moment they are needed and in the precise

amount required. A business entity that successfully implements a streamlined flow throughout its operational processes can potentially achieve a state of zero inventory;

- Jidoka is a quality control methodology that is implemented at every stage of the production process. The primary element of this procedure is autonomation, commonly referred to as automation with a human touch. This entails the utilization of machines that have automatic error prevention mechanisms, resulting in a substantial decrease in the number and severity of defects.

2.2 Kaizen Principles

The development of any Kaizen project is guided by five fundamentals pillars considered crucial in business management:

1. ***Create value for the customer****:* The first Kaizen fundamental asserts that any product or service developed by an organization should aim to meet market needs and satisfy customer expectations. The entire process must be customer-oriented, focusing resources on activities that add value to the customer while avoiding waste with unnecessary activities. The company should seek to understand customer interests and desires and what they are willing to pay for in order to enhance their experience, capture their voice and prioritize quality.

   The tool used to ensure customer satisfaction is the Quality, Cost, and Delivery (QCD) cycle. First, quality, as it is through the creation of products that conform and have quality that keeps customers satisfied. Second, cost management, which aims to optimize costs through increased product quality, company productivity, and work efficiency. And third, speed and agility in delivery. In simpler terms, the company should minimize its operations to what the customer is willing to pay for, typically processes associated with value-added product/service transformation (Imai, 2012).

2. ***Flow efficiency:***

   Creation of an optimized flow through the elimination of waste (*Muda, Mura, and Muri*), activities that do not add value to the customer and for which the customer is unwilling to pay. The elimination of the three types of waste - *Muda, Muri, and Mura* - explicitly promotes increased operational efficiency, enabling the liberation of operators in certain areas and their subsequent reallocation to more critical sectors of the organization, reduces production times, optimizes equipment, and increases productivity. Similarly, creating flow can be seen as a financial benefit since any activity has an associated cost, and eliminating it means eliminating that cost (Ohno and Bodek, 2019).

   Firstly, *Muri* means overload or overburden, whether it be on operators or machines. It is associated with waste caused by loading equipment, resources, or people beyond their capacity. Overloading puts people or machines under stress, reducing their productivity and increasing the possibility of producing defects, thus creating *Muda* (Imai, 2012).

   Secondly, *Mura* encompasses variability, referring to what is inconsistent and contains irregularities. Variability can take three distinct forms in the production process: variation in production planning, variation in workload due to uneven production rhythms among workers, and variation in the quality of the final product (Pieńkowski, 2014).

Lastly, *Muda*, meaning waste, represents all activities that do not add value to the customer, and its reduction or elimination is ideal (Pieńkowski, 2014).

Imai (1986) classifies *Muda* into seven different categories:

- *Overproduction:* Producing more than necessary is considered the worst form of waste. It creates a false sense of security, obscures information, and masks all sorts of problems and other wastes.
- *Inventory:* All material that is waiting contributes to increased operational costs and lead times since it occupies space and requires control and management. It can also contribute to other types of waste such as over-processing and defects.
- *Errors and Defects:* Involves equipment downtime and rework that the customer will not pay for. Products that do not meet the company's quality standards represent increased costs, requiring reprocessing, additional work, and reverse logistics application.
- *Unnecessary Motion:* Any non-value-added movement performed by individuals is wasteful, unnecessary, thus unproductive. It is often associated with inappropriate layout or incorrect task sequencing. This category also includes a lack of attention to ergonomic workstations.
- *Over-processing:* Carrying out a production process incorrectly or without being efficient. This encompasses operations such as inspection, cleaning, or rework, which are non-value-added tasks that the customer will not pay for. Its occurrence is commonly reduced or eliminated through the use of standards.
- *Waiting:* Non-productive time in which operators wait for a cycle to complete, machine repairs, or specific information or tools. During this time operators are not performing value-added tasks.
- *Transport:* Material transportation, such as parts or products, in operations does not add value and can even damage the material. Excessive material transport and might occur due to non-efficient flows. Solutions to this type of waste may involve layout redesign, distance reduction, or even the use of more flexible transportation systems.

3. ***Be Gemba Oriented:*** *Gemba* is a Japanese word used to identify the place where work is carried out, the place where value is added. The Kaizen methodology believes that there is no better place to identify problems and analyse root cause. This Kaizen fundamental argues that being present in daily activities at *Gemba* is what makes it possible to change people's work habits for the better since it is through experience that a total understanding of the process is achieved (Imai, 2012). *Gemba Walks* consist of routine visits by leaders or managers to the value-added area, allowing for direct observation of reality, verification of materials and tools used in the production process, and discussion of improvements using real information and data. Through direct contact between top management and *Gemba*, the flow of information becomes much more precise and frequent among all employees of the company, allowing for a deeper understanding of production difficulties and obstacles and making management support more efficient and effective. It is common for top managers to focus their attention on financial or marketing departments, assuming that this is the correct path to increase company profit. However, it is in *Gemba* that significant improvement

opportunities arise, leading to increased business success and cost reduction (Coimbra, 2013).

4. ***Empower people:***

   Continuous improvement is directly related to the company's culture and the trust in its leaders. Kaizen places total focus on developing the company's culture. It is believed that for a company to be in a state of learning and continuous improvement, it is not enough to analyse opportunities and have resources. There must also be an organizational culture that constantly guides members in the improvement process (Ahmed *et al*, 2009).

   Continuous improvement methodology is highly dependent on people's performance, which is why practicing Kaizen encourages the involvement of all team members, creating work teams and setting objectives aligned with the company's strategy. Additionally, Kaizen believes that it is not good practice to blame employees as errors result from poor process definition, not from the individuals who performed the task. Practicing Kaizen requires breaking paradigms through a strong and unifying culture with well-defined objectives within an organization. This fosters a sense of ownership among all employees in every improvement action. It applies to all areas, every day, with every person. Disregarding any of these assumptions immediately undermines the entire process of continuous improvement (Imai, 1986).

5. ***Visual management /Be Scientific and Transparent:*** Visual management can be defined as the simple organization of all tools, production activities, and performance indicators in the production system so that the system's state can be quickly and easily understood by all involved parties. Characterizing processes and waste through data facilitates problem visualization and the identification of causes and solutions. Furthermore, it promotes information sharing among employees regarding the current state of operations. Much of the information people retain is through vision. Therefore, communication through data, presentation of indicators with good visual management, and conveying factual and transparent messages enable better process control and more efficient and timely flow of information (Narusawa and Shook, 2009).

   The benefits associated with visual-based management are evident: the information flow becomes much simpler, the information is easily identified at points of action, and there is a more comprehensive understanding of the current context of the company. In this way, employees have a greater sense of responsibility for their own processes and actively participate in decision-making and improvement initiatives. It also facilitates continuous feedback and communication of daily goals (Eaidgah *et al*, 2016).

2.3 Line Design and Layout

The organization and structuring of the entire value chain layout through line design play a crucial role in any company (Coimbra, 2013). This involves analysing processes for different products with the goal of creating a design that eliminates non-value-added operations,

establishes unit flow, optimizes space, reduces lead time, and minimizes stocks, thus increasing productivity (Shingo, 1989).

There are various layout formats to consider. In the functional layout, equipment or operations are grouped by function, and material batches need to be moved between areas to flow through the production process. Each division processes the material, generating a batch of products that moves from one stage to another. This layout configuration results in high levels of stocks, long lead time, increased material movement, high space requirements for storage and production, low visibility of the value chain, and increases logistical and management complexity. In addition to these factors, the Bullwhip Effect intensifies, meaning that small changes in customer demand result in demand fluctuations throughout the supply chain. It is the main cause of stock waste and overproduction waste (Muller, 2011).

On the other hand, the flow layout arranges equipment or operations according to the production process, aiming for unit flow and the elimination of batches. This layout brings advantages such as reduced stocks, shorter lead time, less movement between operations, improved visibility of the value chain, and simplified management Examples of this layout include assembly lines and production cells (Shingo, 1989).

The line's cycle time should align with the takt time, which sets the pace for completing a product based on demand and available production time, and it is commonly referred to as the "market rhythm" (Imai, 2012). According to Jacobs and Chase (2009), the takt time establishes the production rhythm necessary to meet customer demand and is calculated using the available production time and the number of units requested by the customer and can be calculated using the Equation 2.1:

$$\text{Takt Time} = \frac{\text{Available Production Time}}{\text{Costumer Demand}} \tag{2.1}$$

The takt time calculation should precede the balancing of any production line.

Achieving a balanced line, where workload is evenly distributed among operators, is crucial, regardless of the production mix. Line balancing maximizes operator and machine utilization and maintains a steady work rhythm.

The takt time and the cycle time, which is the time between the execution of two units, should be in agreement; otherwise, unfavourable situations for the organization will arise (Coimbra, 2013). If the takt time is greater than the cycle time, it will result in overproduction. Conversely, if the takt time is shorter than the cycle time, the production line will be unable to meet customer needs as the time of production of one unit exceeds its demand, decreasing service level.

To size the production line, the theoretical number of operators required to produce at the takt time rhythm can be calculated using Equation 2.2:

$$\text{Number of Operators} = \frac{\sum \text{Operation Time}}{\text{Takt Time}} \tag{2.2}$$

The creation of standard work and *Mura* teams can help overcome the limitation of reduced flexibility in terms of product mix. The standard team is responsible for specific operations, enhancing productivity, while the *Mura* team collaborates with the standard team to absorb demand variations and theoretical operation time (Shingo, 1989).

2.4 Standard work:

Standard work can be defined as the development of protocols that embody the most effective known method of work to date. As per Coimbra (2013), the implementation of standard work

enables the attainment of optimal operator efficiency by minimizing task completion time while ensuring adherence to all quality requirements. According to Imai (2012), standards exhibit the following characteristics:

- They epitomize the superior, most straightforward, and safest approach to executing a given task.
- They serve as a means of preserving institutional knowledge and honing expertise or know-how.
- They establish clear objectives and delineate training targets.
- They facilitate performance measurement for operators.
- They unveil causal relationships, as variability in task execution complicates the analysis of root causes behind potential irregularities.
- They provide a basis for conducting audits or diagnostic assessments.
- They serve as a preventive mechanism against recurrent errors and minimize process variability.
- They furnish a foundation for ongoing maintenance and continuous improvement endeavours.

While most organizations can identify opportunities for improvement and devise suitable remedies, the true challenge lies in sustaining the implemented enhancements. To bridge this gap, immediate action should be taken whenever a particular process deviates from expected performance, necessitating a revision of the work method to rectify any underlying issues.

This underpins the essence of the SDCA cycle (Standardize-Do-Check-Act). Its primary objective is to ensure that employees are well-versed in the prescribed work standards, which should be readily accessible for consultation purposes. The SDCA cycle also signifies a dissatisfaction with the current standard, prompting a proactive approach towards elevating the existing standards to a higher level through a perpetual quest for improvement.

2.5 5S

Improving workspaces facilitates behavioural change and enables efficient organization of the work environment and standardized procedures, thereby eliminating time spent searching for materials, tools, and information. This, in turn, allows for enhanced information management and cost reduction through optimal utilization of materials and equipment (Bastos and Sharman, 2019). It is imperative to transmit information in the simplest, transparent, and effective manner possible to ensure comprehensive understanding and mitigate any potential uncertainties. To accomplish this, standards for object utilization and task execution should be established to mitigate errors stemming from communication breakdowns (Gupta and Jain, 2015).

This approach is commonly referred to as the 5S methodology. The 5S improvement process is succinctly summarized by five Japanese terms (Rastogi *et al*, 2014):

1. ***Seiri (Sort):*** Involves the sorting of items within the workspace, identifying and selecting only the indispensable while discerning the non-essential. The primary objective of this phase is also to eliminate superfluous elements.
2. ***Seiton (Set in Order):*** Encompasses the systematic organization of essential items to ensure their accessibility and efficiency. This step is important as it determines the strategic placement of each object based on frequency of use, weight, and size,

ensuring a streamlined and visually intuitive arrangement for all stakeholders. In essence, it aims to organize the surroundings to establish a seamless workflow, devoid of inefficiencies or wasteful practices, while emphasizing value-added tasks.

3. ***Seiso (Shine/ Sweep):*** Encompasses the cleaning of all aspects of the workspace, maintaining it, and using cleanliness as a means to ensure the proper upkeep of the work area and equipment. Additionally, it is imperative to scrutinize the designated area, restoring and refurbishing equipment and structures to their optimal conditions. This stage of the methodology often serves as a moment for identifying and rectifying existing materials.
4. ***Seiketsu (Standardize):*** Focuses on formulating comprehensive guidelines to sustain orderly and organized work areas, with a special emphasis on making the established standards visually evident and easily comprehensible. The utilization of colours and symbols aids in the seamless identification and utilization of tools. This step ensures the establishment of robust norms that underpin the ongoing maintenance of materials, provided they are regularly updated.
5. ***Shitsuke (Sustain/ Self-discipline):*** Involves steadfast adherence to a continual improvement of the established standards by consistently practicing them. This requires fostering a sense of self-discipline among all operators and conducting periodic audits to ensure the sustained efficacy of the *Gemba*, as this iterative process remains an enduring aspect of the methodology.

This methodology represents one of the most widely utilized Lean tools due to its inherent simplicity, aiming to inspire individuals, improve their work environments, foster improved communication across workstations, and ultimately enhance the quality of products/services and overall productivity (Monden, 1994).

2.6 Daily Kaizen

Daily Kaizen is designed for team organization with the aim of equipping the leader with a set of tools for day-to-day management of their team. It seeks to ensure alignment between performance and objectives, an enhanced ability to react to deviations, optimization of the time devoted to discussing improvement opportunities, thereby increasing their realization, and enhancing communication and motivation within the team. For this purpose, it is essential to have a space where all relevant information is readily available and accessible. Consequently, the design and construction of the Team Board should be the initial steps of Daily Kaizen (Imai, 2012).

There are three fundamental tools that must be present on the team boards: Indicators, Work Plan, and the PDCA (Plan-Do-Check-Act) Improvement Cycle.

The leader and their natural team must define the areas and contents to be placed on the boards. Selecting the key performance indicators and planning methods is crucial for this. After defining the critical themes on the boards, the team meeting dynamics should be created. The goal is to ensure a formal moment when the team convenes to analyse deviations from objectives, validate compliance with the plan, and execute improvement actions. The team meeting should follow a standardized agenda that guarantees its efficiency and that the main topics are addressed during it, as well as having an attendance map. Employees should participate in the evaluation of their natural team's indicators and acquire or reinforce their competencies in analysing them. It is essential that they have visibility and get involved in the planning of their team's work. In addition to this, the aim is for all employees to become more agile and flexible, enhancing the critical and proactive spirit of continuous improvement.

Thus, the use of the PDCA improvement cycle serves as a support tool for improvements identified during the indicator deviation analysis. Thus, improvement suggestions should be divided into small tasks and visually distributed among the team members. The PDCA cycle incorporates the following phases (Anderson *et al*, 1994):

- ***Plan:*** The first phase is the planning, or Plan, of the improvement action. This is the phase in which the steps to be taken for the proper implementation of the action are defined;
- ***Do:*** If an action is in this phase, it means that it is underway, or Do, i.e., measures are being taken to put the suggested action into practice;
- ***Check:*** After all measures have been implemented, the action is in verification, or Check, to verify whether its results match the intended outcome and whether the new way of proceeding benefits the team's operation;
- ***Act:*** After the new way of proceeding has been tested and its benefits proven, the improvement action is complete and, as such, is in the Act phase of the cycle.

Over time, with less monitoring effort, it becomes easier to identify opportunities and solve problems using the Daily Kaizen tool, which promotes collective thinking as a team and swift reaction to deviations in indicators.

Chapter 3 Initial Situation and Problems Found

The logistical hub is staffed by two teams that operate in two distinct zones. One of the teams works in a more controlled, cooler environment, handling products classified as ‘Fresh’ or ‘Frozen’. The other team deals with products considered ‘Dry’.

The present chapter of the dissertation will describe the productive activity that fits within the scope of the project. Consequently, Chapter 3 is divided into four sub-chapters, the first of which describes the process and the layout, detailing how the process unfolds and the initial layout of the labelling lines. The second sub-chapter explains how task division within the process was executed. Following this, the third sub-chapter presents the performance indicator considered in this analysis, how its initial status was calculated, and the process created to obtain and monitor it going forward. In the fourth sub-chapter, various identified improvement opportunities are analysed, including the lack of flow and ergonomics.

3.1 Description of the process and initial layout

The process starts with the opening of 1 or 2 pallets, performed by an operator cutting the shrink wrap that envelops each pallet. After opening the pallet, the operator opens each box and places it on the conveyor belt leading to the workstation equipped with printers and a computer.

The boxes are grouped according to reference, so their placement on the conveyor cannot be arbitrary. The conveyor carries the boxes to the next workstation, where another operator prints labels corresponding to the product. This operator prints the correct number of labels for each box, which must equal the number of products inside. Subsequently, they place the box, with the labels on top, onto the following conveyor belt.

Next, each box advances on the conveyor until an operator from workstations 1 to 6 (one or two operators per workstation/table) picks it up, places it on their table, and labels all the products inside. After labelling, the operator closes the box, apply adhesive tape (when necessary) and places the box back onto the conveyor.

The operators from workstations 3 and 4 (Figure 2), besides labelling, also have the task of placing the labelled boxes onto the direct preparation conveyor belts, organized by reference.

The Direct Preparation team is not part of the labelling process, nor was it within the scope of this project. However, it is important to explain that their function is to scan the already labelled products with a barcode reader, handle them, and place the correct quantity on the pallets being prepared for transport to the store. Once the Direct Preparation operators have used the barcode reader on a product, they must finish distributing that product among the pallets before they can start with another item. This highlights the importance of operators at workstations 3 and 4 organizing products by reference on the Direct Preparation conveyor belts.

Occasionally, it is not possible to prepare directly for the stores, so the operators from workstations 3 and 4, instead of placing the boxes on the direct preparation conveyors, put them on new pallets.

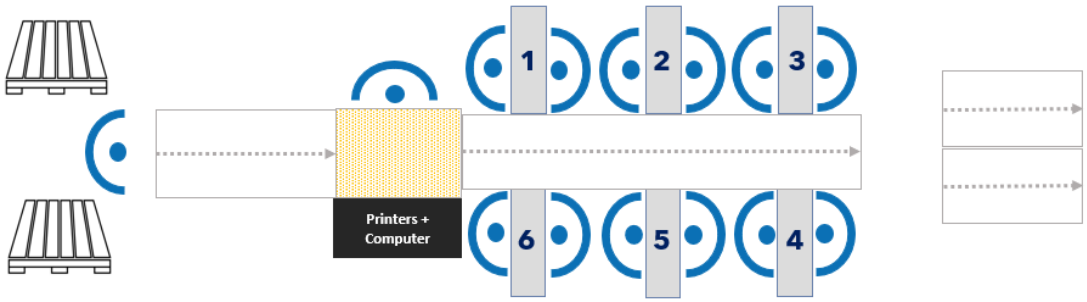

Figure 2 - Initial layout of both lines.

Both teams operate with a variable number of workers, wherein 1 or 2 may be stationed at each labelling workstation/table, and occasionally the 'Dry' team employs a second production line identical to the one described above, depending on demand and number of employees under contract.

3.2 Process Tasks

In the initial phase, together with the company managers and the team leaders, it was crucial to divide the process into tasks/ stages, as represented in Figure 3.

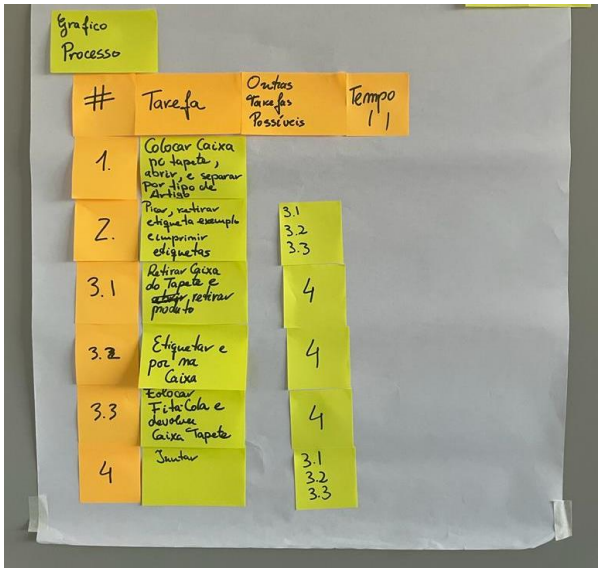

Figure 3 - Divide the process into tasks in a workshop.

The process was partitioned into four tasks:

- *Task 1:* "Unpack". This task involves unwrapping the shrink wrap from the pallet (Figure 4), opening each box (Figure 5), and placing the boxes on the conveyor grouped by reference;

Figure 4 - Unwrapping the pallet.

Figure 5 - Opening a box.

- *Task 2:* "PC". This task consists of taking the boxes from the conveyor located between Task 1 and this task's workstation, using the barcode scanner (Figure 6) if the box is the first of its reference to reach the workstation/ table, printing labels, placing the labels on top of the box, and putting the box on the next conveyor (Figure 7);

Figure 6 - Barcode scanner.

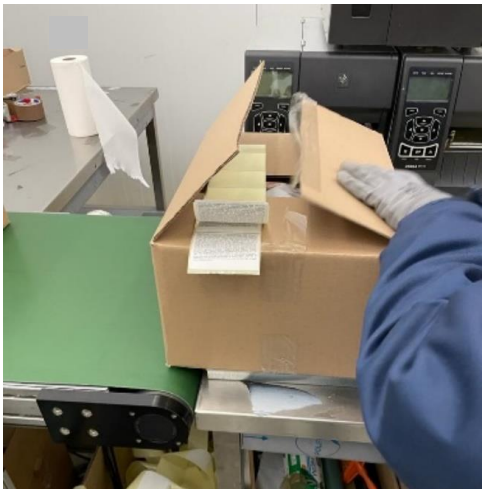

Figure 7 - Putting a box on the next conveyor.

- *Task 3:* "Label". This task was divided into three sub-tasks:
  - 3.1: Remove the box from the conveyor and place it on the table (Figure 8);
  - 3.2: Label all products (Figure 9) and ensure they are all inside the box;

Figure 8 - Remove the box from the conveyor.

Figure 9 - Labelling a product.

- 3.3: Apply adhesive tape, when it is necessary (Figure 10) and return the box to the conveyor (Figure 11);

Figure 10 - Applying adhesive tape.

Figure 11 - Returning the box.

- *Task 4:* "Pack". In this task, the boxes are already labelled and must be grouped by identical references. After grouping, the boxes must be placed on the direct preparation conveyors or onto pallets.

3.3 Indicator Measurement

The company did not have a suitable method for monitoring the productivity of the labelling lines. Regular monitoring of this indicator - preferably daily - was desirable for this project. This would provide enhanced responsiveness to any fluctuations, whether positive or negative.

Aiming to achieve a more detailed record of the hours worked, a process was set up to gather this data daily from the information logged by the Human Resources department. To ensure accuracy, each team leader is responsible for validating these figures.

In one of the initial workshops, two different scenarios were discussed with the aim of finding a method to obtain the value of labelled products from both lines:

- Scenario A: Explore the feasibility of obtaining the daily output of labelled products via counters on each printer. This was the most desirable scenario with the least margin for error, and the only scenario that would allow us to have a real daily productivity indicator.
- Scenario B: Count the finished rolls from each printer. The printer rolls are only changed when they run out, not at the end of the day, so there could be days when a work shift starts with several rolls nearing completion, making the day's production appear higher compared to a day starting with the rolls in their initial stages.

Scenario A was feasible, so it became the method for obtaining the label output and consequently the ongoing productivity measurements of both teams.

For the productivity calculation, several assumptions were made:

- Team Leader's hours are included in the calculation.
- A full day of work is considered as 8 hours, not 7.67 hours. The operators' breaks were disregarded.
- Overtime hours are included.
- Hours of employees who are not part of the line but provided assistance are included.
- The label output refers to the number of labelled products, that is, it refers to the unit of sale to the consumer, which represents the individual form or packaging of a product that is sold directly to the end consumer, not the number of labels. For example, a product with two labels only counts as one in the label output.
- The labelling of milk (number of labels and corresponding hours) was not accounted for in the baseline calculation, nor should it be in monitoring the indicator, due to the peculiarity of the packages not being labelled individually.

Following the establishment of a structured method for obtaining daily productivity, the project's productivity indicator baseline was calculated. This baseline was determined over a period of seven operational days

3.4 Identified Improvement Opportunities

During the initial phase of the project, numerous additional improvement opportunities were identified, either through observations at the *Gemba* or through inputs from the teams. The majority of these improvement opportunities led to the design of several actions and countermeasures, which will be discussed in Chapter 4.

3.4.1 Lack of Flow

A conspicuous absence of flow was noted in the labelling conveyors, as depicted in Figure 12, attributable to various factors:

- A singular conveyor system was in use for managing boxes of distinct product references. Each product reference could exhibit considerable variability in labelling times, contingent upon factors such as the quantity of products contained within, the type of box, the number of labels required to be affixed, whether the product type facilitated easy or difficult label application, and the specific operator performing the task.

- Products, mixed with disparate references, reached the end of the conveyor, requiring operators to reorganise them onto two separate direct preparation conveyors. This increased the level of effort and time spent on this non-value-adding task, in contrast to labelling.
- A mixture of already labelled and yet-to-be-labelled products on a single conveyor.

An absence of flow is indicative of a lack of smooth and continuous material movement throughout the production process, resulting in disruptions, delays, and bottlenecks that hinder efficient workflow progression.

Figure 12 - Lack of flow.

3.4.2 Ergonomic Deficiencies

Another notable opportunity pertained to the lack of ergonomic consideration at various stages of the process. The key points discerned are outlined as follows:

- A disparity in the height between the conveyors and workstation's tables was observed. This unevenness resulted in additional effort on part of each operator to move a box from the conveyor onto their table, and vice versa post-labelling;
- Conveyor side bars created a barrier between the workstation's tables and the conveyor (Figure 13), necessitating operators to lift boxes over the height of the side bars;

Figure 13 - Conveyor side bars.

- The direct preparation conveyors were located at some distance from the end of the labelling conveyor and workstations 3 and 4 (Figure 2). The same occurs when direct preparation for the stores is not carried out, meaning that the pallets where the boxes with the already labelled products have to be placed are also at some distance from workstations 3 and 4 (Figure 2). This leads to greater displacement of the operators who are in charge of the "Pack" task, thereby increasing the time spent on this non-value-adding task and reducing the time available for labelling.
- The operator responsible for the "Unpack" task was required to bend whenever the boxes on the pallet were positioned below waist level, subsequently necessitating lifting the box to a higher level for placement on the conveyor. It is noteworthy that this action was repetitively performed throughout the day and that certain boxes containing products, such as beverages, were significantly heavy.
- Some printers are on a lower shelf of the "PC" task table, as represented in Figure 14. The operator needs to bend down when these printers are being used.

Figure 14 - Printers on a lower shelf of the table.

- After printing the labels, the "PC" operator has to pass each box from the conveyor on their right to the conveyor on their left, across their workstation. This workstation does not have a conveyor or a wheel system to assist with the movement of the box (Figure 15).

Figure 15 - Workstation of Task 2.

It is crucial to note that proper ergonomic design can mitigate health issues, curtail fatigue, foster worker well-being, enhance efficiency and productivity, decrease absenteeism, and

create conducive conditions for operators to perform their tasks more effectively, thus warranting serious consideration.

3.4.3 Additional Opportunities Observed

For some product references, the predetermined and pre-configured sizes of the available printers did not accommodate the text, resulting in it being divided across two or more labels. This limitation extended the duration of Task 3.2, the process of affixing labels to the products, as it often required multiple labels for a single product.

Furthermore, a substantial inconsistency was detected in the labelling process among the operators. Various operators applied different methods for identical boxes and products, leading to an uneven duration of labelling tasks. For instance, while some operators chose to label the boxes with the products still inside, others preferred to remove all the products before labelling.

Workstations were generally disorganised, lacking specific locations for items like adhesive tape dispensers, box cutters, spare tapes, gloves, and personal belongings. Operators often spent an inordinate amount of time searching for these items, which were occasionally missing.

Following a barcode scan, the computer screen displayed an image of the product with a correctly positioned label. However, most of these images were found to be outdated, leading to confusion regarding the accurate location for label placement. This lack of clarity, coupled with the inexperience of some team members, induced numerous label application errors. These errors often triggered additional rework or interruptions in the workflow, as operators sought guidance from more experienced colleagues to ascertain the correct label placement.

The Team Leaders of both teams did not have a clearly defined work schedule, finding themselves required to complete numerous tasks without a defined standard. On some days, priority was given to certain tasks, while on other days, other tasks took precedence, with no structured rationale as to what is indeed most important to be carried out.

Most often, during Task 2, while the printer generates the labels, the operator does not engage in any action that adds value to the process, merely waiting for the printer to complete its task.

Labels were occasionally applied to what are deemed "unproductive" locations. That is, they were placed on parts of the product where, in order to have that side of the product in a condition to be labelled, the product needed to be handled multiple times, leading to a more protracted process. For instance, some products that only have one layer - meaning they are not overlapped in the boxes but placed side by side - were labelled on the side facing the bottom of the box. Operators had to manually turn each product one by one for labelling. However, these products could have been labelled on the side facing the box's opening without needing any manual handling by the operators.

Most often, during Task 2, while the printer generates the labels, the operator does not engage in any action that adds value to the process, merely waiting for the printer to complete its task.

Chapter 4 Design of Solutions and Implementation

Chapter Four will describe the design of solutions and their ensuing implementation. Thus, this chapter is partitioned into ten subsections.

Within the initial three subsections, there shall be an exposition of the procedure employed for task time measurement, an analysis of these measurements, and the new line designs for each labelling team will be outlined.

The fourth subsection offers a presentation of the implemented work standards. In the fifth subsection, the implementation of the 5S across both teams is elucidated.

Subsequent to this, the designed procedure for the information flow intended to update the photographic database is described, and the Daily Kaizen boards of both teams are presented.

The eighth subsection undertakes an analysis with the objective of curtailing the quantity of labels to a singular one per product, for most of the frozen products.

In the ninth subsection, the work schedules developed for both Team Leaders are displayed.

Lastly, the final subsection introduces a supportive tool designed to adjust the capacity of the lines according to the forecasted demand.

4.1 Time Measurement of Each Task

In order to acquire a better understanding of the operations, it was necessary to conduct a comprehensive time measurement of each task. Given that task durations vary in accordance with the product type or category, all products labelled by the Dry and Fresh teams were divided into clusters. Consequently, the products from the Dry team were grouped into four primary clusters: groceries, liquids, feed, and DPH (hygiene and cleaning products). The Fresh team’s products were grouped into two clusters: fresh and frozen. The fresh category was further subdivided into three groups: yogurts, dairy, and charcuterie.

Following this product categorization, time measurements of each task were conducted over six days for the dry line and six days for the fresh line. A total of 569 measurements were made for the fresh line, and 553 for the dry line.

As can be seen in Figure 16, for the Dry team, a record was made of the observed task, the product family, the product specificity, the number of products per box, and the time taken to complete the task.

Dia	Tarefa	Família de produto	Produto	Qt Caixa	Tempo (s)	Picar?
6/fev	1	mercearia	tomate	12	5	
6/fev	1	mercearia	tomate	12	6	
6/fev	2	mercearia	tomate	12	12	1
6/fev	2	mercearia	tomate	12	6	0
6/fev	2	líquido	vinagrete	6	17	1
6/fev	2	líquido	vinagrete	6	8	0
6/fev	3	mercearia	arroz	10	41	
6/fev	3	mercearia	farinha de milho	10	96	
6/fev	3	mercearia	batatas fritas	20	124	
6/fev	3	mercearia	batatas fritas	20	122	
16/fev	3	líquido	em lata	4	30	
16/fev	3	líquido	em lata	4	29	
16/fev	3	ração	ração gato 2kg	6	120	
16/fev	3	ração	ração gato 2kg	6	123	
23/fev	3	DPH	sabonete	12	59	
23/fev	4	DPH	líquido DPH	12	7	
23/fev	4	DPH	líquido DPH	12	5	
23/fev	4	DPH	líquido DPH	12	5	
23/fev	3	mercearia	barras	18	93	
23/fev	3	mercearia	barras	18	150	
23/fev	3	mercearia	barras	18	103	
23/fev	3	mercearia	barras	18	110	
23/fev	3	mercearia	barras	18	132	
24/fev	2	mercearia	bolo	8	17	1
24/fev	2	mercearia	bolo	8	6	0

Figure 16 - Sample of time records from the Dry Goods Team.

For the Fresh team, as depicted in Figure 17, a record was made of the observed task, the product family, the product specificity (for Fresh products, it was recorded whether the product was a sub-family of yogurts, charcuterie, or dairy), the type of box, the number of products per box, and the time taken to complete the task.

Dia	Tarefa	Família de produto	Produto	Tipo Caixa	Qt Caixa	Tempo (s)	Picar?
14/fev	2	Frescos	Iogurtes	aberta	6	2.99	0
14/fev	2	Frescos	Iogurtes	aberta	6	11.86	1
14/fev	3	Frescos	Iogurtes	aberta	6	14.00	
14/fev	3	Frescos	Iogurtes	aberta	6	10.67	
16/fev	1	Congelados		cartão	12	9.14	
16/fev	2	Congelados		cartão	12	8.09	0
16/fev	2	Congelados		cartão	10	15.78	1
16/fev	2	Congelados		cartão	10	24.85	1
16/fev	3.1	Congelados		cartão	16	9.47	
16/fev	3.2	Congelados		cartão	16	300.00	
16/fev	3.3	Congelados		cartão	16	15.77	
16/fev	3.1	Frescos	Cremaria	cartão	10	10.00	
16/fev	3.2	Frescos	Cremaria	cartão	10	36.00	
16/fev	3.3	Frescos	Cremaria	cartão	10	18.00	
15/mar	3.1	Frescos	Charcutaria	cartão	10	2.00	
15/mar	3.2	Frescos	Charcutaria	cartão	10	33.00	
15/mar	3.3	Frescos	Charcutaria	cartão	10	7.00	
15/mar	3.1	Frescos	Charcutaria	cartão	10	3.00	
15/mar	3.2	Frescos	Charcutaria	cartão	10	30.00	
15/mar	3.3	Frescos	Charcutaria	cartão	10	9.00	
15/mar	4	Congelados		aberta	8	3.00	
15/mar	4	Congelados		aberta	8	5.00	
16/mar	3.1	Frescos	Cremaria	aberta	6	2.00	
16/mar	3.2	Frescos	Cremaria	aberta	6	38.00	
16/mar	3.3	Frescos	Cremaria	aberta	6	2.00	

Figure 17 - Sample of time records from the Fresh and Frozen Goods Team.

In these measurements, it was decided to record Task 3 as a whole, without subdivisions, for some product families, due to the fact that for some types of boxes, tape is not applied, and this subdivision would not be particularly relevant in subsequent analyses.

A distinction was made for Task 2 when the product first needed to be read by the barcode reader before proceeding with label printing. This occurs when the box is the first of its kind, hence the Task 2 operator ("PC") must perform this extra step for the system to recognize which label needs to be printed. After the first box of a product, the barcode reader is not necessary until a different product appears. Thus, in the task observation record, in Figure 16 and Figure 17, a "1" was recorded in the far-right column when this extra task was performed and a "0" when it was not.

4.2 Compilation of Measurements

Upon the collection of data, there was a need for comprehensive consolidation and subsequent analysis of the same, both for the Dry Team as well as for the Fresh and Frozen Team.

For Task 2, an examination was conducted on the percentage of boxes that required a barcode scanner to be read, in order to obtain a more accurate measurement of this task.

For each product family, the mean time to complete each task, as well as the average number of items per box, were calculated. Upon completing these calculations, the weighted mean time of each task was determined.

The weighted mean time was employed in this scenario to ensure a more accurate representation of the overall task durations, taking into account the variability and complexity of tasks across different product families.

Each product family may present boxes with different number of items and varying degrees of task complexity. These disparities can significantly affect the time required to perform these tasks, leading to a skewed overall depiction of task times if a simple average were employed. The weighted mean time, however, considers these variations, attributing greater weight to the task durations associated with product families encompassing a larger number of items or more complex tasks.

By calculating the weighted mean time for each task, this variability is duly incorporated into the analysis, rendering the weighted mean time a more accurate measure for understanding the task times across different product families.

Thus, the weighted mean time for each task was calculated using Equation 4.1:

$$\text{Weighted mean time} = \frac{\sum (\text{Number of Items x Time})}{\sum \text{Number os Items}} \tag{4.1}$$

4.2.1 Dry Team

The compiled results from the Dry Team, divided by product family, are represented in Table 1, Table 2, Table 3 and Table 4.

Table 1 - Compiled Groceries' results.

Groceries

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	7.17	7.42	10.84
2	11.63	10.06	10.98
3	112.49	89.56	13.47
4	4.21	4.39	8.19

	Weighted Average (s)	Average (s)	%
2.1	19.52	17.76	0.14
2	10.35	8.81	0.86

Table 2 - Compiled Feed's results.

Feed

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	8.13	8.33	20.13
2	14.70	10.77	13.14
3	215.64	161.06	13.63
4	4.91	5.41	15.76

	Weighted Average (s)	Average (s)	%
2.1	27.68	21.33	0.10
2	13.25	9.59	0.90

Table 3 - Compiled Liquids' results.

Liquids

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	6.78	6.43	7.71
2	8.91	7.92	10.31
3	80.43	74.47	8.18
4	5.67	5.59	11.65

	Weighted Average (s)	Average (s)	%
2.1	17.24	17.83	0.10
2	7.99	6.82	0.90

Table 4 - Compiled DPH's results.

DPH

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	7.24	7.67	8.80
2	6.66	6.50	8.46
3	58.53	53.87	9.43
4	6.00	6.00	12.00

	Weighted Average (s)	Average (s)	%
2.1	13.96	13.50	0.10
2	5.85	5.72	0.90

As can be discerned, the times for Task 1, which corresponds to unwrapping the pallet, opening the box, and placing it on the conveyor belt, vary minimally regardless of the product family and the number of units per box.

The time for Task 2, which corresponds to printing the labels, varies by a few seconds based on the number of products each box contains. The printers take longer to print, the more labels they must print per box. Therefore, the DPH product family, which has the lowest average number of items per box (8.46), has the lowest weighted mean time per box (6.66 seconds). Conversely, the Feed product family, which has the highest average number of items per box (13.14), has the highest weighted mean time per box (14.70 seconds).

The most significant difference in times is observed in Task 3, which corresponds to the task of sticking the labels on the products. The weighted mean time of this task has its greatest variation between DPH at 58.53 seconds and Feed at 215.64 seconds.

The time for Task 4, which corresponds to placing the products on the conveyor belt for the direct preparation team or on pallets, varies minimally with the product family.

In order to group all the Dry product families and gain an overview of the data as a whole, the percentage of labelled products by product family was calculated, based on the products shipped to the stores in 2022. Therefore, the percentage by family is represented in Table 5.

Table 5 - Percentage of labelled products by product family, in 2022.

Family	% in 2022
Groceries	55.05
DPH	22.54
Liquids	7.60
Feed	14.80

After obtaining the historical production percentage, all measurements were consolidated, using the relative weight of the measurements of each product family, as can be seen in Table 6.

Table 6 - Compiled Dry's results

Total

Task	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	7.30	7.54	11.52
2	10.76	9.20	10.68
3	113.16	90.95	12.18
4	4.83	4.99	10.43

4.2.2 Fresh and Frozen Team

The compiled results from the Fresh and Frozen Team, divided by product family, are represented in Table 7, Table 8, Table 9 and Table 10.

Table 7 - Compiled Dairy's results.

Dairy

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	6.00	6.00	14.00
2	16.23	13.61	18.59
3.1	5.43	5.01	15.50
3.2	71.82	52.66	15.02
3.3	7.70	6.52	15.37
4	5.60	5.60	20.00

	Weighted Average (s)	Average (s)	%
2.1	21.36	20.39	30%
2.0	14.03	10.71	70%

Table 8 - Compiled Yogurts' results.

Yogurts

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	3.65	3.66	4.71
2	6.31	6.39	4.88
3	12.82	12.41	5.28
4	4.03	3.72	4.04

	Weighted Average (s)	Average (s)	%
2.1	10.51	10.51	30%
2.0	4.52	4.63	70%

Table 9 - Compiled Charcuterie's results.

Charcuterie

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	6.00	6.00	10.00
2	9.42	9.42	10.62
3.1	3.21	3.25	14.70
3.2	104.20	85.80	14.70
3.3	4.55	5.05	14.70
4	4.38	4.50	11.33

	Weighted Average (s)	Average (s)	%
2.1	13.27	13.25	30%
2.0	7.77	7.78	70%

Table 10 - Compiled Frozen's results.

Frozen

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	5.50	5.96	6.00
2	11.18	11.12	6.93
3.1	8.84	9.40	8.11
3.2	88.24	74.96	8.18
3.3	14.12	13.82	8.35
4	4.00	4.40	8.00

	Weighted Average (s)	Average (s)	%
2.1	16.92	16.26	30%
2.0	8.73	8.91	70%

The time for Task 1 changes minimally regardless of the number of items per box and the product family.

Task 2 also sees little variation in execution time, as its duration largely depends on the time printers take to print the labels; thus, the greater the number of labels per box, the longer the task will take. The only exception is frozen products, which take longer than the rest due to their greater need for handling due to their physical state and the fact that many of these products have two labels instead of just one, taking longer to print them.

The most significant difference in times occurs in Task 3. The yogurt product family takes the least amount of time, due to the low number of items per box (5.28) and because of the type of box, the arrangement of products within the box, and the location for label placement. Yogurt boxes do not have a top cover (Figure 18), eliminating the need to apply tape, and the labels are placed on top of the product, unlike other products where labels are placed underneath or on the side of them. Yogurts are arranged in a single layer, with no yogurts stacked on top of others, negating the need to handle the products for labelling. Thus, yogurts are arranged in a manner that most closely approximates the optimal way for labelling.

Figure 18 - Yogurt boxes.

Still pertaining to Task 3, it is worth noting that the labelling of Frozen products has some specific aspects that are important to mention. Some products are wrapped in cling film

(Figure 19), a very sensitive material that must be carefully handled when unwrapping prior to labelling products because the same cling film must be used again after labelling.

For most frozen products, operators have to pass their hands over the area where each label will be placed to ensure that the label sticks. Due to the way products freeze into irregular shapes depending on how they were placed and transported, for products in closed cardboard boxes, after removing the products from the boxes, operators hit the products on the table so that they become looser and the area where the label is placed is smoother.

Task 3.3 in the Frozen section is significantly more time-consuming, because after placing the products back in the box, most of the time, the box does not close, as can be seen in Figure 20. Therefore, operators exert force on the top of the box, which does not happen with other product families. Products with shrink wrap also require more careful handling. Due to these peculiarities, the time for Task 3.3 is higher for frozen products with 14.12 seconds per box, compared to Dairy with 7.70 seconds and Charcuterie with 4.55 seconds. The time to close the box and apply tape is greater for frozen products than the entire Task 3 for yogurts, which takes 12.82 seconds per box to complete.

Figure 19 - Products wrapped in cling film.

Figure 20 - Box with frozen products.

Similarly to the Dry Team, there is negligible variation in the time taken for Task 4, regardless of the product family or the number of items within a box.

To compile all the Fresh and Frozen product families and attain a comprehensive perspective of the entire data set, the proportion of labelled items per product family was computed, using the data from the products dispatched to the stores in the year 2022. Consequently, the distribution by family is delineated as represented in Table 11.

Table 11 - Percentage of labelled products by product family, in 2022.

Family	% in 2022
Dairy	14.45
Yogurts	33.72
Charcuterie	30.41
Frozen	21.32

Upon procuring the historical production proportion, all recorded measurements consolidated, factoring in the comparative weightage of the measurements from each product family, as illustrated in Table 12.

Table 12 - Compiled Fresh and Frozen results.

Total

	Weighted Average (s)	Average (s)	Average Number of Items per Box
1	5.10	5.20	5.91
2	9.72	9.36	9.04
3	74.36	63.02	10.21
4	4.35	4.37	9.41

4.3 Tasks Balancing and New Layout

Upon the completion of time measurement compilation, the balance of lines for both the Dry and Fresh and Frozen teams could be achieved by means of takt time and operator count calculations, which subsequently facilitated the design of the new line layouts.

4.3.1 Dry team

For the Dry team calculations, several assumptions were made:

- The sum of products shipped to the stores in 2022 was divided by the number of working days to derive the value of the average daily demand for 2022. The same value, i.e., 2 116 boxes, was assumed for the current year;
- The average number of items per box was considered to be 12. This is the value used by the company in its internal analyses of dry products, and thus it was used in this project;
- The total available production time was deemed to be 27 612 seconds (7.67 hours x 3600 seconds).

The takt time was calculated as follows:

$$\text{Takt Time} = \frac{\text{Total Available Production Time}}{\text{Average demand per day}} = \frac{27\,612}{2\,116} = 13{,}05 \text{ seconds}$$

Subsequently, the number of operators was computed:

$$\text{Number of Operators} = \frac{\sum \text{Operation Time}}{\text{Takt Time}} = \frac{136{,}04}{13{,}05} = 10{,}4 \text{ operators}$$

Considering 11 operators, a line balancing was carried out (Figure 21), based on the compiled times of the Dry team, as seen in Section 4.2.1 in Table 6.

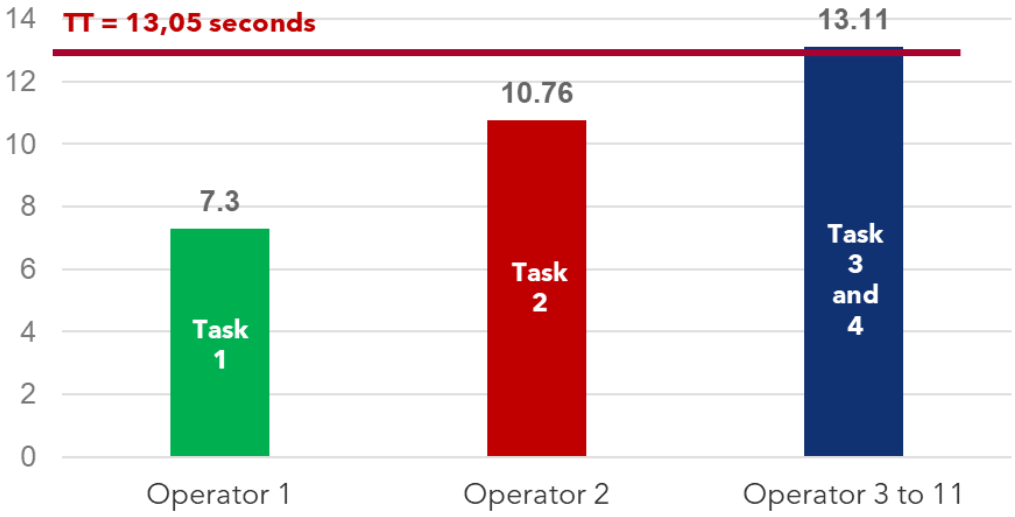

Figure 21 - Dry team's balance chart.

As can be seen from the balance chart, Operators 1 and 2 can perform their tasks in a time below the takt time, whereas the operators of Tasks 3 and 4 only take about 60 milliseconds longer than the takt time to perform their tasks. Hence, it was determined that Operators 1 and 2 would perform Task 3, in addition to the tasks assigned to them, with the remaining of the time available.

Taking into consideration the mean data of products shipped to the stores in 2022, the ideal number of operators is determined to be eleven. It should be noted, however, that demand exhibits considerable seasonality, necessitating fewer operators during certain months and additional workers in others. Instances when more than eleven operators are required could potentially result in overcrowding of the line.

Moreover, it is essential to acknowledge that only seven tables can be situated adjacent to the conveyor belts. Allocating one operator per workstation/ table is beneficial as it offers each operator fewer distractions and more space to perform Task 3.

Therefore, a decision was made to establish a layout for eight operators on the primary line and a distinct layout for a more flexible line, capable of accommodating varying numbers of workers depending on the fluctuations in demand. The configuration of this secondary line will be discussed later in this chapter.

As a result, the layout represented in Figure 22 was implemented for the primary line.

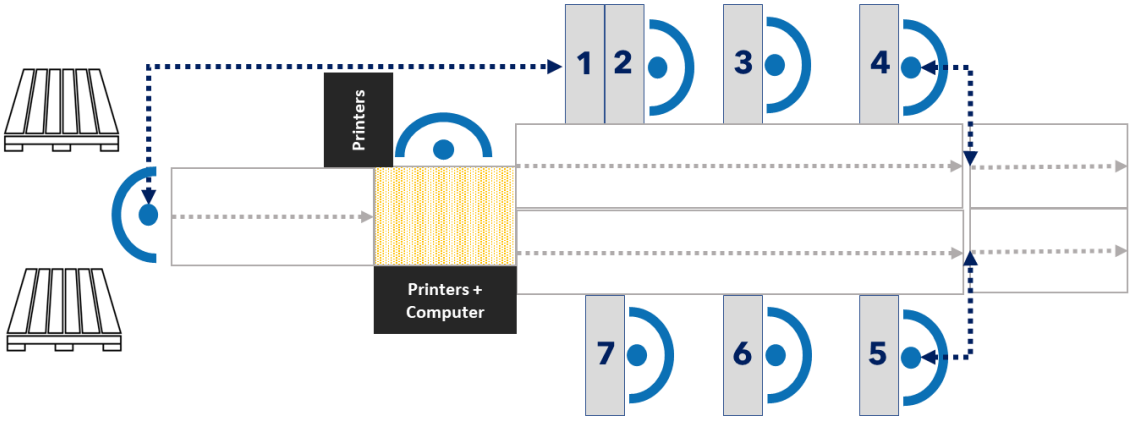

Figure 22 - Dry team primary line layout.

To mitigate the lack of flow on the labelling conveyor, a second conveyor was introduced next to the initial one. The introduction of a second conveyor has several advantages:

- Task 4 operators working at workstation/ tables 4 and 5 have less need to sort boxes by reference before placing them on the direct preparation conveyors because they are only dealing with approximately half of the products and references, which are only labelled by themselves and the two operators at the workstations in front of them;
- Task 4 operators do not have to separate from one labelling conveyor to two direct preparation conveyors, which used to cause some confusion between the two operators. In the new layout, each operator only places boxes from their labelling conveyor onto the preparation conveyor on their side, preventing mixing of products from the two sides of the line;
- Task 3 operators label more boxes per reference because each reference is distributed to only one of the conveyors where three operators are stationed. Thus, they perform fewer different labelling methods per day, reducing the time they spend thinking about the labelling method for each new box arriving at their workstation, as fewer references pass through their conveyor.

Several modifications were made for the new layout:

- Tables and conveyors were placed at the same height, and the sidebars were removed. This way, operators do not need to lift the boxes each time they remove or place them on the conveyor;
- The direct preparation conveyors are now closer to the labelling conveyors, i.e., as close as possible to labelling workstations 4 and 5, thereby reducing the movements of the operators at these labelling workstations;
- A new table was introduced next to the Task 2 workstation. The printers that were on the lower shelf of the table were moved to a new table (Figure 23), eliminating the need for the operator to bend down each time these printers are used;
- A wheel system was installed on top of the table of Task 2 operator's workstation (Figure 24) to assist with the movement of the boxes across the table, making the task less physically demanding for the operator;

Figure 23 - New table for Task 2.

Figure 24 - Wheel system on Task 2 workstation.

- A pallet jack was introduced to assist with Task 1 ("Unpack"). This way, the operator does not need to bend down to pick up the boxes that are at a lower height on the pallet;

- Workstation 1 (Figure 22) was introduced to provide the operator of Task 1 with a dedicated space to label when the conveyor belt preceding Task 2 is full.

In addition to these changes, work standards were also created for the operators:

- The operator at Task 1 "unpack" should move to the reserved labelling workstation 1 whenever the conveyor preceding Task 2 is full;
- All operators of Task 3 are facing the same direction, towards Task 2 workstation, with the exception of Task 1 operator;
- Task 2 operator must label at Task 2 workstation whenever the labelling conveyors are full;
- Task 2 operator distributes work across the conveyors based on the product reference. The same product must always be placed on the same conveyor;
- Task 1 operator must place the boxes on the conveyor, grouped by reference. However, the operator must ensure that not too many consecutive products of the same reference are placed. The operator must alternate the references so that Task 2 operator can alternate the placement of boxes on the two conveyors, preventing one of the conveyors from getting full while the other is empty;
- Task 1 operator must always have two pallets available to be opened in order to comply with the point discussed above.
- Task 2 operator must apply a sample label to each box while the printer is still printing labels, as opposed to waiting for the printer to finish. While the printer is actively generating labels, the operator is able to peel off one of the labels and affix it, thereby converting this time into productive time. The operator may label more than one item if there is still time available. This is a crucial action to prevent the operators who label from having to rework due to incorrect placement of labels through lack of knowledge and experience.

To offset the decreased number of operators in the main line's new layout, a secondary line called the '*Mura* station' was established. As indicated by its nomenclature, this new line is intended to absorb products exhibiting higher variability and accommodate less experienced workers.

The line is designed to be flexible, enabling adaptation to any change in demand. Products that are labelled for stock were given priority for this line, as opposed to those labelled for direct preparation as is the case in the main line. Consequently, at the conclusion of the *Mura* station, operators from Task 4 ('Pack') do not place boxes on the conveyors for direct preparation, but on pallets instead.

The layout of the *Mura* station during periods of high demand, when the line employs six or more operators is represented in Figure 25.

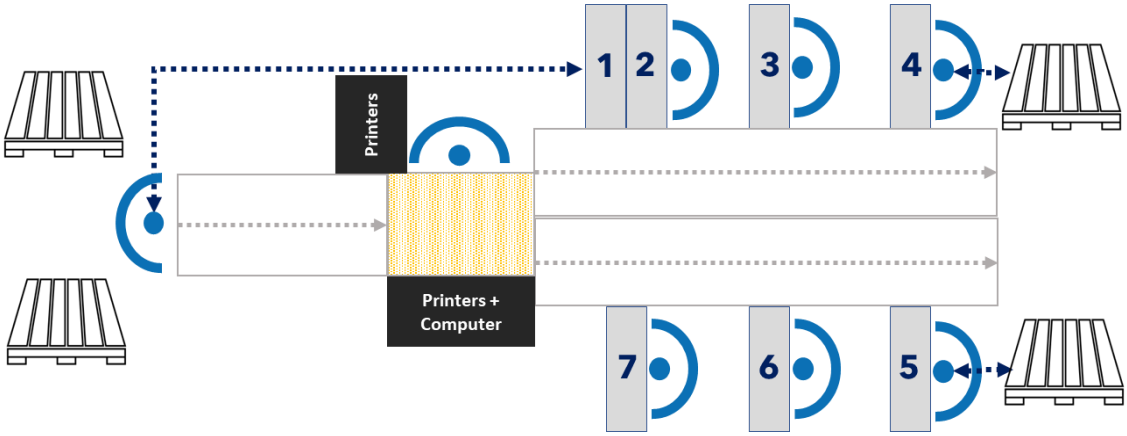

Figure 25 - Mura Station layout during periods of high demand.

This layout and operational process bear resemblance to that of the main line, explained previously, with the sole difference being that operators at workstations 4 and 5 place boxes on pallets situated behind their workstations and at the end of the labelling line.

The layout for periods of low demand, in which the number of workers is equal to or less than five, is depicted in Figure 26.

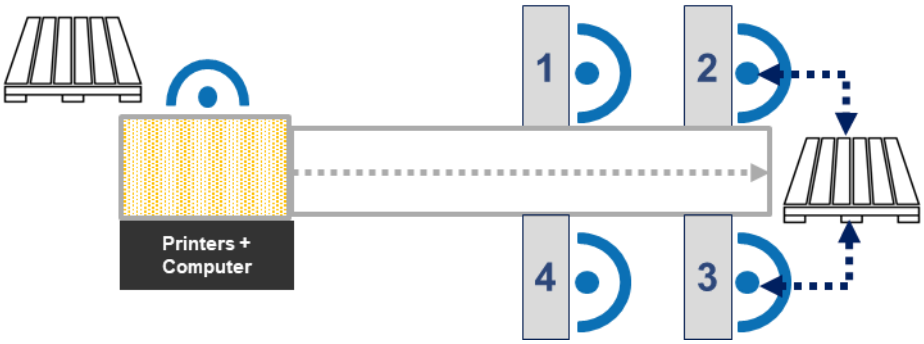

Figure 26 - Mura Station layout during periods of low demand.

In this layout, a single operator performs both Tasks 1 and 2, thereby negating the need for a conveyor between Tasks 1 and 2, unlike in the other layout. The pallet that is being unpacked is placed adjacent to the operator's workstation. Consequently, the printers which were on the auxiliary table in the previous layout need to be repositioned on the shelf below the table housing the other printers and the computer.

Concerning subsequent tasks, only one labelling conveyor is used, and operators from workstations 2 and 3 place the already labelled boxes on the same pallet located between them.

4.3.2 Fresh and Frozen team

For the Fresh and Frozen teams' calculations, certain assumptions were also undertaken:

- By aggregating the number of products distributed to the stores in 2022, and dividing this figure by the number of workdays, the average daily demand for the year 2022 was calculated. It was assumed that this daily average demand for the current year would be the same;
- The average number of items per box was considered to be 8.64;

- The total available production time was taken to be 27 612 seconds (7.67 hours x 3600 seconds);
- It was assumed that the Team Leader labels for 3 hours per day (37.5% of the workday), i.e., 10 800 seconds (3 hours x 3600 seconds).

Takt time was then calculated:

$$\text{Takt Time} = \frac{\text{Total Available Production Time}}{\text{Average demand per day}} = \frac{27\,612}{1\,760} = 15{,}68 \text{ seconds}$$

Subsequently, the number of operators was calculated:

$$\text{Number of Operators} = \frac{\sum \text{Operation Time}}{\text{Takt Time}} = \frac{93.54}{15.68} = 5{,}96 \text{ operators}$$

Considering these calculations, three scenarios for line balancing and layout were presented to the managers.

4.3.2.1 Scenario A: 7 + 1 operators

This is the most comfortable and least disruptive scenario among the three scenarios presented. In this configuration, the line would operate with seven operators plus the Team Leader who labels for three hours per day, approximately.

The operator in Task 1 performs the task in 5.10 seconds, thus having 67% of the time available for Task 3.

$$\text{Time Operator 1 has available for Task 3} = \frac{15{,}68 - 5{,}10}{15{,}68} = 0{,}67 = 67\%$$

Taking into account the hours of the Team Leader and the available hours of the Task 1 operator, a total of 0.375 + 0.67 = 1.045 operators are available, which are added to the five operators who are exclusively on Tasks 3 and 4, as shown in Table 13 and Figure 27.

Table 13 - Fresh and Frozen Team line balancing (A).

Task	Time (s)	Number of Operators	Time per Operator (s)
1	5,10	0,33	5,10
2	9,72	1	9,72
3 and 4	78,72	5 + 1,045 = 6,045	13,02

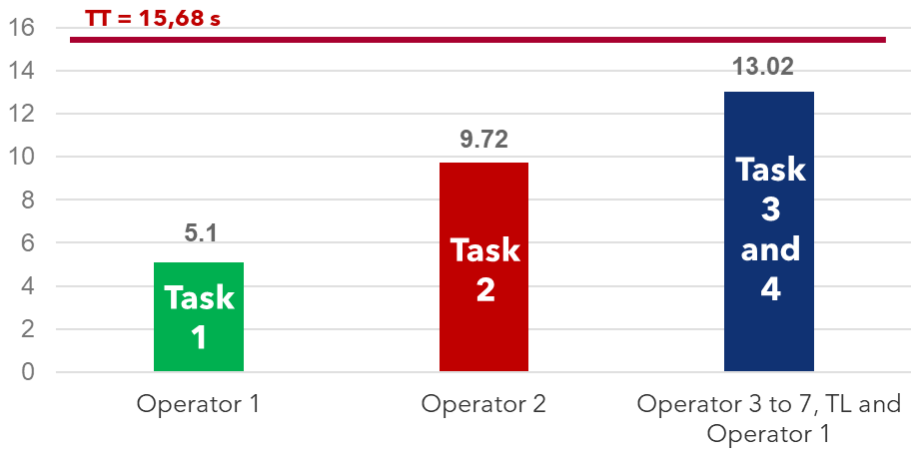

Figure 27 - Fresh and Frozen team's balance chart (A).

The decision was made not to consider the 38% of time that operator 2 would have available for Task 3, treating this time as "extra" to absorb inefficiencies such as operator 1's movement to the labelling workstation.

$$\text{“Extra” Time Operator 2} = \frac{15{,}68 - 9{,}72}{15{,}68} = 0{,}38 = 38\%$$

Due to the unique characteristic of Yogurt having a significantly shorter cycle time compared to other product families, a more detailed analysis was undertaken to assess the balance between tasks, taking into account the product family (Table 14).

In the rightmost column of Table 14, the total time each task takes to complete, divided by the number of operators allocated to it, is displayed. This value is indicated in green when it is lower than the general takt time, and in red when it exceeds the takt time.

Table 14 - Balancing by product family (A).

Task	Time	Nu. Operators	Time per Operator
Frozen			
1	5,50	0,35	**5,50**
2	11,18	1	**11,18**
3 e 4	115,20	6,02	**19,12**
Dairy			
1	6,00	0,38	**6,00**
2	16,23	1,00	**16,23**
3 e 4	90,55	5,99	**15,11**
Yogurts			
1	3,65	1	**3,65**
2	6,31	2	**3,16**
3 e 4	16,85	4,375	**3,85**
Charcuterie			
1	6,00	0,38	**6,00**
2	9,42	1,00	**9,42**
3 e 4	116,34	5,99	**19,41**

As can be seen in Table 14, to prevent Task 2 from becoming the line's bottleneck when labelling yogurts (6.31 seconds), two operators were allocated to this task. In the Frozen and Charcuterie product families, the cycle time of Tasks 3 and 4 is higher than the Takt Time. Whereas, in the Dairy family, Task 2's time exceeds the Takt Time.

After these analyses, the following layouts were designed:

- Layout for Frozen, Dairy, and Charcuterie products (Figure 28)

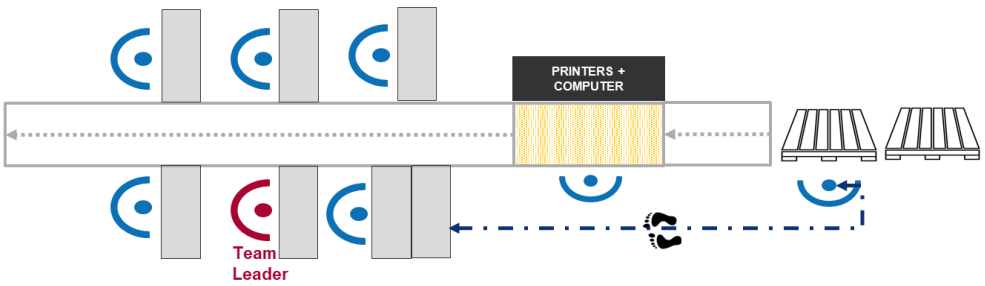

Figure 28 - Layout for Frozen, Dairy, and Charcuterie (A).

This layout has one labelling conveyor and one conveyor between Task 1 and 2; one operator for Task 1; one operator for Task 2; four operators full-time plus the Team Leader and the operator of Task 1’s extra time, for Tasks 3 and 4.

- Layout for Yogurt products (Figure 29)

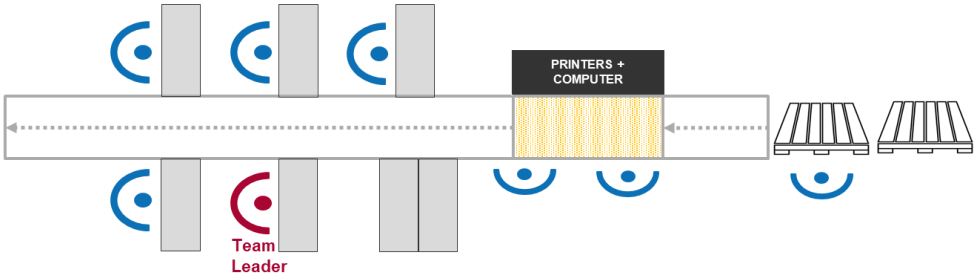

Figure 29 - Layout for Yogurt (A).

One operator moves from their labelling workstation to the Task 2 workstation, thus leaving Task 3 with one less operator and Task 2 with one more operator when the line is labelling yogurts.

4.3.2.2 Scenario B: 6 + 1 operators

In this scenario, the line would operate with 6 operators in addition to the Team Leader who labels for 3 hours per day.

The operator of Task 1 completes the task in 5.10 seconds, thereby having 67% of the time available to carry out Task 3.

$$\text{Time Operator 1 has available for Task 3} = \frac{15{,}68 - 5{,}10}{15{,}68} = 0{,}67 = 67\%$$

Taking into account the hours of the Team Leader and the hours of the operator 1, a total of 0.375 + 0.67 =1.045 “extra” operators are obtained. These are added to the 4 operators who are exclusively on Tasks 3 and 4, as shown in Table 15 and Figure 30.

Table 15 - Fresh and Frozen Team line balancing (B).

Task	Time (s)	Number of Operators	Time per Operator (s)
1	5,10	0,33	5,10
2	9,72	1	9,72
3 and 4	78,72	4 + 1,045 = 5,045	15,60

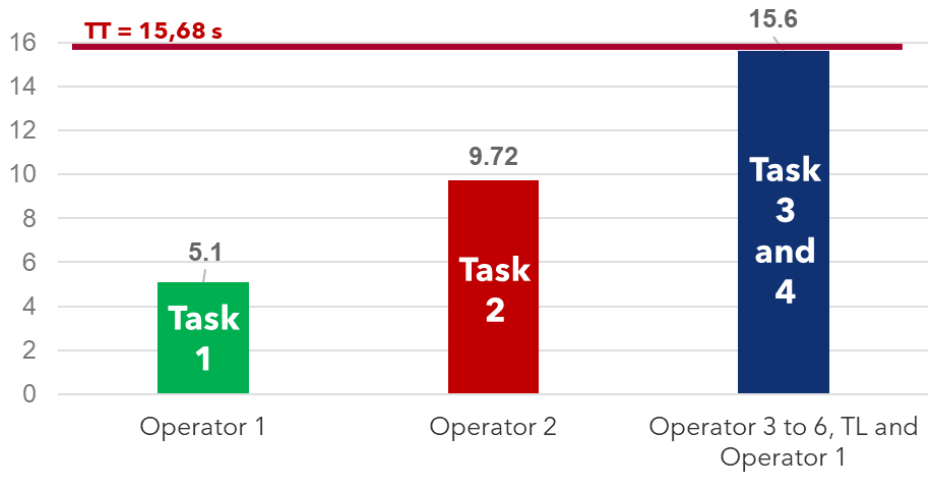

Figure 30 - Fresh and Frozen team's balance chart (B).

It was decided not to consider the 38% of the time that Operator 2 would have available for Task 3. This time was considered as an "extra" time to absorb inefficiencies such as the displacement of Operator 1 to the labelling table.

$$\text{“Extra” Time Operator 2} = \frac{15{,}68 - 9{,}72}{15{,}68} = 0{,}38 = 38\%$$

Next, an analysis was performed on the balance between tasks, taking into account the product family (Table 16).

Table 16 - Balancing by product family (B).

Task	Time	Nu. Operators	Time per Operator
Frozen			
1	5,50	0,35	**5,50**
2	11,18	1	**11,18**
3 and 4	115,20	5,02	**22,93**
Dairy			
1	6,00	0,38	**6,00**
2	16,23	1,00	**16,23**
3 and 4	90,55	4,99	**18,14**
Yogurts			
1	3,65	1	**3,65**
2	6,31	2	**3,16**
3 and 4	16,85	3,375	**4,99**
Charcuterie			
1	6,00	0,38	**6,00**
2	9,42	1,00	**9,42**
3 and 4	116,34	4,99	**23,30**

In order to prevent Task 2 to be the bottleneck when the line is labelling yogurts, with a cycle time of 6.31 seconds, two operators were allocated to this task.

In the product families of Frozen and Charcuterie, the cycle time of Tasks 3 and 4 is greater than the Takt Time. Meanwhile, in the Dairy family, both Tasks 2 and Tasks 3 and 4 have a cycle time that is higher than the Takt Time.

The following layouts were designed:

- Layout for Frozen, Dairy, and Charcuterie products (Figure 31)

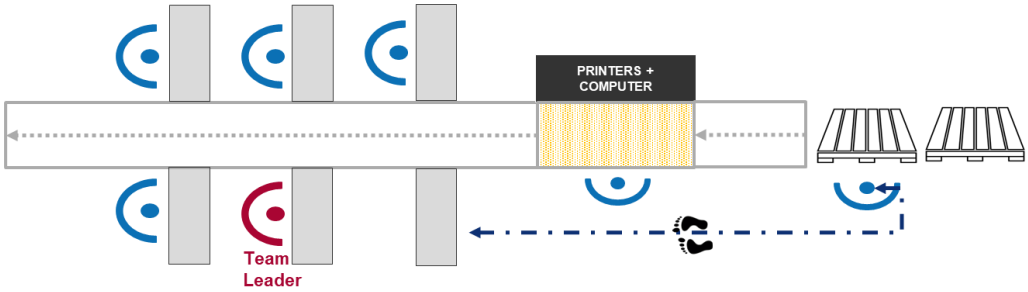

Figure 31 - Layout for Frozen, Dairy, and Charcuterie products (B).

This layout has one labelling conveyor and another conveyor between Task 1 and 2; one operator on Task 1; one operator on Task 2; four full-time operators plus the Team Leader and the operator of Task 1 with the remaining time on Tasks 3 and 4.

- Layout for Yogurt products (Figure 32)

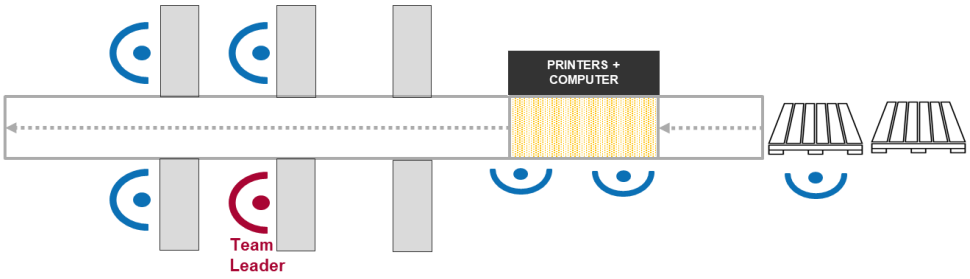

Figure 32 - Layout for Yogurt products (B).

In this layout, Task 3 loses one operator to Task 2.

4.3.2.3 Scenario C: 6 + 1 operators

Scenario C represents the most disruptive option. In this scenario, Task 1 and Task 2 were consolidated into a single operation.

Under this scenario, the line would function with six operators plus the Team Leader who applies labels for three hours per day.

With this arrangement, the cycle times for Task 1 and 2 (14.82 seconds) and for Task 3 and 4 (14.64 seconds) align closely with the Takt Time (15.68 seconds), as shown in Table 17 and Figure 33.

Table 17 - Fresh and Frozen Team line balancing (C).

Task	Time (s)	Number of Operators	Time per Operator (s)
1 and 2	14,82	1	14,82
3 and 4	78,72	5+0,375 = 5,375	14,64

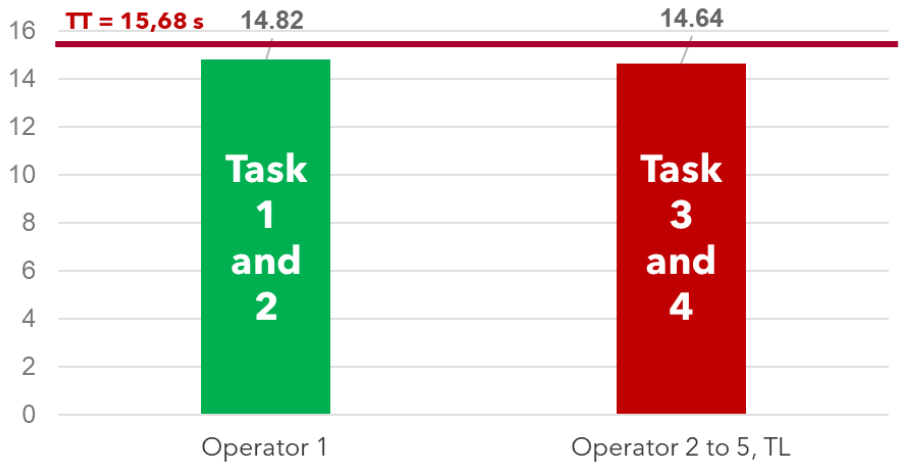

Figure 33 - Fresh and Frozen team's balance chart (C).

Despite the cycle time of Tasks 1 and 2 being near the Takt Time, a modification was made to the working method of operator 1 that allows for an overlap of the times of the two tasks that were measured separately, thus reducing the time for the two tasks when performed by the same operator. Considering the time when Task 2 operator is not adding value due to waiting for the printer to finish printing the labels, the machine's time should be utilized by the operator to remove the boxes from the pallet and place them on their desk (Task 1). Hence, it

is feasible to overlap a portion of the time of the two tasks, thereby yielding additional flexibility in the process.

As can be observed in Table 18, with this balancing the cycle time for the majority of tasks exceeds the Takt Time, but this is offset by the shorter time for the Yogurt family. For the Yogurt family, in order to better balance the tasks' cycle times, two operators were assigned to perform Tasks 1 and 2.

Table 18 - Balancing by product family (C).

Task	Time	Nu. Operators	Time per Operator
Frozen			
1 and 2	16,68	1	**16,68**
3 and 4	115,20	5,375	**21,43**
Dairy			
1 and 2	22,23	1	**22,23**
3 and 4	90,55	5,375	**16,85**
Yogurts			
1 and 2	9,97	2	**4,98**
3 and 4	16,85	4,375	**3,85**
Charcuterie			
1 and 2	15,42	1	**15,42**
3 and 4	116,34	5,375	**21,64**

Both layouts do not have a conveyor before Task 2 workstation, enabling operator 1 to perform both Tasks 1 and 2. In this configuration, the operator is tasked with removing the boxes from the pallet and placing them directly on the table where the printers are situated. This action is carried out while the printer is printing labels for the previous box.

The following layouts were developed:

- Layout for Frozen, Dairy, and Charcuterie products (Figure 34)

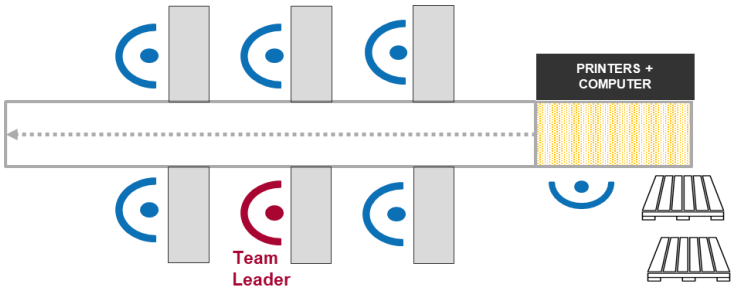

Figure 34 - Layout for Frozen, Dairy, and Charcuterie products (C).

This layout has only one labelling conveyor, one operator in Task 1 and 2, and five operators plus the Team Leader in Tasks 3 and 4.

- Layout for Yogurt products (Figure 35)

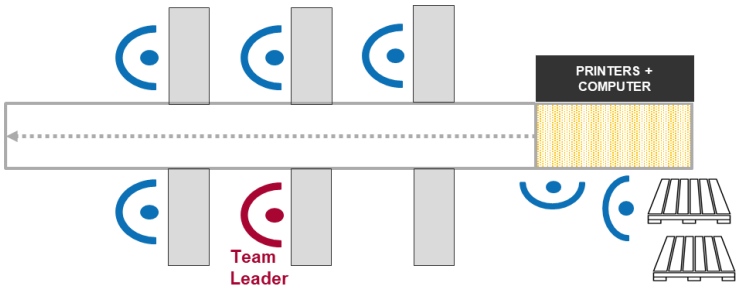

Figure 35 - Layout for Yogurt products (C).

For the Yogurt family, one of the Task 3 operators now performs Task 1 and 2.

4.3.2.4 Chosen Scenario

The defined scenarios were presented to the managers of the company, aiming at a joint decision regarding the scenario to be applied.

The selected scenario was scenario C, with six operators plus the Team Leader. The implementation of this scenario was contested by the operators due to the removal of the conveyor that preceded Task 2, and an assumed higher physical demand for Tasks 1 and 2 to be performed by the same operator.

To mitigate this effect, a pallet jack was introduced at the beginning of the line, as shown in Figure 36, to facilitate the work of the operator of Tasks 1 and 2. This pallet jack allows the boxes to be at waist level for the operator, thus eliminating the need for the operator to bend down each time they need to pick up boxes that are at a low height on the pallet.

Figure 36 - Pallet jack at the beginning of the line.

In addition to this change, other modifications were made:

- Tables and conveyor belts were levelled to be at the same height, and the side bars were removed. These changes improve the ergonomics of Task 3, preventing operators from needing to lift the boxes to remove or place them on the conveyor belt;
- The conveyor belts of the direct preparation team were placed near the end of the labelling line to reduce the movement of the operators of Task 4;
- A wheel system was added to the printers' table to facilitate dragging the boxes to the labelling conveyor belt;

- The area where the two pallets must be placed was delimited, as represented in Figure 37, so that the pallets are always close to the operator of Tasks 1 and 2.

Figure 37 - Delimitation of the area for two pallets.

4.4 Work Standards

The teams did not have a defined process for executing tasks. This resulted in substantial variability in methodologies and task completion times for the same product.

Accordingly, it was of utmost importance to develop work standards, analysing each task and its variations based on the type of box and product organization within the box.

Considering the thousands of different products labelled by the teams, clusters were established for each task. Each standard defined the actions to be performed, ordered by the sequence of execution, paired with images to illustrate each action.

4.4.1 Clustering of Standards for the Dry Team

The following clusters were created for the Dry Team:

- *Task 1:* Three standards depending on the type of box. Products were grouped into closed cardboard boxes (Appendix A), thermo shrink plastic boxes, primarily used for liquids (Appendix B), and thermo shrink plastic boxes with cardboard trays, the standard for which can be observed in Figure 38.

Figure 38 - Dry Team Standard, Task 1, shrink plastic boxes with cardboard trays.

- *Task 2*: A singular standard. All references could be encompassed within a single standard for this task, as it is performed in the same way regardless of the reference (Appendix C).
- *Task 3*: Seven standards depending on the organization of the products within the box and the surface where the labels are placed. Standards were developed for products with:
  - A single layer inside the box (Appendix D);
  - Two or more layers and labels on the upper surface, the standard for which can be observed in Figure 39;

Figure 39 - Dry Team Standard, Task 3, two or more layers, upper surface.

- Two or more layers and labels on the side surface (Appendix E);
- Two or more layers and labels on the bottom surface (Appendix F);
- Wrapped in thermo shrink plastic (Appendix G);
- Wrapped in thermo shrink plastic with a cardboard tray (Appendix H).

- *Task 4:* A singular standard for all products (Appendix I).

In crafting these standards, various methods employed by the operators to label the products were taken into consideration, with the aim of identifying the most time-efficient method. Thus, several tests were executed, in which the durations of alternative methods were measured. An example of these tests can be observed in Table 19.

Table 19 - Test of two or more layers of products and labels on the side surface.

Methods	Time
1. All products are all labelled first before being placed in the box	• 1´14´´ • 1´10´´
2. Labelling and placing the product in the box, item by item	• 49´´ • 55´´

For boxes with two or more layers of products and labels on the side surface, two methods were evaluated during the third step of the process. The scenario of labelling and placing the product in the box, item by item, proved quicker than the scenario in which products were all labelled first before being placed in the box. Consequently, this is the scenario reflected in the standard presented in Appendix E.

4.4.2 Clustering of Standards for the Fresh and Frozen Team

The following standards were developed for the Fresh and Frozen Team:

- *Task 1 and 2:* A general standard, with four different ways to open boxes depending on the type (Appendix J). In addition to this standard, two more were created: one for when only one operator is performing these tasks (Appendix K) and another for when there are two operators, as shown in Figure 40 and Figure 41.

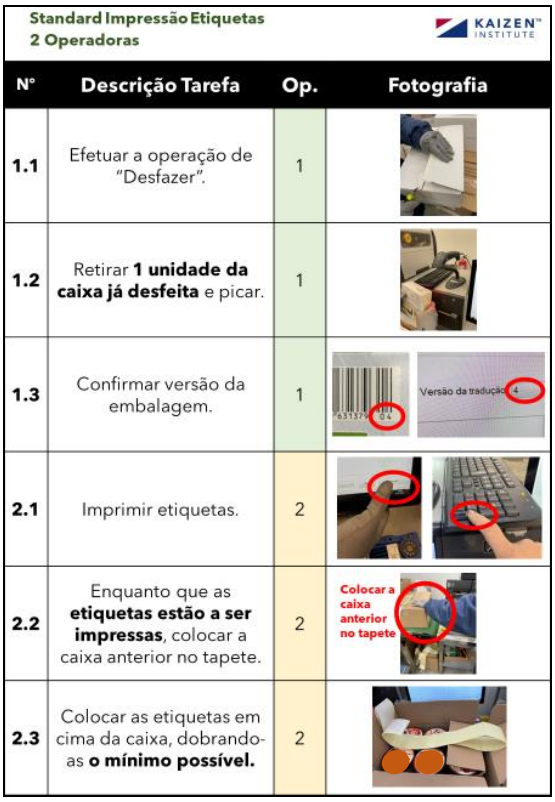

Figure 40 - Standard, two operators (part 1).

Figure 41 - Standard, two operators (part 2).

- *Task 3:* Nine standards depending on the type of box, the organization of products within the box, and the surface where the labels are placed. Standards were established for products with:
    - A closed cardboard box, one layer of a fresh product (Appendix L);
    - A closed cardboard box, two or more layers of fresh products (Appendix M);
    - An open cardboard box, one layer of a fresh product (Appendix N);
    - An open cardboard box, two or more layers of fresh products (Appendix O);
    - Wrapped in thermo shrink plastic and the product being fresh (Appendix P);
    - Wrapped in thermo shrink plastic, the product being a frozen pizza (Appendix Q);

- Wrapped in thermo shrink plastic, the product being ice cream (Figure 42);

Figure 42 - Fresh and Frozen Team Standard, Task 3, pizza wrapped in shrink plastic.

- A closed cardboard box and the product being frozen (Appendix R);
- Wrapped in cling film and the product being frozen (Appendix S).

- *Task 4:* A singular standard for all products (Appendix T).

Tests were also conducted in the Fresh and Frozen teams to ascertain the most efficient working methods. An illustration of these tests can be found in Table 20.

Table 20 -Test of open cardboard boxes with a single layer of fresh products.

Methods	Time
1. The box is not removed from the conveyor belt and the labelling is done directly with the box on the conveyor when it is possible	• 11″ • 11″
2. The box is removed from the conveyor belt, the products are labelled with the box on top of the table, and then returned to the conveyor	• 17″ • 15″

Two scenarios were contemplated for Task 3, concerning open cardboard boxes with a single layer of fresh products. In the first scenario, the box is not removed from the conveyor belt and the labelling is done directly with the box on top the conveyor when it is possible. In the

second scenario, the box is removed from the conveyor belt, the products are labelled with the box on top of the table, and then returned to the conveyor. The first scenario proved to be the quickest to complete, hence it is the scenario reflected in the standard presented in Appendix N.

4.4.3 Implementation of Standards

After the work standards were finalized, two presentations were made to the teams to train them on the new working methods that the operators would have to follow. They were also informed of the results of the tests carried out.

The implementation of standards can sometimes be difficult to execute due to resistance to changing ingrained habits. The operators were made aware that it is common to feel some discomfort during the transition phase to new working methods.

The standards were placed at each workstation, as shown in Figure 43, so that they can be consulted at any time.

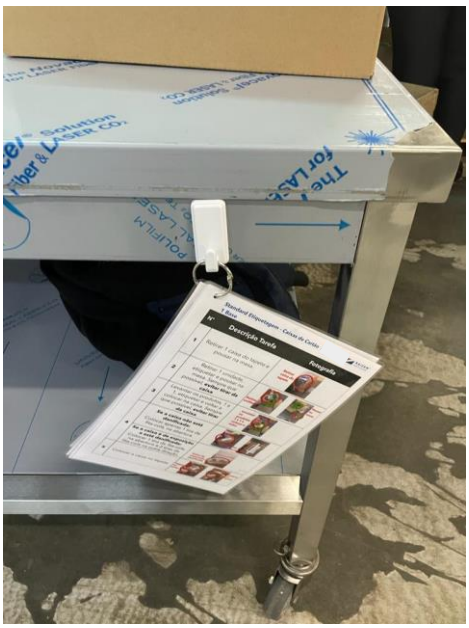

Figure 43 - Standards placed at a workstation.

4.5 5S

The workstations were disorganized, hence the need to implement the 5S.

First, a screening and organization of the tools necessary for each workstation was done. Identifications were placed on all the workstations. On top of the tables, a place was established for the tape dispenser and for the box cutter, which are the tools most used by the operators (Figure 44). Under the table, specific places were defined for the rolls of tape, for the spare tape dispenser, for a sheet where write-offs are recorded and a pen, for the operators' gloves and water bottles, and for the paper used to clean the tables (Figure 45).

Figure 44 - 5S on top of tables.

Figure 45 - 5S under the tables.

Next, operators were made aware of the importance of having their workstation organized and clean.

To sustain the 5S's performed, quick-fill forms were placed on each workstation. Each operator has to fill one out at the start of their workday and place it on their table. If all answers are positive, the green side (Figure 46) must be facing up, while if any answer is negative, the red side (Figure 47) must be visible. In this way, the Team Leader can control the state of each workstation and establish improvement actions if any of them fail in the audit.

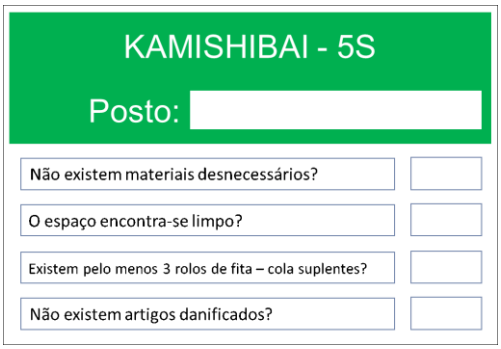

Figure 46 – Kamishibai's green side.

Figure 47 - Kamishibai's red side.

4.6 Updating the photographs database

The computer screen of Task 2 displays an image of the labelled product. This allows the computer operator to affix a sample label on each box. However, most of the photos were outdated, with labels placed incorrectly, and many products lacked photographs.

4.6.1 Information Flow for New Photographs

A process for updating the photographs was defined, as represented in Figure 48. This process involves the participation of individuals and departments outside the labelling teams.

The process is triggered by Task 2 operators noticing a lack of a photo or an outdated photo. After this detection, the operator must remove all products from the line.

The Team Leader must verify that the photo is outdated or missing, and take a new photo with the correct label placement. If the Team Leader has the autonomy to validate the change, the

products should return to the conveyor with the sample label correctly placed. At the end of the day, the Team Leader must send the photo to a back office employee who will update the database with the new photo.

However, most of the time, the positioning of the photos needs to be validated by the quality department and management. Therefore, the Team Leader must send the photo to this department, which validates the new photo or suggests a different placement. If another placement is suggested, the Team Leader must take a new photo, place the products on the line, and send the photos to be included in the database.

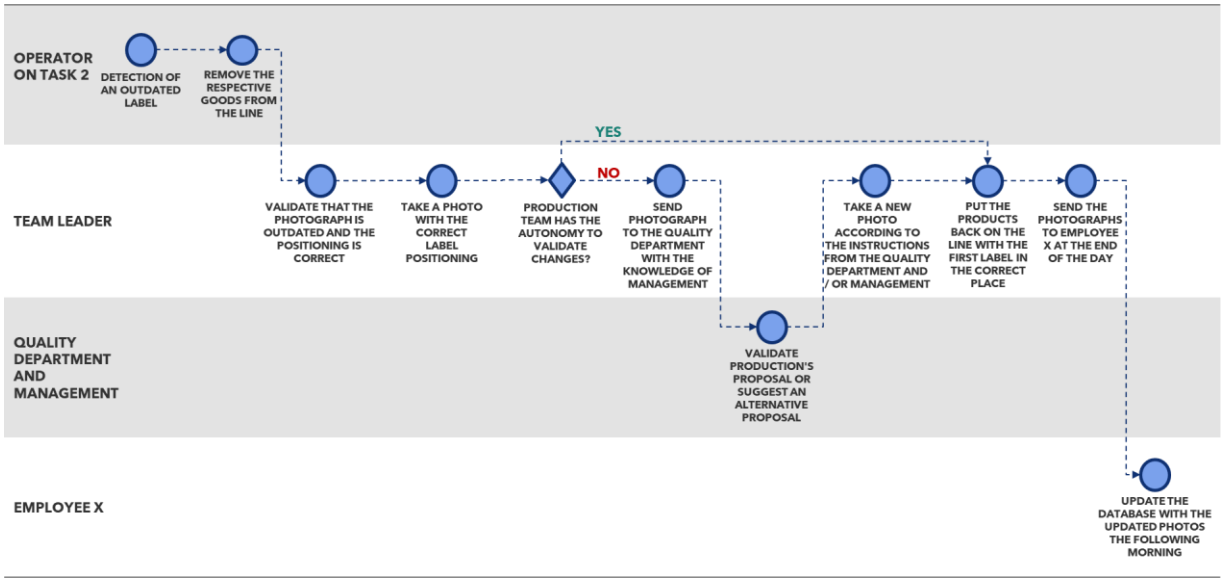

Figure 48 - Information Flow for New Photographs.

4.6.2 Information Flow for Improving Label Positioning

Some labels were placed in locations where the labelling process was more difficult, for example requiring a great deal of handling of the products by the operators. Therefore, changing the position of labels to locations that facilitate the labelling process leads to a reduction in the time it takes to label and consequently an increase in productivity. Hence, a process was defined to improve the positioning of the labels, which can be seen in Figure 49, from the moment an opportunity for improvement is identified by one of the operators, through approval by the Team Leader, Quality Department, and management team, until the end of the process where the database is updated with the photo of the new label placement.

The differences in this process compared to the process described in Section 4.6.1 are that the Team Leader never has the autonomy to change the positioning of the labels, and the quality department and management team can reject the proposal, without offering any alternative proposal, thus ending the process.

This is a continuous improvement process, which requires the contribution of all operators.

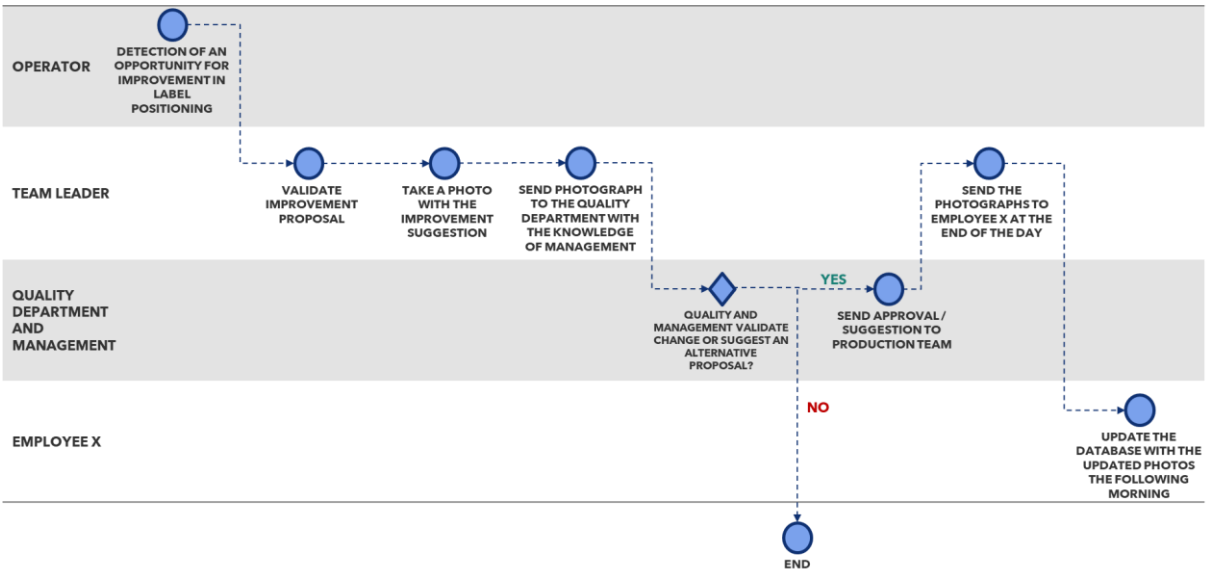

Figure 49 - Information Flow for Improving Label Positioning.

4.7 Daily Kaizen

In order to ensure that the initiatives are sustained, a Daily Kaizen board was implemented for the Dry team, which can be seen in Figure 50, and another for the Fresh and Frozen team (Appendix U). Daily Kaizen meetings occur daily before the start of work shift and are led by the Team Leader, involving the entire team for five and a half minutes.

The Daily Kaizen boards are divided into four sections: people, work plan, indicators, and action plan.

The "people" section includes the agenda, meeting duration, and attendance map.

In the "work plan" section, operators can check which task they need to perform that day, as the work plan is filled out for the entire week. Due to the greater wear of Task 1, all tasks rotate every half-shift. Thus, operators can be assigned Tasks 1, 2, 3, or 4 in the Dry team. In the Fresh and Frozen teams, the assigned tasks are Tasks 1 and 2 simultaneously, Task 3, Task 4, and Task 3 combined with helping the operator of Task 1 and 2 when labelling Yogurts. Besides task assignment, the work plan also defines which product family the team will label that day and the number of pallets from each family that the team is expected to label.

The "indicators" section monitors the previous day's productivity indicator, products labelled/hour, using visual management via a bar chart coloured green or red, depending on whether the value is above or below the target. Another monitored indicator is the daily quantity of boxes or items damaged due to operator handling. The third indicator is the confidence curve of proposed improvement actions. This indicator is the percentage of finished improvement actions relative to proposed actions, each month. The last indicator is a weekly indicator and corresponds to the quantity of improved label positioning achieved.

Finally, the "action plan" section, designed based on the PDCA cycle, includes four sections corresponding to planned, ongoing, verification, and completed actions, where operators can write improvement actions and monitor their development. At this stage, operators share the difficulties they face and define the respective actions to solve them.

This area aims to increase transparency, sharing daily performance with the operators, and encouraging mutual aid, by quickly identifying members with problems and exploring their causes.

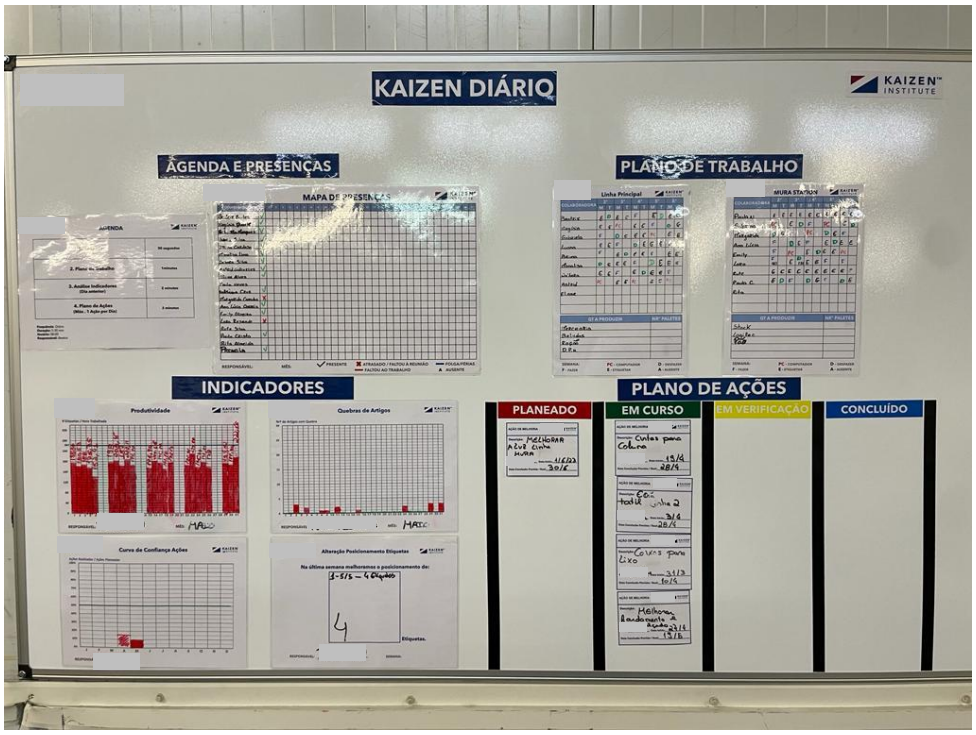

Figure 50 - Dry team Daily Kaizen board.

The Daily Kaizen board allows the team to be fully aligned, with clear objectives and visible results.

To ensure the boards are filled out correctly, the meetings occur as scheduled, start without delays, and all agenda topics are discussed, audits were conducted. The results of the audits were subsequently analysed with the Team Leaders and company managers.

4.8 New Label Size for Frozen Products

The use of two or more labels on the same product was quite common in frozen products. As explained in Section 3.4.3, this is because the text does not fit on any of the pre-configured sizes available in the printers.

The company did not have a database where it could identify which products had more than one label. Therefore, one of the stores was asked to survey a unit of each frozen product that fit this description and send all the products back to the logistics center.

In total, 83 different products were received. As can be seen in Table 21, of the 83 products received, 58 were the combination of 2 medium labels applied horizontally, representing 70% of the products received, and 14 were the combination of 2 medium labels applied vertically, representing 17% of the products received. The remaining 13% of products had various configurations.

Table 21 - Combination of labels on frozen products.

	Products	%
2 Medium Labels Horizontally	58	69,88%
2 Medium Labels Vertically	14	16,87%
Others	11	13,25%

The number of items that have 2 medium labels arranged horizontally could be even higher, because only one type of ice cream was sent, and there are dozens of other ice creams references, for example with other flavours, that were not sent by the store.

As a result of this analysis, two new label sizes, which are the combination of two medium labels, were ordered from the label roll supplier.

Subsequently, two new printers were introduced to the Fresh and Frozen teams, thereby avoiding the application of two labels in about 87% of frozen products, considering the sample received.

4.9 Team Leaders' Schedule

Team Leaders did not have a schedule for the tasks they had to perform, nor a clear definition of the tasks they needed to prioritize.

In order to understand their work, both Team Leaders were shadowed for a day. All the tasks they performed, their duration, and the hours at which they were carried out were recorded.

4.9.1 Dry Team's Leader

The tasks that the Dry Team Leader performs were grouped into a schedule, along with three checklists.

The first checklist, represented in Table 22, represents the daily schedule. This schedule includes tasks such as leading the Daily Kaizen meeting, checking the 5S kamishibais at each workstation, checking and responding to emails, among others.

Table 22 - Dry Team Leader daily schedule.

Schedule	Task	OK/NOK
08h00-08h05	Daily Kaizen Meeting	
08h05-08h10	Check workstation 5S kamishibais	
08h10-09h00	Process control	
09h00-09h02	Alignment with preparation team	
09h02-09h12	Check and respond to emails	
09h12-09h14	Alignment with stock team	
09h14-10h25	Process control	
10h25-10h40	Break	
10h40-10h55	Process control	
10h55-11h15	Fresh Daily Kaizen Meeting (only on Tuesdays)	
11h15-12h50	Process control	
12h50-13h00	Check and respond to emails	
13h00-14h00	Lunch break	
14h00-14h45	Process control	
14h45-14h47	Alignment with preparation team	
14h47-16h45	Process control	
16h45-16h55	Check and respond to emails	
16h55-17h00	Prepare next day's Daily Kaizen Meeting	
17h00	Send photographs	

Throughout the day, the Team Leader must carry out tasks that are considered process controls. Priorities were defined for these tasks, as can be seen in Table 23. Thus, for example, placing two pallets at the beginning of the labelling lines so that the lines have products before Task 1 takes priority over controlling operators' compliance with work standards. Therefore, when more than one of these tasks must be performed, the Team Leader consults this checklist in which the tasks are listed in order of priority.

Table 23 - Dry Team Leader, process control.

Priority	Task	OK/NOK
10	Place 2 pallets on the lines	
10	Remove pallets from the line area (stock)	
9	Substitute operators when they go to the bathroom	
8	Communication with the logistics director	
7	Send products without translation	
6	Unload truck	
5	Validation of compliance with standards	
2	Take stock pallets to picking	
1	Take photographs	
1	Communication with the Fresh and Frozen Team Leader	
1	Reorganization of pallets in the warehouse	
1	Move empty pallets (stacks)	

Some tasks are not carried out daily, such as planning the work for the following week, so a third checklist was created with these tasks and their duration, as shown in Table 24.

Table 24 - Dry Team Leader, weekly tasks.

Day / Schedule	Task	Duration	OK/NOK
Tuesday/ 16h30	Take out the trash	10 min	
Wednesday/ 16h30	Take out the trash	10 min	
Thursday/ 15h00	Plan for next week's dry team	30 min	
Thursday/ 15h50	Print and cut DPH flyers	20 min	
Thursday/ 16h30	Analyze weekly production	15 min	
Friday/ 16h00	Validate weekly plan of fresh team	5 min	
Friday/ 16h30	Take out the trash	10 min	

4.9.2 Fresh and Frozen Team's Leader

Similar to the Dry Team's Leader, the tasks performed by the Fresh and Frozen Team's Leader were grouped into a schedule with three checklists.

The checklist in Table 25 represents the daily schedule. This schedule has fewer tasks than the Dry Team Leader's and only includes tasks like leading the Daily Kaizen meeting, checking the 5S's kamishibais at each workstation, performing process control, taking out the trash, and sending photos to be updated in the database. The rows in Table 25 that are in green represent tasks that are only carried out on Tuesdays, because on this day this day the work shift is from 11:00 am to 8:00 pm.

Table 25 - Fresh and Frozen Team Leader daily schedule.

Schedule	Task	OK/NOK
08h00-08h05	Daily Kaizen Meeting	
08h05-08h10	Check workstation 5S kamishibais	
08h10-11h00	Process control	
11h00-11h05	Daily Kaizen Meeting (on Tuesdays)	
11h05-11h10	VCheck workstation 5S kamishibais (on Tuesdays)	
11h10-16h45	Process control	
16h45-17h00	Take out the trash	
17h00	Send photograps	
17h00-19h45	Process control (on Tuesdays)	
19h45-20h00	Take out the trash (on Tuesdays)	
20h00	Send photograps (on Tuesdays)	

The Team Leader must perform tasks that are process controls throughout the day. As can be seen in Table 26, priorities were defined for these tasks.

Table 26 - Fresh and Frozen Team Leader, process control.

Priority	Task	OK/NOK
11	Remove pallets and place a new pallet	
10	Move empty pallets	
9	Assist in post-setup of pallet exchange	
8	Unload truck	
7	Validation of compliance with standards	
6	Align with the preparation team	
5	Constant monitoring of improvement opportunities	
4	Carry already labeled frozen pallets	
3	Take photographs	
2	Communication with the logistics director	
1	Monitoring of damaged goods for the Daily Kaizen indicator	

Finally, as shown in Table 27, only two tasks are performed weekly, which are planning the work for the following week and validating this plan with the Dry Team's Leader.

Table 27 - Fresh and Frozen Team Leader, weekly tasks.

Day / Schedule	Task	Duration	OK/NOK
Thursday/ 08h10	Make work plan for the following week	10 min	
Friday/ 16h00	Validate the weekly plan with the Dry goods Team Leader	5 min	

4.10 Load/Capacity Tool

During the project's final weeks, a tool was developed in Excel to assist the logistics director with planning the following week of work. This tool operates on a weekly temporal framework, permitting accurate calculation of the workforce required. Moreover, it assesses the theoretical quantity of products due for labelling within a specified week and each corresponding day, and offers a daily status of labelling, i.e., whether production on a certain day is ahead or behind the theoretically planned production.

Initiation requires the filling of the grey cells in Table 28. The first cell represents the average number of boxes on each pallet, a figure that, as per corporate records, stands proximately at 50. In the second cell, the logistics director can introduce a safety factor in the form of a percentage, concerning the calculated processing time, thus deriving the processing time with a safety buffer to be utilized in subsequent calculations.

Table 28 - Assumptions for Excel tool.

Assumptions	
Available Time / Day (s)	27612
Average Number of Boxes / Pallet	**50**
Average Number of Items / Box	12
Processing Time / Box (s)	136.04
Safety Buffer	**20%**
Processing Time with Safety Buffer (s)	163.24

On each week's conclusion, the logistics director makes a prediction of the number of pallets expected to arrive in the subsequent week, a figure that must be recorded in the grey cell demonstrated in Table 29.

Table 29 – Forecast.

Week	**12**
Number of Pallets	210
Number of Boxes	10500
Number of Products	126000

The planned daily production for the ensuing week is the quotient of the number of boxes from Table 29 and the five operational days of the week, resulting in an equable takt time for all days of the week. The calculation of the number of operators employs the processing time with safety buffer, the outcome of which can be viewed in the green cells of Table 30.

Table 30 - Number of operators.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Planned Daily Production (Boxes)	2100	2100	2100	2100	2100
Takt Time (s)	13.15	13.15	13.15	13.15	13.15
Number of Operators	12.42	12.42	12.42	12.42	12.42
Number of Operators (round up)	13	13	13	13	13

After each working day, the actual value of labelled products is inputted, which is automatically converted into boxes under the assumption that each box contains an average of 12 items.

The actual production figure is juxtaposed with the planned figure, thereby facilitating understanding as to whether the production is ahead or behind the planned schedule. The final row of Table 31 illustrates that when the labelling lines fall short of the planned output, a red numerical value is displayed denoting the number of boxes, whereas surplus production is denoted by a green numerical value.

Table 31 - Daily analysis.

Real Daily Number of Products Labelled	23156	29788	24012	23010	26528
Real Number of Operators	12	14	13	13	13
Real Daily Production (Boxes)	1930	2482	2001	1918	2211
Planned Weekly Accumulated Production (Boxes)	2100	4200	6300	8400	10500
Real Weekly Accumulated Production (Boxes)	1930	4412	6413	8331	10541
Difference (Boxes)	-170	212	113	-70	41

This tool enables the logistics director to aptly tailor capacity to the demand-driven workload. Additionally, it enhances visibility on a daily basis regarding the work performed, thereby allowing for appropriate action to rectify any deviations.

Chapter 5 Conclusions and Future Work

The work conducted during the course of this Master's thesis represented a joint effort between the Kaizen Institute and the client company to accomplish a common goal: increasing the productivity of the labelling lines by 33%. A comprehensive approach was adopted, employing disruptive thinking and methodologies to optimize the balancing of work among the operators, improving the ergonomics of their workstations, and enhancing the overall operational layout. Moreover, the 5S methodology was implemented to ensure a more organized and efficient workplace, and two information flows were established to update the photo database, further optimizing the labelling process.

Despite the numerous improvements implemented, the productivity indicator does not accurately represent the work conducted. Two factors have rendered the comparison of productivity between the initial baseline measurement and the project's final weeks invalid.

The first factor relates to the significant variation in the mix of labelled products compared to the initial situation. The products sold by the stores vary depending on the time of year, with some products selling more at certain times and less at others. As the product mix is inherently seasonal, even with the consistent application of the same layout, methods, and work standards, productivity fluctuates throughout the year as the product mix changes. The most realistic method of measuring productivity changes is to compare with the corresponding period in the previous year, in which the product mix would likely be similar.

The second factor pertains to the timing of the productivity measurement. It was conducted over a seven-day period at the inception of the project. During this interval, the teams were smaller and primarily comprised of experienced operators. However, as the demand to label products for store shipment increased, the teams expanded to include inexperienced and, consequently, less productive operators

Despite these limitations, the impact of the new layout on the dry goods team was evident in the fifteen days of work following its implementation. The graph in Figure 51 illustrates the productivity values following the implementation of the new layout compared to the initial productivity baseline, represented by a horizontal line on the graph. During this period, the product mix had not substantially changed and was still similar to the initial product mix, and a 12% productivity increase is observed. It's noteworthy that on 12 out of the 15 days, productivity surpassed the initial level. This productivity increase was achieved during the operators' adaptation phase to the new operational rules, and even without the implementation of the task-specific work standards.

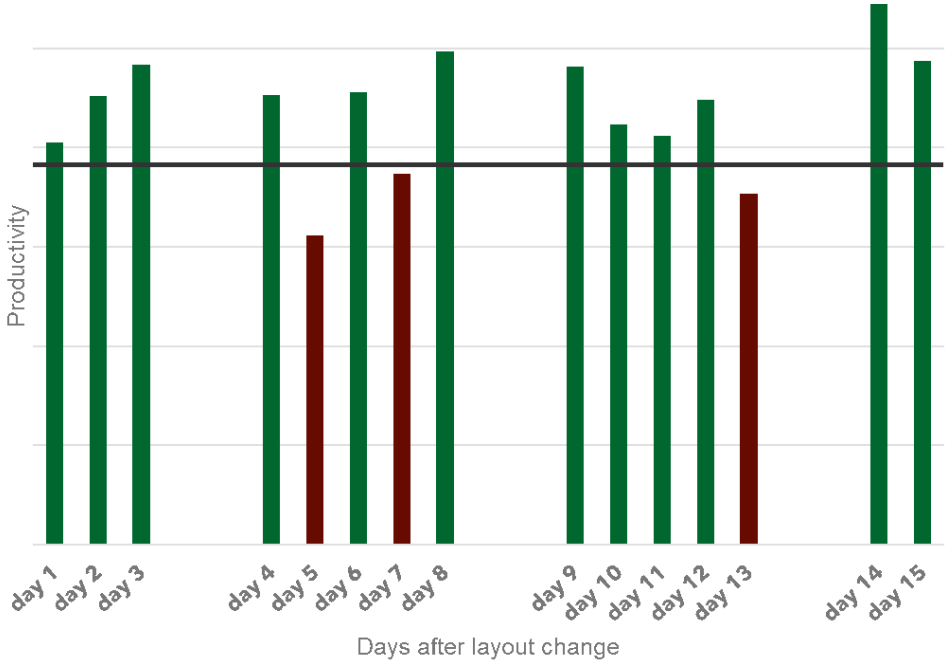

Figure 51 - Productivity on the 15 days after the layout change

Another promising indicator is the increase observed in the 90th percentile of productivity. This metric showed a 17% increase compared to the initial productivity value and a 7% increase compared to the 90th percentile of the baseline productivity period. This is particularly significant as it suggests that even with a higher number of days featuring an unfavourable product mix, the most productive days (the top 10%) saw an increase in productivity. In simpler terms, on their best days, the team was performing even better than they were initially, suggesting that the changes implemented were indeed effective in boosting overall productivity.

Subsequently, it was possible to reconstruct the historical data for the year 2022, and a 28% productivity increase was observed when comparing equivalent periods.

It is important to acknowledge that striving for a significant improvement often involves overcoming various challenges and complexities.

The implementation of new work standards, although intangible in some respects, will have a tangible impact on productivity once workers have fully adapted. It will facilitate easier integration of new operators, ensuring knowledge retention within the company even if experienced operators depart. This is expected to result in reduced variability in terms of productivity among operators, ensuring all tasks are performed in the most efficient manner identified thus far. The standardization was a reflection of the continuity of best practices within the organization.

The project facilitated enhanced visibility of the labelling teams' performance for the company. Prior to this initiative, the company lacked the ability to quantify their daily production accurately. However, now the company has the capacity to track daily output, crucial for assessing performance and identifying areas of improvement.

The introduction of Daily Kaizen meetings played a crucial role in managing behaviour change, increasing operator engagement and commitment. It served as a vital component for changing mindsets and aligning the teams with the company's objectives.

The development of the Excel tool provided the logistics director with a more effective method for planning the forthcoming work week and making necessary corrections from one day to the next. The Team Leaders, in turn, gained a more structured and appropriate working methodology, allowing them to focus more accurately on their tasks.

In terms of future work, various opportunities for further improvement were identified. The planning process could be conducted more proactively, aligning the demands from the stores with the orders to the suppliers, allowing the company to determine the required production quantity and adjust the workforce accordingly. Furthermore, developing a method to determine the quantity of products arriving at the logistics center by product family would allow for better segmentation, enabling the lines to dedicate full days to labelling a single product family. Teams can also benefit from gaining more experience and becoming more accustomed to the work methods. Creating a training plan for new, inexperienced operators will be essential to expedite their approach to the level of their more experienced colleagues. Therefore, the learning curves and time required for operators to fully adapt to the new procedures and work standards will be improved.

This project has laid the foundation for a culture of continuous improvement within the organization, and there is considerable potential for building upon this work in the future. The methodologies employed, including the 5S principles and the new information flows for updating the photo database, have instilled a more systematic and data-driven approach towards operational improvement, and the tangible results achieved offer strong motivation to pursue further advancements. The journey towards operational excellence is a continuous one, and the learnings from this project provide valuable insights for future initiatives.

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Appendix A: Dry Team Standard, Task 1, closed cardboard boxes

Standard Desfazer – Caixas de Cartão

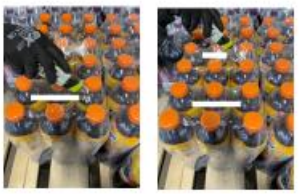
KAIZEN INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Cortar a camada de forma a ter acessibilidade ao produto.	
2	Verificar se o produto que está na palete é para ser etiquetado ou não.	
3	**Se os produtos estão acima da altura do tapete:** Colocar a caixa no tapete e cortar 1 vez, de um lado ao outro.	
	Se os produtos estão abaixo da altura do tapete: Cortar a caixa de um lado ao outro e colocar no tapete.	

Appendix B: Dry Team Standard, Task 1, thermos shrink plastic boxes

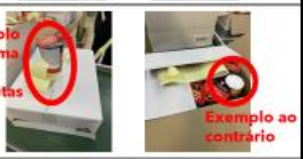
Standard Desfazer – Caixas de Plástico Termo Retrátil

KAIZEN INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Cortar a camada de forma a ter acessibilidade ao produto.	
2	Verificar se o produto que está na palete é para ser etiquetado ou não.	
3	**Se os produtos estão acima da altura do tapete:** Colocar caixa no tapete e cortar 1 vez, a meio, mas não de um lado ao outro.	
	Se os produtos estão abaixo da altura do tapete: Cortar a caixa a meio, mas não de um lado ao outro e colocar no tapete.	

Appendix C: Dry Team Standard, Task 2

Standard Impressão Etiquetas

Nº	Descrição Tarefa	Fotografia
1	Pegar na caixa, retirar 1 unidade e picar.	
2	Confirmar a versão da embalagem.	
3	Imprimir etiquetas.	
4	Colar etiqueta exemplo, enquanto está a ser impressa uma nova tira de etiquetas	
5	Colocar etiquetas em cima da caixa. **Dobrar o mínimo as etiquetas, apenas para não caírem.**	
6	Colocar produto exemplo em cima das etiquetas, **exceto** com garrafas e latas (colocar o produto ao contrário).	
7*	Se o tapete estiver cheio, **etiquetar na mesa da impressão**.	


Standard Impressão Etiquetas
KAIZEN INSTITUTE
➢ Se a linha estiver CHEIA, a operadora deve parar de imprimir e começar a ETIQUETAR, na própria MESA DE IMPRESSÃO.
Linhas CHEIAS, portanto ETIQUETAR.
Linha VAZIA, continuar a IMPRIMIR.
➢ As etiquetas têm de ser dobradas o mínimo possível. Dobrar apenas o estritamente necessário para que as etiquetas não caiam da caixa.
Etiquetas dobradas apenas o estritamente necessário.
Etiquetas dobradas em excesso.

Appendix D: Dry Team Standard, Task 3, single layer

Standard Etiquetagem – Caixas de Cartão
1 Base

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Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Retirar 1 unidade, etiquetar e pousar na mesa. Sempre que possível, **evitar tirar da caixa**.	
3	Levantar os produtos, 1 a 1, etiquetar e voltar a colocar na caixa. Sempre que possível, **evitar tirar da caixa**.	
4	**Se a caixa não está danificada:** Colocar apenas 1 tira de fita-cola, na abertura.	
	Se a caixa é de exposição e está danificada: Colocar 1 tira de fita-cola, na abertura e 2 tiras de fita-cola na outra direção.	
5	Colocar a caixa no tapete.	

Appendix E: Dry Team Standard, Task 3, two or more layers, side surface

Standard Etiquetagem – Caixas de Cartão
2 Bases ou mais e Etiquetas Laterais

KAIZEN INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Tirar todos os produtos da caixa, virando a caixa ao contrário.	
3	Etiquetar e colocar na caixa, artigo a artigo.	
4	**Se a caixa não está danificada:** Colocar apenas 1 tira de fita-cola, na abertura.	
	Se a caixa é de exposição e está danificada: Colocar 1 tira de fita-cola, na abertura e 2 tiras de fita-cola na outra direção.	
5	Colocar a caixa no tapete.	

Appendix F: Dry Team Standard, Task 3, two or more layers, bottom surface

Standard Etiquetagem – Caixas de Cartão
2 Bases ou mais e Etiquetas Inferiores

KAIZEN INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Tirar todos os produtos da caixa, virando a caixa ao contrário.	
3	Etiquetar 1 base e colocar dentro da caixa, etiquetar a base seguinte e colocar dentro da caixa, …	
4	**Se a caixa não está danificada:** Colocar apenas 1 tira de fita-cola, na abertura.	
	Se a caixa é de exposição e está danificada: Colocar 1 tira de fita-cola, na abertura e 2 tiras de fita-cola na outra direção.	
5	Colocar a caixa no tapete.	

Appendix G: Dry Team Standard, Task 3, thermo shrink plastic

Standard Etiquetagem- Caixas de Plástico Termo Retráteis

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Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Retirar apenas as embalagens do meio e etiquetar, 1 a 1, conforme se vai retirando, deixando as dos cantos na caixa.	
3	Etiquetar as embalagens dos cantos e voltar a colocar as embalagens do meio dentro da caixa.	
4	Colocar **2 tiras de fita-cola** na direção contrária ao corte. Apenas colocar o **papel das etiquetas** por baixo da fita-cola quando a fita-cola **danifica o produto** ou quando a fita-cola **danifica as próprias etiquetas**.	
5	Colocar a caixa no tapete.	

Appendix H: Dry Team Standard, Task 3, thermo shrink plastic with a cardboard tray

Standard Etiquetagem- Caixas de Plástico Termo Retráteis com Bandeja de Cartão

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Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Tirar as embalagens do meio na direção da janela, etiquetar e colocar na mesa.	
3	Etiquetar as restantes embalagens, 1 a 1, e voltar a colocar na caixa as embalagens que estão na mesa (já etiquetadas no passo 2).	
4	Colocar apenas 1 tira de fita-cola. Se **1 tira de fita-cola** não garantir a estabilidade, colocar mais fita-cola.	 
5	Colocar a caixa no tapete.	

Appendix I: Dry Team Standard, Task 4

Appendix J: Fresh and Frozen Team Standard, Task 1

Standard Desfazer

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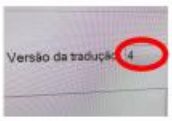
Tipo de Caixa	Fotografia/ Descrição
Cartão Fechada com Fita Cola	**Cortar as faces superiores/laterais e cortar no meio com o x-ato** 
Cartão Fechada com Cola	**Abrir as faces superiores com as mãos** 
Plástico Retratilizado nos Frescos	**Cortar o plástico em janela** 
➢ Cartão Aberta ➢ Plástico Retratilizado nos Congelados ➢ Vitafilme	**Não é necessário cortar nem abrir a caixa** Vitafilme  Caixa aberta  Plástico Retratilizado Congelados 

Appendix K: Fresh and Frozen Team Standard, Task 1 and 2, 1 operator

Standard Impressão Etiquetas
1 Operadora

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar **1 unidade da caixa já desfeita** e picar.	
2	Confirmar a versão da embalagem.	 
3	Imprimir etiquetas.	 
4	Enquanto que as **etiquetas estão a ser impressas**, pegar numa caixa da palete e realizar a operação de **"Desfazer".**	
5	Colocar as etiquetas em cima da caixa, dobrando-as **o mínimo possível.**	
6	Colocar produto no tapete.	

Standard Impressão Etiquetas
1 Operadora

KAIZEN™ INSTITUTE

- Se a **linha estiver CHEIA**, a operadora deve **parar de imprimir** e **começar a ETIQUETAR.**
- Se a caixa tiver menos de **6 unidades e não for necessário virar o material** todo para cima da mesa, então etiquetar na **própria MESA DE IMPRESSÃO**.
- Caso contrário, etiquetar numa **MESA AUXILIAR.**

Linha CHEIA, portanto ETIQUETAR.

Linha VAZIA, continuar a IMPRIMIR.

- As **etiquetas têm de ser dobradas o mínimo possível.** Dobrar apenas o estritamente necessário para que as etiquetas não caiam da caixa.

Etiquetas dobradas apenas o estritamente necessário.

Etiquetas dobradas em excesso.

Appendix L: Fresh and Frozen Team Standard, Task 3, closed cardboard box, one layer of a fresh product

Standard Etiquetagem Frescos
Caixas de Cartão (Fechadas)
1 Base

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Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Retirar o mínimo de unidades possíveis da caixa, etiquetar e pousar na mesa, 1 a 1. Sempre que possível, **evitar tirar da caixa**.	
3	Levantar os produtos, 1 a 1, etiquetar e voltar a colocar na caixa. Sempre que possível, **evitar levantar os produtos**.	
4	Colocar a(s) unidade(s) que estão pousadas na mesa na caixa.	
5	Colocar 2 tiras de fita-cola nas extremidades da caixa.	
6	Colocar a caixa no tapete.	

Appendix M: Fresh and Frozen Team Standard, Task 3, closed cardboard box, two or more layers of a fresh product

Standard Etiquetagem Frescos
Caixas de Cartão (Fechadas)
2 Bases ou mais

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Retirar todos as unidades da caixa, virando a caixa ao contrário.	
3	Etiquetar 1 base, e colocar a mesma na caixa, etiquetar outra e voltar a colocar na caixa, etc…	 
5	Colocar o número **mínimo** de tiras de **fita-cola**, de forma a garantir a estabilidade do produto.	
6	Colocar a caixa no tapete.	

Appendix N: Fresh and Frozen Team Standard, Task 3, open cardboard box, one layer of a fresh product

Standard Etiquetagem Frescos
Caixas de Cartão Bandeja (Abertas)
1 Base

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa. Sempre que possível, **evitar tirar do tapete**.	
2	Etiquetar todos os produtos, de uma só vez.	 
3	Colocar a caixa no tapete.	

Appendix O: Fresh and Frozen Team Standard, Task 3, open cardboard box, two or more layers of a fresh product

Standard Etiquetagem Frescos
Caixas de Cartão Bandeja (Abertas)
2 Bases ou mais

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	 Retirar 1 caixa do tapete
2	**Se for Iogurtes:** Etiquetar a base superior, retirar o mínimo de unidades possíveis da base superior para cima da mesa, etiquetar a base inferior e voltar a colocar os produtos que estão em cima da mesa na caixa.	 Etiquetar a base superior  Retirar o mínimo possível para a mesa Etiquetar a base inferior
	Se não for Iogurtes: Retirar todos as unidades da caixa, virando a caixa ao contrário, etiquetar e voltar a colocar na caixa, base a base.	 Virar a caixa ao contrário  Etiquetar e colocar na caixa, base a base
3	Colocar a caixa no tapete.	

Appendix P: Fresh and Frozen Team Standard, Task 3, wrapped in thermo shrink plastic, fresh product

Standard Etiquetagem Frescos
Plástico Retratilizado

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Retirar apenas as embalagens do meio, etiquetar e pousa-las na mesa, 1 a 1. Deixar as dos cantos.	
3	Etiquetar as embalagens dos cantos e voltar a colocar as do meio dentro da caixa.	 
4	Colocar o número **mínimo** de tiras de **fita-cola**, de forma a garantir a estabilidade do produto.	
5	Colocar a caixa no tapete.	

Appendix Q: Fresh and Frozen Team Standard, Task 3, thermo shrink plastic, frozen pizza

Standard Etiquetagem Congelados
Plástico Retratilizado
Pizzas

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Cortar o retrátil, de um dos lados.	
3	Abrir a janela, para apenas 1 lado.	
4	Etiquetar as pizzas e coloca-las na mesa, 1 a 1, com exceção da última.	
5	Etiquetar a pizza que está no interior do retrátil, não a retirando e depois colocar todas as pizzas na caixa.	
6	Fechar novamente o plástico e colocar 2 tirar de fita-cola na direção contrária ao corte.	
7	Colocar a caixa no tapete.	

Appendix R: Fresh and Frozen Team Standard, Task 3, closed cardboard box, frozen

Standard Etiquetagem Congelados
Caixa de Cartão

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	 Retirar 1 caixa do tapete  Pousar na mesa.
2	Retirar todos as unidades da caixa, virando a caixa ao contrário.	 
3	Pegar em cada embalagem, bater nela para uniformizar o produto (quando é necessário), etiquetar e voltar a colocar os artigos na caixa, 1 a 1.	 Etiquetar  Colocar na caixa
4	Colocar o número mínimo de tirar de fita-cola, de forma a garantir a estabilidade do produto.	 
5	Colocar a caixa no tapete.	 

Appendix S: Fresh and Frozen Team Standard, Task 3, cling film, frozen

Standard Etiquetagem Congelados Viltafilme

KAIZEN™ INSTITUTE

Nº	Descrição Tarefa	Fotografia
1	Retirar 1 caixa do tapete e pousar na mesa.	
2	Desenrolar o vitafilme até à última base.	
3	Retirar todas as unidades da caixa e pousar na mesa, com exceção da última.	
4	Etiquetar a unidade que está por cima do vitafilme.	
5	Etiquetar as unidades que estão em cima da mesa, e colocar no vitafilme, 1 a 1..	
6	Enrolar o vitafilme, apertando-o.	
7	Colocar 1 tira de fita-cola na extremidade do vitafilme.	
8	Colocar a caixa no tapete.	

Appendix T: Fresh and Frozen Team Standard, Task 4

Appendix U: Daily Kaizen Board for the Fresh and Frozen Team