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Improvement of the in-store picking process using lean management: the case of Leroy Merlin

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Master in Management of Services and Technology

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PhD, Teresa Sofia Sardinha Cardoso de Gomes Grilo, Assistant Professor at ISCTE Business School

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BUSINESS
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Department of Marketing, Operations and General Management

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Resumo

Hoje em dia o sucesso das empresas está fortemente ligado com a sua capacidade de serem sustentáveis o que é conseguido através da capacidade de redução de custos garantindo o lucro. Uma forma de redução de custos é através da eliminação de desperdícios, ou seja, atividades que não acrescentam valor para o cliente nem são cruciais para a atividade da empresa.

Como tal, a *Leroy Merlin*, está constantemente à procura de formas de tornar o seu negócio sustentável, garantindo eficácia e eficiência. Para melhorar a sua performance, a empresa identificou que o processo de *picking* em loja apresentava várias ineficiências, em especial na loja de Alfragide. Esta tese desenvolve-se na forma de projeto em colaboração com a empresa, e em especial com a loja, para encontrar formas de melhorar o processo, conseguindo um aumento da produtividade garantido o cumprimento da data de entrega ao cliente. Este projeto baseou-se numa adaptação de uma metodologia de implementação *lean* conjuntamente com a metodologia de investigação-ação.

Através de uma análise estruturada e com o apoio de ferramentas de gestão *lean* (mapeamento do processo e diagrama de causa-efeito) foram identificadas as principais causas de baixa produtividade e por sua vez desenvolvidas ações que visem o aumento da produtividade e/ou qualidade. As melhorias realizadas passaram pela alteração do layout, reestruturação da equipa, criação de um procedimento para os artigos em falta e criação de instruções de trabalho standardizadas. Todas foram testadas, mas apenas 3 destas soluções foram levadas para a frente, resultando num notório aumento da produtividade, a qual passou de 30 para 66.4 linhas/dia/FTE. Foram ainda definidas alguma ações para garantir a sustentabilidade deste projeto ao longo do tempo, permitindo também a expansão destas ações para outras lojas.

Palavras-chave: Investigação-ação; Melhoria de processos; *Picking*; *Picking* em loja; Gestão *Lean*; Ferramentas *Lean*.

Abstract

Nowadays, the success of companies is strongly linked to their ability to be sustainable, which is achieved through the ability to reduce costs while guaranteeing profit. One way of reducing costs is by eliminating waste, i.e. activities that neither add value to the customer nor are crucial to the company's activity.

As such, Leroy Merlin constantly looks for ways to make its business sustainable, guaranteeing effectiveness and efficiency. In order to improve its performance, the company identified that the in-store picking process had several inefficiencies, especially in the Alfragide store. This thesis was developed in the form of a project in collaboration with the company, and especially with the store, to find ways of improving the process, achieving an increase in productivity while ensuring that the customer's delivery date was met. This project was based on adapting a lean implementation methodology with the action research methodology.

Through a structured analysis and with the support of lean management tools (process mapping and cause-effect diagrams), the main causes of low productivity were identified, and actions were developed to increase productivity and/or quality. The improvements included changing the layout, restructuring the team, creating a procedure for missing items and creating standardized work instructions. All were tested, but only 3 of these solutions were taken forward, resulting in a notable increase in productivity, from 30 to 66.4 lines/day/FTE. Several actions were also defined to ensure the sustainability of this project over time, allowing it to be expanded to other stores.

Keywords: Action research; Process improvement; Picking; In-store picking; Lean management; Lean tools.

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Glossary

- APP – Application
- ARC – Action Research Cycle
- BPI - Business process improvement
- BPM - Business Process Management
- BVA - Business Value Add
- CC- Click and Collect
- CVA - Customer Value Add
- FTE - Full time equivalent
- GSB – (Grande superfície de construção) Large stores
- LM – Leroy Merlin
- LMPT - Leroy Merlin Portugal
- MSB – (Média superfície de construção) Medium stores
- PG - Pick&Go
- PROXI – (*Loja de proximidade*) Small/proximity stores
- SKU - Stock-keeping unit
- TL – Team leader
- TPS - Toyota Production System
- VSM - Value Stream Map

1. Introduction

This chapter aims to present and contextualize the topic that will be addressed along this project, briefly explaining the associated topics. This project is developed in the context of the retail sector, more concretely in the Store Logistics of the company Leroy Merlin Portugal (LMPT). This chapter, in addition to presenting the main and specific objectives, describes the topic addressed and introduces the methodology used for its analysis and investigation. The chapter ends with the presentation of the work structure to guide the reader.

1.1. Background

In this very competitive market that we are currently living in, the success of companies is deeply linked to their ability to be sustainable. According to Widodo et al. (2020) achieving a sustainable business depends on the company's ability to reduce its costs while ensuring its profitability. The same author explains that one method for reducing costs, within the Toyota Production System (TPS) philosophy, involves eliminating or reducing superfluous elements, often referred to as waste. Alongside this, there is a continuous pursuit of enhancing effectiveness and efficiency in all business processes. Organisations strive not only to attain their desired results but also to continually improve and introduce new capabilities to differentiate themselves from their competitors (Kock et al., 2008).

Leroy Merlin Portugal, leading company in the DIY market, is no exception and is one of the companies, in the retail sector, that is increasingly giving importance to making its business sustainable by guaranteeing effectiveness and increasing efficiency. In this sector, the quality and the ability to adapt are extremely important characteristics for success due to factors such as customer demand and the intensity of competition (Barroso, 2023). In this highly competitive sector, companies avoid changing their core processes unless they are totally confident that such a change will result in a substantial overall gain for the company (Moghdeb et al., 2011). Instead, they focus on those processes that are complementary and indirectly impact the core of the company.

Aware of the challenges in today's business environment, LMPT is confident that it will establish a resilient and sustainable supply chain within a two-year timeframe, emphasizing that all decisions are aligned with this objective. Several fields play a role in reaching this goal at LMPT, including transportation, inventory and flows, online operations, national logistics, regional platforms, and in-store logistics. The interdependence of these areas is very noticeable when it comes to customer satisfaction, as they are all interconnected to provide the best customer experience. LMPT hopes to create a solid and sustainable culture of continuous improvement in the company. This project is relevant to the company because it is expected to provide benefits for that specific area and the others may also benefit from it since certain improvements can be common.

In this regard, the company had already identified a process with some shortcomings and a significant impact on its performance and customer satisfaction, namely RSS picking hereafter referred to as “in-store picking”. So, the aim of this project will be to improve the productivity of the in-store picking team (hereafter referred to as “team”) by Identifying the problems that compromise the efficiency of this process, focusing on keeping and improving the activities with value added for the customer, reducing the non-value-added but indispensable ones, and eliminating the non-value-added activities also known as waste. This will be achieved through a lean philosophy.

To conclude, this study is of great importance since the methods used in warehouse picking are not suitable when it comes to the in-store picking because of factors such as the layout, the used supports, the presence of customers, among other reasons so it's an area with a lot to explore.

1.2. Objectives

Considering the information presented above, the research question for this project is: “How to increase the productivity of the in-store picking team and guarantee compliance with the customer due date at Leroy Merlin?”

In order to support the response to the primary objective of this project, i.e., the research question, several specific sub objectives were defined:

- Observe and map the current picking process by creating an "as is" representation.
- Characterize the process based on its objectives and performance.
- Identify the root causes of low productivity as well as wasteful activities, along with potential solutions for enhancement within the process.
- Implement the appropriate improvements to then make a comparative evaluation of the productivity.

1.3. Methodology

This study employs a dual-method approach that integrates a Lean implementation framework with the Action Research Cycle (ARC) to address the research question. The methodology is carefully designed to align with the project's objectives and the specific challenges identified within the in-store picking process.

The Lean implementation framework, adapted from the work of Ferreira et al. (2023), serves as the foundational structure for this research. This framework is composed of six sequential steps - Preparation, Awareness, Tools, Actions, Implementation, and Sustainability - each of which is crucial for the systematic reduction of inefficiencies and waste within the process. To enhance the applicability and rigor of the framework, each step is executed through iterative ARC. These cycles

facilitate continuous improvement and ensure that the solutions are both practical and rooted in real-world observations.

Action Research, characterized by its participatory and collaborative nature, is particularly suited to this study, which involves active engagement with the company's employees. This approach not only helps in diagnosing the core issues but also empowers the participants to take ownership of the change process. The ARC used in this study follows the four basic steps proposed by Coghlan & Brannick (2005): Diagnosing, Planning Action, Taking Action, and Evaluating. This cyclical process allows for ongoing refinement and adaptation of the Lean framework, ensuring that each phase is thoroughly explored and optimized before progressing to the next.

By integrating these methodologies, the research aims to develop a robust and sustainable solution that improves the efficiency of the in-store picking process while fostering a culture of continuous improvement within the company.

1.4. Scope

Leroy Merlin's multiformat divides its stores into 3 categories according to their size and number of employees. We can find large stores (GSB), medium stores (MSB) and small/proximity stores (PROXI). All of them are composed of the commercial part and the logistics part, both in terms of infrastructure and human resources, but it is in the GSBs where the greatest volume of work and logistical flows is seen, and it is also in these stores that it is most urgent to improve processes for having a more noticeable impact on the company. Thus, this project will only take place in one GSB store, more precisely the Leroy Merlin (LM) store in Alfragide, which has around 10,000 m2, 289 workers, of which 107 are in the logistics field, including 13 assigned to the in-store picking process (Data from November 2023). This store will act as a pilot-store so that the improvements made, if positive for the company, can then be replicated both to other stores.

1.5. Structure of the document

The In-company projects generally follow a structure that divides them into five parts. This paper will follow a similar structure and it is divided into an introduction, a literature review, the methodology, the case study and finally the conclusion.

The first chapter presents a contextualization of the retail market and the challenges faced in the picking process, from which the research question and specific objectives are defined, followed by a brief explanation of the methodology that will be used and also the scope and structure of the project. The second chapter contains a literature review of the relevant topics to this project in order to provide theoretical support for this project and also to understand which studies and research have already been carried out in the field of the problem at hand. The third chapter refers to the methodology that

will be used in this study and, in turn, how the data will be collected and analysed and how the actions will be implemented and evaluated. The fourth chapter, since it is an in-company project, is presented the case study in which the entire process of measuring, analysing and implementing improvements for the company takes place through the methodology defines, as well as presenting the results obtained. Finally, a conclusion is presented with the aim of answering the research question raised at the beginning, setting out not only the benefits for the company, but also the limitations faced during the development of the work and the study opportunities found that could be the subject of further research.

2. Literature Review

To provide theoretical support to this project, research was done on the topics of business improvement, lean thinking and order picking, presenting those concepts and the studies carried out so far. The literature review was partly based on several books related to the area of management, logistics and continuous improvement and in research articles available in multiple database platforms. The search for articles relevant to the topic was carried out on the research platforms B-ON, Emerald, EBSCO and Research gate with a greater emphasis on articles published from 2000 to the present date (not excluding previous articles when considered relevant) and English written. It was also considered whether the articles had been peer-reviewed and their quality through the SCImago Journal & Country Rank platform. The main keywords used to filter the research were business process management (BPM), business process improvement (BPI), lean thinking, lean manufacturing, waste, lean tools, lean supply chain; order picking and in-store picking.

2.1. Business Process Management

The term “Business Process Management” suggests the rise of a more integrated and holistic method for implementing process adjustments, incorporating the most effective elements from process management, redesign, improvement, and automation (Harmon, 2014).

2.1.1. Business Process Management VS Business Process Change

Business Process Management and Business Process Change are related concepts that focus on improving and optimizing business processes. These two concepts meet in the fact that they both convey the idea of an action to be taken in the business environment, however, they refer to different aspects of this process improvement journey as explained below.

The **Business Process Management**, from a business administration point of view, intends to increase customers satisfaction, reduce operational costs and establish new products and services at low cost (Weske, 2007). It has emerged from a wide range of different ideas and patterns, one could easily argue that the term "business process management" was conceived to suggest the emergence of a more complete approach to process transformations, combining process management, redesign, improvement and automation (Harmon, 2014). Therefore, it may involve both incremental improvements (process change) and large-scale process reengineering. This approach facilitates process improvement and, at the same time, contributes to the optimisation of the organisational outcomes.

Related to this topic, it is important to highlight the concept of BPM groups, usually owned by the more experienced companies with the purpose to consider all possible process change initiatives, to prioritize interventions, to coordinate efforts, and to document results (Harmon, 2014). These groups

serve as platforms for knowledge sharing, networking, and collaboration, allowing members to exchange insights, experiences, best practices, and innovations related to BPM.

The **Business Process Change**, according to Harmon (2014), refers to the intentional modification of business processes within an organisation to achieve specific goals, improve efficiency, enhance effectiveness, or adapt to changing business environments. It involves identifying areas where processes are inefficient, ineffective, or outdated and then implementing changes to improve them.

Nowadays, it is possible to perceive that organisations are committed to make changes to maintain and increase their business attractiveness and to gain competitive advantage over their competitors. It is fostered by the emergence of new technologies, which make organisations rapidly realize that they could only make changes if they speed up the search for innovation and if they gamble in understanding how processes are performed and how they can be improved (Harmon, 2014).

This way it is crucial to analyse and control the processes on a regular basis in order to identify any issues or need for improvement that may be not allowing the company to have a better performance. Facing a situation like this, is relevant to develop appropriate actions that intend to redefine or improve the processes. This adjustment is also important to be conducted in an external perspective, since it is vital to adapt to market requirements and its current changes, to get market position and competitive advantage as mentioned before (Adesola & Baines, n.d.; Yousfi et al., 2019).

Bearing in mind the above mentioned, nowadays there are different approaches that we can take to improve the performance of a company's business processes. The choice of method depends on the organisation's goals and the nature of the business. Harmon (2014) highlighted some of them, namely process redesign, process automation and process improvement.

2.1.2. Process Redesign

Mansar & Reijers, in their paper published in 2007, make a clear distinction between process redesign and process reengineering as they are often confused terms. The author explains that process redesign has a narrower scope, i.e., how to manage a process considering its specific tasks, while process reengineering, in a broader sense, refers to all the aspects inherent in restructuring a process within an organisation. However, as the author says, this distinction ends up having a more academic purpose because, in practice, there is no great limitation to the use of these terms. In this sense, and as addressed by Harmon (2014), in this project process redesign is the whole act of redesigning a process, whether it involves its adjacent tasks or whether this redesign has a greater impact on the organisation.

Through an extensive analysis of every aspect of the process, this approach usually results in changes in the sequence performed until the time of change, alterations in job positions, or change in job descriptions, and usually ends up with the introduction of automation (Harmon, 2014; Mansar & Reijers, 2007). As pointed out by Vanwersch et al. (2016), the redesign of business processes has

positive impacts related to the reduction in process time and costs, as well as improvements in customer satisfaction. This work can be performed either by professionals inside the company or external ones, but the goal is always to improve the performance.

2.1.3. Process Automation

The Process automation that can be, or not, used jointly with Process Redesign or Process Improvement is designed to automate a specific process or activity. As in the process redesign it can be performed by internal or external professionals. This approach refers to the "use of computers and software applications to assist employees or to replace employees in the performance of a business process"(Harmon, 2014, p. 23). The automation process allows the process to use fewer resources, which makes it less costly and more efficient. Although the introduction of automation can entail a high cost (purchase, development, implementation, training, and maintenance) for the company at the time of its introduction, this cost is generally offset by productivity gains and an increase in the number of outputs that are produced, ceteris paribus, the time variable. It can also lead to higher quality and reduced variability and biases in the process. Nevertheless, a pain point stated by Mansar & Reijers (2007) is that when a system performs a task, it is less flexible in handling variations when they occur than humans.

2.1.4. Process improvement

The Process improvement is focused on the incremental improvement of the more complex existing processes in the company. Usually linked to more minor and specific changes in the process, it is under the responsibility of the managers (or, occasionally, everyone else) in charge of that process (Harmon, 2014). It is a systematic approach that organisations use to enhance their existing processes, workflows, and operations to achieve better efficiency, effectiveness, quality, and overall performance. Process improvement has been studied more and more over the last few years, especially since it became clear that there was a lack of a structured step-by-step approach and associated guidelines to guide the successful implementation process (Adesola & Baines, 2005). Facing this issue, the Business Process Improvement arose as a well-established methodology and one of the most renowned approaches that support organisations in improving processes in a continuous and structured way (Kashfi & Aliee, 2020; Widodo et al., 2020).

2.2. Business Process Improvement

Even though the term BPI does not have a universally accepted definition, it was initially defined in 1997 by Harington as "a methodology that is designed to bring step-function improvements in administrative and support processes using approaches such as process benchmarking, process redesign, and process re-engineering" (Adesola & Baines, 2005, p. 2) this being the most used

definition. Since its origin, this concept has been pursued consciously or unconsciously by business owners and/or managers, as stated by Yousfi et al. (2019). He also defined this concept as “any process-based changes, minor or major, to move from as-is process to its to-be version” (p. 14:3).

But the main question is “Why should we improve a business process?”. The answer is given by Yousfi et al. (2019) when pointed out at least four reasons: (1) Processes are designed by humans and since humans are not perfect, the processes will not be able to reach that state either. (2) Organisations have a natural tendency to improve organically over time. However, if they fail to embrace improvement, their processes will fall behind the competition, leading to a gradual decline in performance. (3) The market is constantly changing from the entrance of new competitors to changing customer preferences. (4) Regardless of the economic environment, organisations seek BPI either for positive or negative reasons (To respond to an expansion or to seek a better performance). Given this, it is easy to understand that BPI can be used as a prevention (trying to foresee the moves) or coping instrument (in response to a changing business environment).

Therefore, several approaches have been developed for implementing BPI, such as simulation, optimization, Lean, Six Sigma and, Lean Six Sigma.

2.2.1. Simulation

Simulation is applied in the context of BPM to improve effectiveness and efficiency. This approach improves the process performance by analysing and optimizing the company’s processes and detecting defects to make better decisions for the improving process (Mehdouani et al., 2019).

Simulation is a method used to evaluate the performance of business processes under specific conditions or scenarios. It involves testing the performance by adjusting certain parameters to compare current and future processes. Simulation tools can analyse the efficiency of process flows and help anticipate and solve problems that may arise in the future. Simulation results indicate the optimal number of resources necessary to enhance the performance characteristics of the business process (Somphanpae & Boonsiri, 2016; Vuksic et al., 2018).

2.2.2. Optimization

Optimization is another approach used within the concept of BPI. It is described as the way to find “the best possible solution to a problem given a set of limitations (or constraints)” (Coello Coello, 2006, p. 29). Business process optimization involves designing practical and effective process conceptions incorporating optimal attribute values, such as duration and cost. The viability of a process design depends on satisfying the process requirements (involving essential input resources and expected output resources) and establishing connectivity between the activities within the process design through the respective input and output resources (Vergidis et al., 2012). The choice of technique to

use, from among the various techniques known to date, is based on the nature of the problem in question. Generally, this choice is simple and straightforward, but there may be situations in which there is a conflict of criteria, i.e., optimization in relation to a certain criterion may jeopardize the result with emphasis on another criterion (Rao, 2009).

2.2.3. Lean

Considering the definition of BPI stated by Harrington - "BPI is an approach to increase the effectiveness and efficiency of business processes that provide output to internal and external customers" - it is indeed relevant to consider lean as a key philosophy within BPI studies (Curatolo et al., 2014), especially when considering the goals of reducing waste and increasing efficiency (Widodo et al., 2020).

First and foremost, the term "Lean production" was first coined by Krafcik (1988) and is characterized by very low inventory levels to save costs and to quickly detect and solve quality problems. Although the lean production management policy holds higher risks, i.e., a small disruption can stop the whole production, the return is particularly significant (Krafcik, 1988). Lean production is an alternative to the traditional large-scale production system. It focuses on eliminating waste (or *Muda* in Japanese) and on continuous improvement with high employee involvement (Curatolo et al., 2014). Several authors and academies define Lean in different ways. We can summarize those ideas as "an integrated multi-dimensional approach encompassing a wide variety of management practices based on the philosophy of eliminating waste through continuous improvement" (Gupta et al., 2016, p. 1026), but one that is particularly relevant to highlight is the one provided by Comm and Mathaisel that describes Lean as a way to do more with less (Gupta et al., 2016). Besides, Gupta et al. (2016) point out that lean must not be seen only as a toolbox but as a philosophy and a way of thinking, and this one is the most common mistake companies make when applying the Lean approach.

2.2.4. Six Sigma

Another approach to process improvement is Six Sigma. Six Sigma was created by W. Edwards Deming and Joseph M. Juran In the mid-1980s, and it is an initiative that aims to make the entire workforce aware of the value of process improvement and provides the organisational structure to support a continuous improvement effort (Harmon, 2014).

Harmon (2014) states that Six Sigma is characterised by a range of statistical techniques managers use to measure and make potential changes to a process to improve its performance. In order to achieve better results, the managers must involve the workers in the process of analysis since the process improvement focuses on teams and not on individual efforts. As per Bendell (2005), this strategic approach, through variation reduction, will reduce costs, increase customer satisfaction, improve quality, and generate benefits to operational and financial performance.

With excellence as an underlying philosophy (Fairbanks, 2007), this approach usually follows the lifecycle of a Six Sigma project, comprising five phases, denominated as the DMAIC cycle: Define, Measure, Analyse, Improve and Control. Explaining this procedure in more detail, we start by clearly outlining the issue at hand and defining project objectives, followed by collecting and evaluating data to understand the current process performance. Then, the data must be closely analysed to identify the underlying root causes of the problem. The improvement stage is characterised by developing potential solutions and testing their viability to finally enter the stage of controlling through mechanisms and monitoring the long-term process performance. This cycle ensures the detection and correction of any deviations, ensuring continuous improvement.

2.2.5. Lean Six Sigma

The Lean Six Sigma (LSS) is a process improvement approach combining Lean manufacturing principles and Six Sigma methods. The integration of Lean and Six Sigma leads to reductions in waste, decrease in process variability and errors, elimination of rework time, increase in productivity and flexibility and, as a result, a reduction of inventory levels between workstations (Bendell, 2005; Chen et al., 2010).

This holistic approach to process improvement is needed to improve performance as measured by quality, cost, delivery, and customer satisfaction (Snee, 2010). Additionally, Snee (2010) states that LSS is a business strategy and methodology that increases process performance and improves bottom-line results and is also an effective leadership development tool. The most common benefit that businesses aim to achieve when applying this approach is the incrementation in the quality of the products. When the cultural paradigm of lean is aligned with the data research of Six Sigma, an environment is created that is conducive to genuine and sustainable BPI in organisations (Pepper & Spedding, 2010).

Having presented the methods most frequently used in process improvement, it is easy to distinguish their main applications and differences and decide which is most suitable for the problem. This project does not aim to act on process variation or quality excellence. Instead, it aims to identify the main areas of waste and, consequently, activities that do not add value for the customer, to act on them and improve the efficiency and effectiveness of the process, reducing waste, lead time and human resources. Additionally, as explained by Leroy Merlin's supply chain leader, the company's goal is to create a solid and sustainable continuous improvement culture that allows them to be more objective, concrete and helping to build a more compelling value proposition for the customer. Considering this, the most appropriate approach for the case under study is Lean, which will be explored below.

2.3. Lean

2.3.1. Definition and contextualization

Lean was first conceived to be a set of principles, shortly after was converted as a manufacturing strategy and later, emerged as a manufacturing philosophy. However, one thing is clear, the primary focus of this philosophy is to reduce waste activities to enhance customer value and become more competitive (Jasti & Sharma, 2015). This increasingly popular philosophy, created by Taiichi Ohno and Eiji Toyoda, was developed in Japan by the Toyota Motor Corporation in 1950 as a set of management techniques and practices that define the company's production system (Jasti & Sharma, 2015).

The concept of Lean was better explained through the introduction of the five Lean Principles by Womack and Jones in 1996 in a book called Lean Thinking. According to Bakke & Johansen (2019), the principles are value, value stream, flow, pull, and perfection. The principles are respectively related to the identification of the value perceived by the customer; the identification of the value stream (all the actions needed to bring a product to the customer) and consequent elimination of waste; the achievement of an optimized flow through the process; pacing by a pull (or kanban) signal (systems where production depends on customer demand); and the continuous pursuit of perfection (Bendell, 2005; Curatolo et al., 2014).

The fast-changing market is pushing companies to reduce or eliminate waste to increase their efficiency, which brings out products with lower costs, better quality and less lead time (George, 2002). Due to the implementation of Lean manufacturing principles, many industries worldwide have cut down the cost of their product in the manufacturing phase and have raised profits (Anand & Kodali, 2008). However, the benefits are not only quantitative, there are also qualitative benefits since it improves the value delivered to the customer, increasing customer satisfaction.

2.3.2. Waste

Since the Lean philosophy is directly related to the identification and elimination of waste, it is important to understand the definition of this concept and the existing types. According to Russell and Taylor, Waste is an activity that does not provide additional value to the final customer (as cited in Jasti & Sharma (2015). With the introduction of the TPS, Ohno identified seven types of waste: transport, inventory, motion, waiting, overproduction, overprocessing, and defects.

Harmon (2014) stated that the identification of non-value activities could be tricky because there is a difference between activities that do not add value to the customer since some are perfectly dispensable (Waste) and others are required to keep the company functioning, are legally imposed or are necessarily to support Customer Value Add (CVA) activities (Business Value Add (BVA) - (e.g., tax-paying process)). The same author explained the types of waste as shown in the Table 2.1.

TYPE OF WASTE	DEFINITION
Transportation	Refers to the unnecessary movement of materials. Ideally, a WIP should pass from one workstation to another, without being stacked, stored, or handled by anyone not directly involved in adding value to the work-in-progress.
Inventory	Refers to any excess inventory that is not directly required for current customer orders. It includes both excess of raw materials and excess finished goods. Excess inventory might also include marketing materials that are created but never mailed or parts that are stocked but never used.
Motion	Refers to any extra steps taken by employees when they perform a task. It refers to employees who must move to access tools or a telephone, and it refers to an employee who must walk to another area to pick up items that he or she needs to process.
Waiting Time	Also known as queuing. Refers to periods of inactivity that result when an upstream process does not deliver an adequate supply of a required input on time. Often, as a result, the affected process then proceeds to do non–value-adding work or is engaged in overproduction of some alternative output.
Overproduction	Occurs when a process continues to generate outputs after it should have stopped. This occurs because the process does not rely on a Just-In-Time schedule or because it does not get feedback from an upstream process to stop production.
Overprocessing	Refers to any extra operations, any rework, or any movement of work to storage. It also includes situations in which the customer is asked the same question twice because, although the information was obtained and recorded once, it is unavailable to the second worker.
Defects	Refers to any output that is unacceptable to the downstream process or the customer. Similarly, it can refer to situations in which incorrect information is entered on forms. All rework is waste.

Table 2.1: Description of the 7 types of waste according to Harmon (2014).

In addition to these seven wastes, Bakke & Johansen (2019) presented another category of waste, namely “skills misuse”, which refers to the incorrect allocation of people to tasks which results in poor exploitation of talents and abilities and low employee motivation and difficulty in career progression.

2.4. Lean and Picking

In Leroy Merlin's business, the in-store picking process is an integral part of its supply chain. The following sections explore the use of lean within studies focused on supply chain and picking in general, as well as in-store picking in particular (given that this is the focus of this project).

2.4.1. Lean in Supply Chain

A supply chain (also called logistic network) is a system that interconnects people, resources, information, and activities to move a product or service from the supplier to the customer (R. K. Singh & Sharma, 2014). To ensure the sustainability of this network, the concept of supply chain management emerged. Singh & Sharma (2014) describe this concept as “a set of approaches and practices to effectively integrate suppliers, manufacturers, distributors, and customers for improving the long-term performance of the individual firms” (p. 524).

A study carried out in 2019 by Moyano-Fuentes, Bruque-Camara, and Maqueira-Marin shows that one of the main challenges companies face when starting lean initiatives within the supply chain is achieving better integration with their main suppliers and customers (Reyes et al., 2023). This is where the concept of a lean supply chain comes in. It is described by Reyes et al. (2023) “as a set of organisations that are directly linked by upstream and downstream flows of products, services, finance and information, which work collaboratively to reduce costs and waste by efficiently and effectively extracting what is required to meet individual customers’ needs” (p. 1209).

2.4.2. Order Picking

Current market trends caused by e-commerce and globalisation that lead to increased customer expectations force warehouses to handle a large number of orders in short periods of time. This puts enormous pressure on withdrawing products from the warehouse to fulfil customer orders, or in other words, "order picking" (Vanheusden et al., 2022). Most commonly, these orders are placed online to be picked up in-store, as discussed in the papers carried out by Hovelaque et al. (2007); MacCarthy et al. (2019); Pietri et al. (2021) and Vazquez-Noguerol et al. (2022). However, in addition to online orders (“click and collect”), this project also covers the picking of in-store purchases that generate a stock reserve as they will be picked up by the customer at the store later ("reserve and collect") and purchases made both online and offline where the stock resides in the store and home delivery is associated ("ship from store").

The definition presented above is better clarified by Koster et al. (2007), who explained that order picking encompasses the activities of organizing and arranging customer orders, allocating warehouse inventory to specific order lines, authorizing orders for execution, retrieving items from designated storage areas, and handling the selected items. Customer orders comprise individual order lines, each representing a product or stock-keeping unit (SKU) in a specified quantity. This is the most labour-intensive (80% of warehouses in Western Europe are manually operated) function and, therefore, the most expensive (holds 55% of all the operating costs) (Koster et al., 2007; Tompkins et al., 2010).

As picking is one of the activities with the highest costs for the company, it is considered one of the top priorities for increasing productivity and consequently reducing costs (Purba et al., 2018). According to Gattorna (1997) there are a variety of factors that mainly affect the efficiency of picking, such as the location of the products, the layout of the warehouse, the customer demand, the method used and the experience of the employees (Marcoulaki et al., 2005). Productivity can be measured in various ways, but the time for picking is a standard measure. It can be divided into the time to travel (from the starting point, the different locations, and the finishing point) (according to Tompkins et al. (2010), it is around 50% of the total time), the time for picking (pick up all the items needed from each location), and the remaining time (Purba et al., 2018). This remaining time can involve assembling the

pallets for shipment, preparing the trolleys to start picking, or even placing the items in the shopping bags. These factors directly or indirectly impact the process's efficiency or the service's quality. Due to their relevance, more and more studies on the subject are starting to emerge, such as the article by Pietri et al. (2021), which describes a mathematical model that guides employees on how to organize the items in the shopping bags while picking is purposed.

Looking at these concepts from a lean perspective, this remaining time, in other words, all the time used for something other than picking the item and travelling to and from its location, is a waste and does not add value for the customer. However, travelling can also be considered waste when it is excessive and unnecessary (Bartholdi & Hackman, 2019). The picking process is full of wastes that have a huge impact on its efficiency. With a lean approach, it will be possible to analyse those wastes, eliminating or reducing them in order to improve the process and make it more productive.

Order picking in warehouses is a well-examined topic supported by many case studies, scientific articles and conferences (Pietri et al., 2021). Indeed, doing a quick search for scientific articles, peer-reviewed, that contain "Order Picking" in their title, it is possible to come across 5851 scientific articles published up to December 2023. This body of research includes investigation into picking routes, storage policies, batch allocation, among others. However, as explained by Pietri et al. (2021), the methods used in warehouses are unsuitable for in-store picking. The author also pointed some reasons for this, such as the defined layout and the difficulty of changing it, the supports used for transportation (that may not be suitable for the item type or to be carried around the store), the radio frequency tool for item validation and the presence of customers along the way, which cause frequent interruptions (this last topic was addressed by Neves-Moreira & Amorim (2024) when they proposed a hybrid solution approach to reduce the customer encounters with the pickers). Those considerations are further supported by Filipe et al. (2017), who states that when designing the layout of a store, the factors under consideration are the ones that follow the premise of increasing profits and ensuring customer satisfaction (variety, visibility and strategic position), rather than the ones with high influence on picking productivity. When faced with these factors, Seghezzi et al. (2022) proposed a solution that consisted of creating a reserved area containing stock of the most likely products to be ordered online. This solution generated time benefits as the main constraints encountered when picking in the store were removed. Therefore, in order to achieve success and overcome the challenges faced due to the fact that this process is carried out in a store environment, it is necessary to pay attention to some factors such as the waves for picking, the batch of orders, the number of workers needed, the ideal working hours, among others. Some of these are addressed by Difrancesco et al. (2021), who presents a model to determine the optimal time for batching orders and then start the picking and the delivery, and the most suitable number of workers to increase the service level by having a two-hour delivery ship-from-store.

2.4.3. Picking and Lean

From the brief analysis done in the last section, two aspects stand out: The importance of applying a lean philosophy in the picking process and the in-store picking process being poorly developed and studied so far. Given this, research was done through the platform "B-on" on "Picking and Lean". The criteria used to obtain coherent and study relevant articles consisted of being peer-reviewed, in English, with full text being available and an expander that allows the term to be searched in the full text of the articles was applied. This research led us to a range of 40 papers, of which, after reading their abstracts, only 11 are concerned with applying lean concepts or tools in a picking activity (either order picking or picking of components to production). The remaining articles were excluded because they did not apply Lean, or because the reference to picking was somewhat abstract. In the 11 articles analysed, the topic that stands out is the use of the Value Stream Map (VSM) to analyse the process before and after identifying problems and applying improvements, which was found in 6 of the articles (Wang et al. (2022a); Vanwersch et al. (2016); Andrejić et al. (2021); Raghuram & Arjunan (2022); Pacheco et al. (2023) and Baby et al. (2018)). In the remaining articles, the following topics were found:

- Implementation of improvements to reduce waste of time, overproduction, waiting, movement and also the lack of standardisation (ÇETİN et al., 2022; Guimarães et al., 2022);
- Application of improvements to standardize supply, eliminate picking cart delays, manage materials in supermarket boxes, and enhance control and efficiency in the picking process with kanban for better oversight of valuable materials. (Mourato et al., 2020);
- Redesign of three workstations on an assembly line, reducing the space required for materials and the walking distance and decreasing non-value adding work (Finnsgård et al., 2011);
- Implementation of LSS using tools such as Cause-and-Effect Diagram, 5Whys, Spaghetti Diagram, Flow Process Analysis, and Action Plan (KAMIŃSKA, 2021);

Something common to these articles is the use of lean tools. These tools are applied with the aim of identifying and eliminating waste, leading to more efficient resource utilization and cost reduction. However, these tools have been used in lean applications in a broad way for the concept of picking. For this project, it is relevant to consider which lean tools make sense to apply in an in-store picking context. In the literature, there are several tools that can be used within the framework of lean methodology that have already been discussed by the authors Bicheno & Holweg (2016), Purushothaman et al. (2020) and Tayal & Kalsi (2020). Among the various existing tools, those considered suitable for implementation in the context of LM in-store picking have been explored:

Flowchart

It is common in lean manufacturing to come across the VSM. This type of diagram describes the tasks carried out at various points in the process, giving visibility of workstations, warehouses, suppliers,

information, waiting areas, inventory, and so on (Kemper et al., 2010). However, this tool is more suitable for manufacturing or when working with a complex process with several stakeholders. In the specific case of this project, the scope is the improvement of a single process influenced by a single team, so instead of the VSM, it is more appropriate to use a simpler but more precise tool, the flowchart. This traditional diagram allows the visualization of all the stages of a process, including the associated decision points. It does not provide quantitative information and uses special shapes to represent different types of actions or steps in a process (Kemper et al., 2010).

Cause-effect Diagram

Also known as the fishbone diagram or Ishikawa diagram, it is distinguished by bringing out many causes for a specific problem (Tayal & Singh Kalsi, 2020). Pragmatically speaking, it consists of exploring the various branches that can be the cause of a problem and analysing the causes of each branch in turn, making possible the determination of the root causes of the problem and the design of an action plan to fix them. To obtain the root cause, the 5 whys technique is used, which consists of consecutively questioning the reason for the causes until the root cause is obtained. The root causes are those which give rise to all subsequent problems, and which can actually be changed in order to act on the problem.

Spaghetti Diagram

Allows a clear visualisation of the movement of workers or materials through the production area (Santos et al., 2023). It consists of drawing lines between the various production points so that each line represents a movement made. As explained by Santos et al. (2023), the more movements made between the same places, the wider the line, demonstrating the inefficiency of the selected layout. The spaghetti diagram is essentially useful for analysing small production areas and the impact of layout changes (Daneshjo et al., 2021).

5S

5S is a vital approach, where the outcome is the reduction of production losses and improvement in quality and safety. As the name suggests, it is characterized by five words that begin with the letter “s” in Japanese (Tayal & Singh Kalsi, 2020). When a company has problems with tracking, inconsistency, recognition, space and hygiene, this tool should be applied to guarantee organisation (Seiri), uniformity (Seiton), cleanliness (Seizo), standardization (Seiketsu) and sustainability (Shitsuke). Going into more detail, Seiri refers to sorting the elements used in the process, removing completely unnecessary items from the workplace, and storing items rarely used in a place outside the work area. Seiton stands for "A place for everything and everything in its place" (Gupta & Jain, 2015). This organisation is attained through labelling, colour coding, homogeneity, delimiting areas, etc. Seiso is related to the cleanliness of the space, providing a safe and secure place for work and motivating the employees. Seiketsu is concerned with the execution of the work, always in the exact same way

ensuring a high standard of workplace organisation. Lastly, Shitsuke is the discipline in the process and consistency of the method applied (Gupta & Jain, 2015; Tayal & Singh Kalsi, 2020).

Kanban

As explained by B. Singh & Sharma (2009), "Kanban" is a Japanese word that means card and is used to reduce inventory, avoid overproduction and overprocessing. These cards can contain symbols or words and are used to schedule and manage the flow of the products (Harmon, 2014). Regardless of the format, the aim is to allow visual monitoring of the production flow.

Visual Management

As explained by Parry & Turner (2006), visual management was developed with the aim of facilitating communication to help drive operations and processes in real-time through simple visual instruments containing core information of the process. Bilalis et al. (2002) stated that usually, the information available is not the problem but the communication of that information. The same author points out some of the best visual aids such as graphical representations, pictures, posters, schematics, symbols, transparencies, and colour coding. Every person involved must fully understand all the information.

Standard work

It refers to the documented and consistently followed set of best practices, procedures, and methods that represent the most efficient and effective way to complete a particular task or process, preventing workers from performing other tasks that are not foreseen in their work plan, leading to a loss of time and focus on their work (Realyvásquez-Vargas et al., 2019). This tool facilitates the consistent, timely, and repeatable execution of processes, aiming to reduce variability and enhance throughput between workstations, as stated in Lu & Yang (2015) study.

2.5. Conclusion

Through the literature review performed in this chapter, it was found that no work has been done so far on the in-store picking process with a focus on continuous improvement, more precisely with the application of a lean management framework. The application of lean tools to reduce waste and make the business more competitive makes great sense when it comes to in-store picking, as it is a task performed by humans, which means higher costs and risk of errors. Several studies have been carried out on both in-store picking and the application of lean tools in order picking, but none aims to increase the productivity of the in-store picking process using lean management tools so far. Due to this gap, this project has the potential to contribute to the literature. For this contribution, some of the lean tools presented above will be used to analyse the process, to find and reduce waste and to introduce this philosophy to the picking team.

3. Methodology

This chapter presents the methodology adopted to investigate the research question, describing the procedures used and justifying the methodological choices. This methodology combines a lean implementation framework with Action Research cycles. Additionally, the data analysis structure is outlined, along with the details of the different phases of the study.

3.1. Lean implementation framework

One of the studies presented in the literature that guides the implementation of a lean methodology in real-life cases is the one performed by Ferreira et al. (2023) where a framework is developed and implemented to apply lean principles to the product development process. This framework, composed of six steps, allowed to obtain gains in efficiency of the process in study and a decrease of 20% in wasteful activities.

This framework was developed due to the difficulty of applying more systematic approaches and identifying waste on intangible tasks. This difficulty was perceived because product development is an activity with several challenges, such as high variability and the fact that it is based on a flow of information rather than materials. The in-store picking process comprises a flow of materials but also a large flow of information in the opposite direction, and variability, which is a very impactful characteristic of the process. As such, this project will be developed through an adaptation of the framework presented by Ferreira et al. (2023) since it will be built on the same six steps proposed by the author, although the development of each of these steps is done through action research. This will also demonstrate the framework's viability in other areas, specifically in the in-store picking process. The framework is made up of six steps such as preparation, awareness, tools, actions, implementation, and sustainability. This project will then apply these six steps through ARC.

3.2. Action research methodology

Action research is an approach to research that aims both to act and create knowledge or theory about action (Coughlan & Coghlan, 2002). It tries to understand the problems (research) and then provides an explanation through practice (action). Furthermore, it foresees a participative and collaborative approach with the aim of developing solutions to an organisation's challenges in real-life cases (Erro-Garcés & Alfaro-Tanco, 2020; Saunders et al., 2019). For these reasons, and as already mentioned in the introduction, this methodology will be used in the project as it aims to address a real problem in the company, specifically the low productivity of picking. In order to take action on this problem, the participation and collaboration of the team carrying out this job throughout the project is essential.

In the words of Shani & Pasmore (1985), “action research may be defined as an emergent inquiry process in which behavioural science knowledge is integrated with existing organisational problems”

(p.208). It is committed to bringing about change in organisations, empowering employees to deal with problems and embedding scientific knowledge. Some of the features mentioned by this author are natural setting, collaboration, mutual education, and system development. A particular characteristic presented by Saunders et al. (2019) is that although it starts within a particular context and guided by a defined research question, its emergent and iterative nature can change the focus of the question as the study progresses.

This research method stands out for its cooperative approach since the members of the process under study have an active participation in the cyclical process. This participation ranges from collecting data directly from people, including them in brainstorming sessions and actively listening to their opinions on the process, to their participation in implementing the defined changes and subsequently receiving feedback (Coghlan & Brannick, 2005). By having the company participate in the study, it is possible to obtain more accurate information, making the study more valuable and authentic for the company that decides to carry out the project (Erro-Garcés & Alfaro-Tanco, 2020).

A characteristic of action research is that it is continuously developed based on cycles as a sequence of events. The literature does not limit how the cycle is designed or developed, but all studies centre on the same idea, regardless of the number of phases included. The ARC is presented in the literature by many authors in a variety of ways. However, for this in-company project, we will follow the one presented by Coghlan & Brannick (2005), only considering the 4 basic steps: Diagnosing, planning action, taking action, and evaluating. The framework presented by this author was chosen for its simplicity, ease of use and suitability to LM. Below is a brief explanation of each of the phases.

- **Diagnosing:** Establish a clear understanding of the problem at hand, collecting and analysing data to identify relevant patterns, trends, and insights as well as interpretation, discussion, and hypothesis formulation, serving as a basis for action planning. The repetition of cycles usually leads to new formulations of the diagnosis, and for this the rationale and evidence that led to the reformulation must be clearly presented.
- **Planning action**: With the setting of objectives and identification of strategies, the action plan is developed, taking into account stakeholders' involvement, risk mitigation, and flexibility and adaptation. This process entails translating insights from the diagnosis phase into concrete plans for addressing the identified problem or issue.
- **Taking action**: It is the phase where the plans developed during the previous phase, are implemented, and interventions are made. It's highly possible that unexpected challenges will arise so it is important to remain flexible and responsive as well as keep thorough records of the implementation process. It is about putting plans into motion.

- **Evaluating**: It is crucial for assessing the impact of the action research process and determining the extent to which the objectives have been achieved. It provides an opportunity for reflection, learning, and continuous improvement, helping to inform future iterations of the ARC.

3.3. Methodology structure

As previously mentioned, the methodology used in this project is an adapted version of the framework proposed by Ferreira et al. (2023), integrated with the action research methodology, specifically the ARC proposed by Coghlan & Brannick (2005). Figure 3.1 provides a visually supported understanding of the structure proposed used. This integration ensures an iterative approach, as ARC will be used to develop each step in the framework. One or more cycles were carried out within each step, ensuring it is complete before moving on. The different cycles within a step can correspond to the application of different tools. Throughout the project, a mixed method approach is used, i.e. the methods (quantitative or qualitative) of data collection and analysis depend on the type of problem.

3.3.1. Preparation

In the first step, as the name suggests, preparation is made to begin the study. This is done by identifying points for improvement, collecting quantitative data on productivity and carrying out some direct observation to understand the process, analyse the time spent and identify any inefficiencies. This is followed by a presentation to the project team, explaining their role over the coming months.

3.3.2. Awareness

In the second step, the goal is introducing the lean concepts to the team and create commitment to the project. For that, a training session must be held, created and delivered by the researcher together with the company. Then, some brainstorming sessions and in-depth interviews must be carried out, giving the workers the opportunity to express their feelings and beliefs about the work done also contributing to the creation of daily huddles.

3.3.3. Tools

In the Tools step, there is the greatest concentration on collecting and analysing data to pave the way for improvements. To build the process mapping, representing the “as is”, direct observation must be carried out along with semi-structured interviews with employees asking the questions below.

- On a typical day, how do you start your work? What is the sequence of tasks required for picking?
- How are priorities set at times of peak workflow?
- How do you proceed when there is a shortage of material or when other factors make the job impossible?
- When do you consider your work to be finished? What are the last steps of your task?

With the process mapped, is made an analysis at this stage to identify where the main waste and non-value-added activities are, using qualitative and quantitative methods. To understand the existing causes, a cause-effect diagram should be constructed using the 5 Whys technique in a brainstorming session with the in-store picking operators (hereafter referred to as “operators”). Then, as the number of causes found was quite large, a multi-voting session was held to narrow down the causes to be addressed in the following phases. Each of these results must always be validated directly with the logistics managers.

3.3.4. Actions

In this step, with the opportunities for improvement found in the previous phase, ideas for improving the process are developed, i.e. actions to be implemented. At this stage, some quantitative data will be also collected whenever relevant to complement the development of the actions.

3.3.5. Implementation

In the fifth step, the defined actions are brought to life, and quantitative data is collected to evaluate the results and realise the impact obtained. Great emphasis is placed on standardising processes in order to promote a lean management culture from now on.

3.3.6. Sustainability

Finally, to sustain the project, there is a big focus on the creation of routines and giving visibility to the top management to gain support and commitment. It is also essential to extend and consolidate results, making the team's involvement with the practices implemented continuously over time.

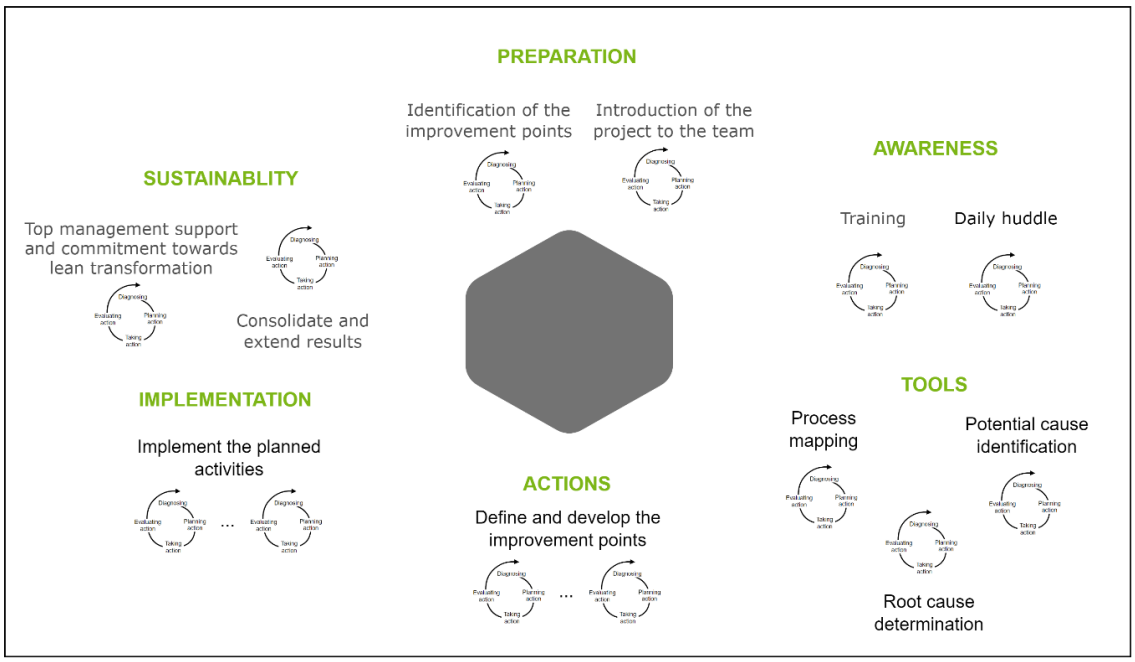

Figure 3.1. Structure of the project methodology

4. Case study

This chapter is dedicated to the case study which is developed according to the methodology presented in the previous chapter. This chapter begins by contextualizing the company and the processes that will be worked on, showing some relevant data for the practical component of this work. It then follows the structure of the methodology, which consists of six steps - Preparation, Awareness, Tools, Actions, Implementation, and Sustainability. The analysis and discussion of the results obtained in the different phases of the project are also provided in this chapter.

4.1. Context and Purpose

4.1.1. The company: Leroy Merlin

Leroy Merlin belongs to the ADEO Group (French business group), which is made up of a set of companies operating in the DIY and construction, decoration, garden and well-being and lifestyling sectors. The company is Europe's market leader in the DIY sector and third in the world. It is present in more than 20 countries, employs around 150,000 people and serves more than 452 million customers worldwide. The company's culture believes in changing the world through the actions of its employees and is guided by the motto "We are useful to ourselves, to others and to the world".

One of the group's most important companies is Leroy Merlin, which is present in several countries and operates in the DIY, construction, decoration and garden sectors. In Portugal, it has more than 6,000 employees, spread across its central office (12%), stores (81%) and warehouses (7%). In geographical terms, Portugal has 47 commercial establishments organized into 8 Life Zones/Regions (Annexe A). It also has an e-commerce website allowing for an omnichannel strategy. As Leroy Merlin's objective is to be a platform company, it follows the “multi-concept” strategy, centred on the customer promise and with a model more adapted to the development of the business and market consumption trends. It consists of 3 types of stores:

- PROXY - proximity store between 400 and 1000 m2, number of employees between 22 and 40 and 13000 Stock Keeping units (SKUs) - 13 stores.
- MSB - Medium-sized DIY store with a size between 1000 and 4000 m2, number of employees between 40 and 100 and 18000 SKUs - 16 stores.
- GSB - Large DIY stores between 4000 and 14000 m2, with more than 100 employees and 24000 SKUs - 18 stores.

4.1.2. Leroy Merlin logistics

This project will be developed within the store logistics, part of the supply chain department. The picking process carried out by all the stores is a crucial part of the business as it prepares orders that have already been paid for by the customer to be collected in-store or delivered to their home.

Leroy Merlin's supply chain is committed to maintaining an efficient and responsible supply chain to ensure customer satisfaction and the continued success of its business operations. In order to meet its customers' needs and achieve business success, LM relies heavily on a specialised and robust supply chain. The vast network of suppliers and efficient logistics infrastructure, combined with efficient inventory management and process optimization, ensure that a wide range of products is available in stores across the country and that the customer experience is the best one possible. There is also a commitment to promoting sustainable practices throughout supply chain, minimizing the environmental impact of its operations. Supply chain's structure is divided into seven areas:

- **Transports:** Plans transportation operations, supplies stores and delivers orders to customers' houses.
- **National logistics operations:** Manage the warehouse operations that supply all the stores.
- **Regional logistics operations:** Manage the operations of the regional platforms that supply a number of stores in a particular region.
- **Stock and flow operations:** Manage the replenishment algorithm for warehouses and stores in order to guarantee product availability while avoiding overstock.
- **Transformation projects:** Ensure the digital transformation of the SC, operational projects and continuous improvement.
- **Store logistics:** Coordinate processes from receiving goods in store, replenishing shelves, and picking and delivering customer orders.

Logistics is present in all 47 stores, reporting to their director. However, the logistics teams in the stores are functionally dependent on a central team, composed of 1 director and 3 managers, which defines the strategy, processes, and organisation of the various teams in the stores. This team is divided and specialised in three pillars: Flow & warehouse management, shelf management & stock reliability and customer delivery management. Under these pillars are managed, respectively, the goods reception, warehousing and preparation, the shelf restocking and, management and stock reliability routines and the customer order lifecycle management, ensuring the customer promise.

One of the tasks managed by the customer delivery management pillar is the process of picking customer orders which is carried out by all the stores, every day, which will be the focus of this project.

4.1.3. In-store picking process

A Leroy Merlin customer can purchase in a physical store or on the website. When a customer is in the store and the item is available, they can pay for it straight away and take it home, otherwise (when the item is not available in the store or when the order is placed online), they can choose one of two ways to access their order: Collect in store or set up home delivery.

Regardless of the route chosen by the customer, LM's computer system will automatically define where the item should leave from (store, warehouse, or supplier) to meet the customer's deadline.

- If it leaves the **supplier**, it can go directly to the customer's home if there is an associated home delivery, or it can go to the store if the customer wishes to pick up their order at the store.
- If it leaves the national warehouse, it can go to a regional platform (from where it is shipped to the customer's home) or to a store if the customer wishes to pick up their order at the store.
- If it leaves the store, it can be dispatched to a regional platform (from where it is dispatched to the customer's home) or placed in the order storage area until the customer comes to pick it up.

An order with several items can also have several flows at the same time. Whenever the system orders an item to be removed from the store, either for collection or delivery, a specialised team begins the in-store picking process, as shown in figures Figure 4.1 and Figure 4.2 . The information system used to support this process is an application developed by the company group called "Pick&Go" (PG) (Some screenshots of the application (APP) are in Annexe B. This APP generates tasks that are divided into urgent (when the deadline is less than 48 hours or 72 hours - orders with in-store collection and orders with home delivery, respectively) and non-urgent (the remaining ones). Within this division, tasks appear in priority order. Because there is stock that is stored in the store warehouse, the in-store picking team is also responsible for picking the items in Dedicated Stock.

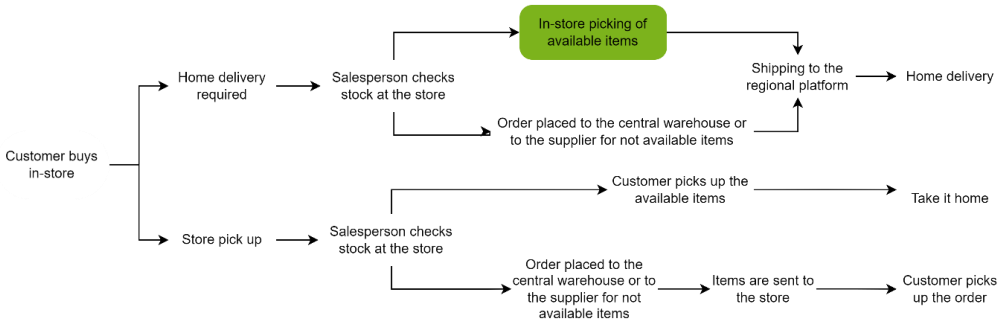

Figure 4.1. Order process for in-store orders.

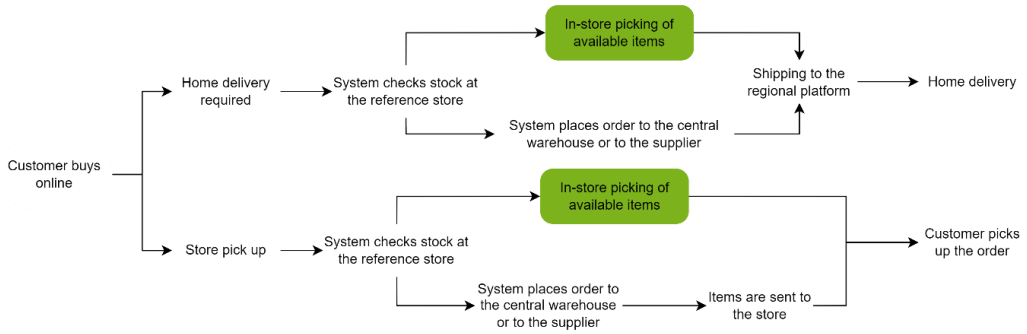

Figure 4.2. Order process for online orders.

4.1.4. In-store picking team – Alfragide store.

The Alfragide store is made up of a logistics team of around 100 people who are divided into activities ranging from reception, replenishment, warehouse management, picking, goods removal and stock reliability. It's a challenging logistics operation, working 24 hours a day and spread over 3 floors and around 2000 square meters.

The picking team has a designated area in the warehouse of 65 square meters where they prepare and pack pallets, either to store it as the customer will be collecting them in-store, or to ship to the regional platforms for home delivery. However, this team also spends a lot of time inside the store, picking. The team is made up of one team leader (TL) (full time) and 12 members, 8 full time, 1 part time (25h/week) and 3 part time (20h/week). One member works night shifts (10pm - 7am) and the others are distributed throughout the day.

In addition to picking orders in-store, this team performs other tasks, including:

- Handling transfers of items to and from other stores.
- Handling returns of customer orders that were not delivered because the customer was not at home or because the customer refused the order.
- Handling returns of items to suppliers when they are received by mistake or have a defect.

However, within the scope of this project we will only focus on the in-store picking task (from the moment the order appears in the PG APP to be picked until it is packed and has an address assigned).

4.2. Preparation

Preparation is the first step in the lean implementation methodology used in this project. It is essential to direct the focus of the project to the real problems and to make everyone clear about the project.

4.2.1. Action research cycle A.1 – Identification of the improvement points

Focused on its commitment to maintaining a responsible and efficient supply chain that guarantees customer satisfaction and the success of the company's operations, LM has already found that one of the processes that is consuming the most resources and revealing some inefficiencies is In-store Picking. The Alfragide store, because it is one of the oldest stores, and therefore somewhat outdated and has three floors (which means that the picking team needs to move around a vast area), stands out among the others for having more inefficiency and lower productivity. In Figure 4.3 a comparison can be seen between all GSB stores of their average productivity per full time equivalent (FTE) between November 2023 and January 2024. The average productivity of the Alfragide store in these three months is 30.4 picked lines per day per FTE, which is well below the average of the comparable stores (GSBs), which is 66.1 picked lines per day per FTE.

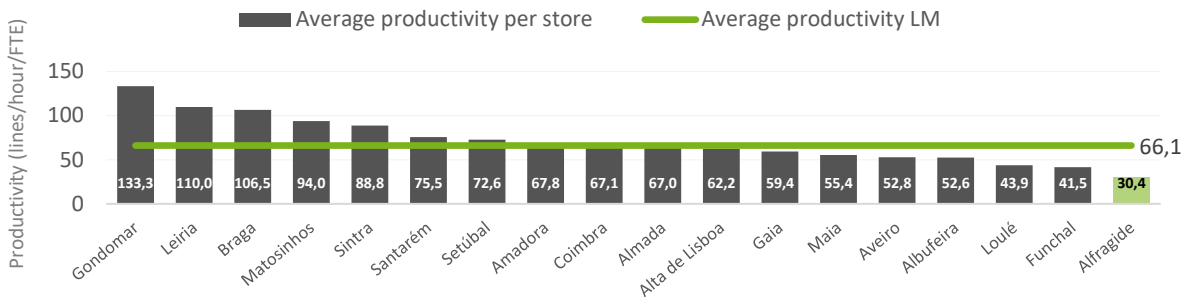

Figure 4.3. In-store picking productivity at GSB stores

This productivity is calculated daily by all the stores, considering all the lines that have been picked and put away, by the number of FTE who have been assigned to picking tasks that day. For the Alfragide store, the monthly average values for productivity, lines picked per day and the number of FTE, are shown in Table 4.1. Only values from October to January are shown, as it was only after this point that the store started measuring productivity using this system.

	OCT	NOV	DEC	JAN
Productivity (lines/hour/FTE)	35,16	34,81	27,13	34,89
Lines Picked and addressed per day	199	221	170	200
Total FTEs per day	5,9	6,5	6,6	5,9

Table 4.1. Average monthly values of productivity and its components

Direct observation

To better understand the in-store picking process in this store, a period of direct observation of the process was carried out to understand the amount of time spent on each subtask and, in turn, to identify the wastes that occur in the process.

Diagnosing

A discussion with the store's logistics managers led to the conclusion that it was unknown why the Alfragide store had the lowest productivity compared to other GSB stores. To do this, a sample of the activities carried out during the in-store picking process must be analysed.

Planning action

For this analysis, every 5 seconds the operator's activity was recorded from a set of 10 activities (including the "other" option for non-picking task). The 10 activities were defined together with the in-store picking TL (hereafter referred to as “TL”). A table with a detailed description of what is done in each of the activities can be found in

Annexe C. Observation should cover 8 hours, spaced out, to cover the hourly period of a working day. To avoid influencing the team performance it was explained that they would be followed by the researcher but with the purpose of learning how the process is done. Questions were avoided during the observation process so as not to influence the times recorded.

Taking action

The analysis of the activity sample was carried out over a total of 8 hours and 8 minutes, which is equivalent to 5798 observations. A total of 9 operators were monitored, with each operator's observation time varying according to their availability. It was equivalent to the average picking of 60 lines (according to the actual average of 8 minutes per line). The records for each operator and the distribution by activity can be found in Annexe D. A summary of the data obtained was compiled in Table 4.2, listing the activities defined and the respective percentage of time spent on them.

ACTIVITY	% of time
Assemble and pack pallet	21,02%
Walking	17,80%
Seach for place, technical material, or items	11,37%
Transporting	10,16%
Pick and Go	9,04%
Place item on the cart	8,02%
Others	6,74%
Administrative work	5,81%
Waiting for free space/information/material	5,04%
Ask for help/communicate	5,00%

Table 4.2. Percentage of time spent on each in-store picking activity.

Evaluating

The analysis shows that operators spend around 21% of their working time preparing and packing pallets, either for picking at the store or for home delivery, followed by a large percentage of time spent on movement, either moving around empty (17.8%) or transporting (10.2%). Given the type of process, it is expected that a large proportion of time is invested in motion (from the starting point, the different locations, and the finishing point), but some excessive and unnecessary movement was observed, generally caused by the fact that the technical materials were not in a strategic location. Another aspect to highlight is the time spent searching (11.4%) for items, picking locations, technical equipment, and people. This is due to a lack of organisation between the various logistics and sales teams, and the PG system needs to be better adapted to the reality of the store. In addition, 6.7% of the time is used to carry out tasks that are not directly related to the in-store picking process, which has been recorded in the " others" category, most of which are inevitable (talking to customers when they ask questions) or necessary to overcome constraints (move pallets/items that are in the way or send/receive freight elevator). The tasks of administrative work, waiting for free space/

information/material and asking for help/communication, despite having a more residual value in terms of time spent, because they are not added-value tasks for the client, need to be reduced in order to make the process more efficient. This observation was crucial as it provided valuable information that would support decision-making throughout the following stages of the project.

4.2.2. Action research cycle A.2 – Introduction of the project to the store and team

Diagnosing

Since the team is very keen to be involved in projects aimed at improving their work, and no other internal projects are currently being carried out with a direct impact on them, it made sense to be heavily involved with the team in the project. This involvement ranges from brainstorming to defining and implementing action plans. It is also essential to present the project to the rest of the store so that everyone is aware of the possible changes and actions developed with and by the team.

Planning action

The managers requested that no specific people be involved in the project, but rather that everyone participate and that small working groups be set up when necessary. The project presentation to the team should be made to everyone at once so that any doubts can be raised and clarified for everyone. Regarding the presentation of the project to the rest of the store, it is the responsibility of the logistics manager to present it to the store committee.

Taking action

The whole team, including the team leader and one of the managers, was gathered in the meeting room to present the conclusions drawn from the activity sample analysis and to explain the project. It was emphasized that there would be more direct work with the TL as they are the ones who make the decisions about changes and coordinate them, ensuring that they make sense for the team.

Evaluation

After the presentation, the whole team showed interest in being part of the project wishing to contribute to improving the process and they were clear about their role and relevance.

4.3. Awareness

This is the second step in the lean implementation methodology and is essential to ensure that the team's knowledge is uniform. It focuses on introducing and explaining lean management concepts to the whole team and creating a feeling of belonging to the project among daily management.

4.3.1. Action research cycle B.1 – Training

Diagnosing

When the project was presented to the whole team, there was some concern among the employees as they were unfamiliar with most of the lean terms and concepts used. Given this and the participatory and collaborative nature of this project, it was necessary to develop background awareness and create a solid knowledge for the project. The best way to create awareness in operational teams that cannot stop the whole operation for long is through short, enlightening training sessions with practical examples suited to their reality.

Planning action

One training session was set up, focusing on explaining the lean concepts. This training will be based on a previous one provided by the company to the logistics managers and already completed by those in this store. For the logistics managers, this training was conducted by a specialised external company, which provided all the content so that the training can now be replicated. This training should be given by the researcher together with the logistics managers in a session of 2 hours at maximum.

Taking action

The training session was attended by nine operators, one TL, one logistic manager, and the researcher. It took place in the store's training room, was conducted by the manager with the researcher's support, lasted 1 hour and 30 minutes and was supported by the Annexe E. The slides in the attachment are in Portuguese since everyone in the team is a Portuguese speaker and it was created just for this purpose.

Evaluating

With this action it is expected to develop background awareness and create a strong basis for the project. The feedback given by the operators was that they were already trying to identify some wasteful activities but nothing in such a structured way, nor did they really know how to deal with them. They also said that some of the actions to be taken would have to come from the manager, as they did not feel confident or empowered to make certain changes. Overall, all the operators felt that the training was very useful, however, they provided feedback saying that they still did not understand how they were going to apply these concepts in their daily tasks.

4.3.2. Action research cycle B.2 – Huddle and huddle board

Diagnosing

As expected, the need for a sense of belonging to the project on the part of the team was noted. In addition, the company had planned to implement daily management in all operations, so it was considered that this was the right moment to do it, by creating daily huddles, which is a technique used to improve team communication usually performed in the healthcare sector (Shaikh, 2020).

However, due to its versatility and the fact that its main objective is to improve communication, collaboration and productivity, it can be used in various industries. For that visual support will be used a huddle board representing team daily tasks, levels of performance and opportunities for improvement. As advocated by Rajaraman (2019), the contents in the board must be reintroduced every day before the huddle and it must not be longer that 15 minutes.

Planning action

As there is already a plan to implement the daily management frameworks, an external company has already set up a training session to build up the framework. This training, conducted by the TL, explains the concepts of daily management, team performance indicators and Plan, Do, Check and Act (PDCA) framework, to build a board adapted to the team at the end of that training. The prototype must then be sent for production and the final boards returned to the store. This board should be used daily by the team, but essentially by the TL to support the daily management meetings. This board provides visual support of the work, the tasks to be carried out and their priority, the team's performance by visualizing and monitoring daily results, and it also allows to work on small changes in the team or in the way of working that ultimately lead to major improvements.

Taking action

The training lasted a total of 5 hours, with most of the team present. Through the discussion generated during the training, the main tasks carried out by the team throughout the day were defined, as well as the main team performance indicators that make sense to analyse the daily performance.

The prototype was then sent to a partner company to be produced. As soon as the board was delivered to the store, an area next to the administrative zone was defined and the board was fixed to the wall. The surrounding floor area was limited to prevent material or items from blocking access to the board. Pictures of the operators were printed and plasticized, as well as some icons to give visibility of whether the task had been completed or not. It is also worth noting that the tasks for the Team Work Plan have also been printed on magnetic material so that they can be easily replaced by other tasks that become a priority.

A month later, it was already possible to see that the team had taken some ownership of it, making it an essential tool in their daily work, as can be seen in Figure 4.4.

Figure 4.4. Daily management board

Evaluating

Using the PDCA cycle, the team started to effectively understand how to apply some of the concepts they had learned in the training, namely being able to classify their actions as value-added activities for the customer, for the business or waste. One manager underlined the importance of this event to develop autonomy and confidence among the team:

> *"The huddle board has given the team a great deal of autonomy and the ability to easily analyse the prioritize throughout the day. Initially, the team was very stuck and waiting to be told what task each person was going to do, but they gained autonomy and confidence to be able to manage the daily plan with a lot of dedication."*

The benefits were also noted by all the members of the team who ended up considering the board an indispensable tool in their work and one of the collaborators stated that:

> *"Since we started working with the huddle board, the team has been able to manage its day-to-day life better and prioritize the most important tasks and follow up on them. We've also been able to analyse what's going well and where we need to improve over time."*

4.4. Tools

The application of lean tools helps to gain an in-depth understanding of how the in-store picking process works as well as to analyse the aspects for improvement.

4.4.1. Action research cycle C.1 – Process mapping

All the operators know the process and carry it out without too much difficulty. Anyone with no knowledge of the process usually learns the basics of the task in just one day, but mapping out the process reveals that the process can only be done properly if there is already some experience and a lot of knowledge.

Diagnosing

In discussion with the store's logistics manager, it was found that there was no support describing the process from start to finish, only a few outdated indications of certain parts of the process. To understand the process and identify areas for improvement, it was necessary to map it out. Some operators also identified the lack of a consultation point as a difficulty in their day-to-day work.

Planning action

To map out the process, it was explained to all the workers that they would be observed for several days by the researcher and that they would be asked some questions previously defined and presented in the methodology. As we are dealing with a single process without many parties involved, the tool used to map out the process will be a flowchart, because it allows the visualization of all the stages of

a process, including the associated decision points. At the end of the mapping, the process must be validated with the TL and logistics managers.

Taking action

The process mapping was carried out over a period of 2 weeks by observing 9 operators several times. The mapping is divided into two branches, splitting urgent tasks from non-urgent tasks, as they present several differences throughout the process. This division is due to a very important factor: the promise time given to the customer. Since it's a task that can be affected for just a few minutes, there's always someone assigned to the picking work to ensure an automatic response to requests that come in. During a working day, picking is constantly happening, but the task can be interrupted for reasons of force majeure, such as rest and lunch breaks and the end of working hours.

The complete process mapping can be found in Annexe F, but for a better reading of this work, a summarized version of the process mapping is shown in Figure 4.5. It should be noted that in this short version the division between urgent and non-urgent tasks has been ignored, as only the main tasks that are common to both types of mission have been considered.

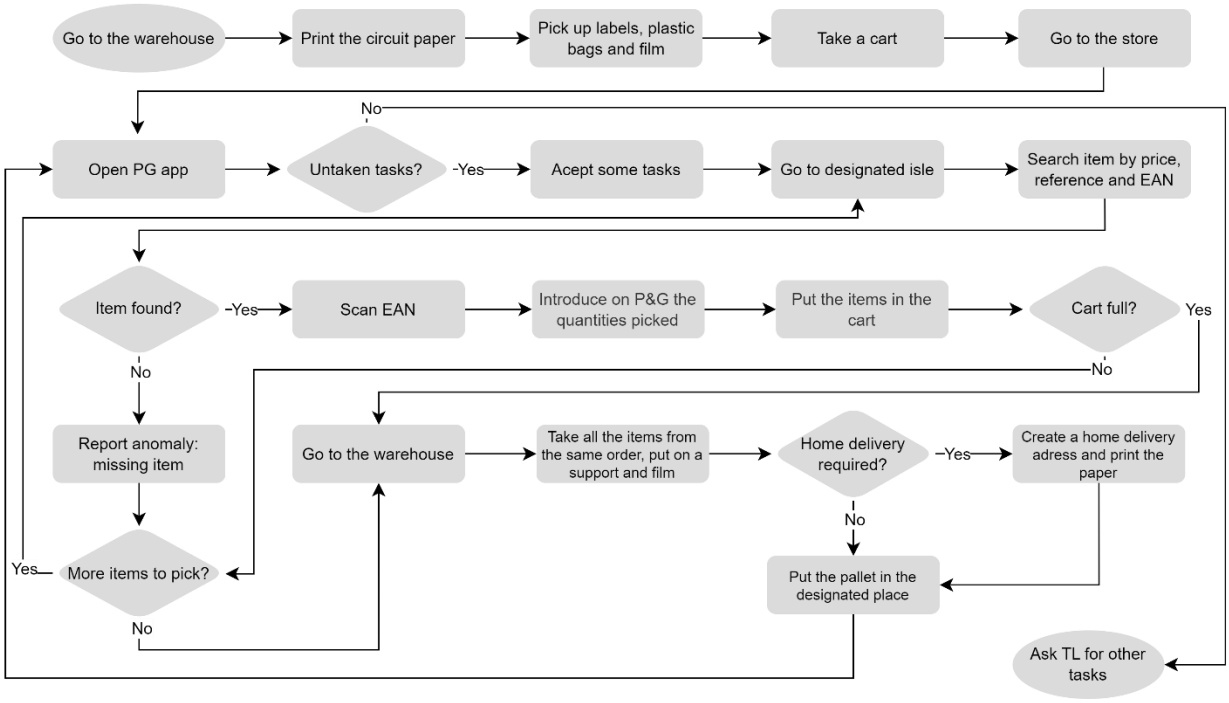

Figure 4.5. Summarized process mapping

Evaluating

Through the process mapping we can see the complexity of the picking process and the dependence on the various sub-tasks to make the item available to the customer. The main conclusions that can be drawn both from the questions asked and from the analysis of it are:

- The process is not uniform; each item must be checked on the circuit (The fact that the APPdoes not have all the information about the delivery circuit means that more steps are added to the process) and, considering their dimensions and characteristics, the treatment is also different (in some cases a special trolley or pallet is required for transportation).
- Many tasks are linked or dependent; just one person must carry them out since they are highly affected by interruptions.
- Some decision points are subjective; they depend on the person's understanding. For example, "There's still time to pick up more items" is a decision that will depend on the speed of the operator and their perspective on time as well as packaging standards, which were noted to be different between workers.
- The process is very long; it is difficult for operators to stay focused because they constantly switch between small sub-tasks, mainly because the picking part is quite different from the packing part.

As these are the main pain points found in the currently defined process, and after meeting with the logistics managers to present the conclusions, it was apparent that the main factors giving rise to these pain points are the lack of dedication in the planning of the task, the procedures being poorly simplified, the lack of continuous training and the lack of consistency and efficiency in the changes made over the last few years.

4.4.2. Action research cycle C.2 – Potential cause identification

Diagnosing

The mapping of the process gives us a glimpse of the inefficiencies arising from the sub-tasks required to carry out the process. However, it was necessary to go further and understand what other factors impact sub-tasks from the perspective of those who do the job every day, particularly the factors that are not directly related to the process design.

Planning action

This perspective is achieved through the cause-effect diagram, which is designed to identify all the causes and sub-causes of a given problem. For this, it was planned to include the team in a brainstorming session where once the problem to be solved was presented, the possible causes and what led to them would be discussed. Operators should feel comfortable giving their opinions and talking about what they experience daily, with the researcher participating simply as a moderator, encouraging discussion when needed. To this end, logistics managers must not be present.

Taking action

As it was impossible to stop the whole operation for a few hours, two brainstorming sessions, with three hours each, were held on two separate days, with four participants in each session. The session

began with a short introduction to the cause-effect diagram, explaining its use and why it was relevant to the current study. Once presented the problem of low productivity, some inputs about the reasons behind this problem began to emerge. Some questions were asked throughout the session to dig deeper into specific issues and find the root cause. In the end, some causes that were not presented by the operators but that were perceived throughout the observation period so far were added. As a result, six different dimensions were identified, such as software, work area, technical material, task definition, movement and unavailable items. Within this, some main and root causes were identified and can be seen in the cause-effect diagram created and presented in Figure 4.6.

Evaluating

In a perfect world, all the causes described in the cause-effect diagram should be considered to ensure the resolution of all inefficiencies identified that compromise productivity performance. Despite the relevance of all the causes presented, prioritization is crucial since we have limited resources and time, as well as company limitations on what can be changed.

4.4.3. Action research cycle C.3 – Root cause determination

Diagnosing

The vast list of causes of low productivity presented is highly relevant for logistics managers to act in order to solve inefficiencies. However, in this project, it will be necessary to prioritize which causes have the most significant impact in order to draw conclusions about the actions to be taken.

Planning action

To identify the causes with the most significant impact on productivity the multi-voting tool will be used to help narrow down the number of ideas in a list. Voting will be carried out by all team members by voting on a form created for this purpose. Each team member must vote for the five causes they consider the most impactful from a list of 18 causes built up previously during the brainstorming sessions (shown in Figure 4.6).

Taking action

The form was attended by 11 operators, who answered correctly by selecting 5 of the causes presented. The form was filled out in the presence of the researcher to ensure that it was completed correctly and to clarify any doubts. The results of the multi-voting were added in Figure 4.6Figure 4.6. The circle with the number inserted next to the root cause represents the number of times that a cause has been identified as one of the five most impactful on productivity.

Evaluating

The multi-voting method made it possible to prioritize the six dimensions of causes initially identified. As seen in Table 4.3, the sum of the votes for the causes for each dimension leads to the work area

being identified as the most problematic in the workers' view, followed by movement and, in turn, software and unavailable items. With fewer votes and none of the causes receiving at least 5 or 6 votes (the maximum seen in the remaining causes), we have technical material and task definition.

Dimension	Votes
Software	10
Work area	13
Technical material	8
Task definition	3
Movement	11
Unavailable items	10

Table 4.3. Multi-voting results by dimension

The most critical categories (work area, software, movement and unavailable items) present at least one of the causes that was identified by approximately half of the employees as one of the top 5 (Frequent crossing of the work area by other employees, lack of information on PG, Click and Collect (CC) drop-off area downstairs and stock shortages, respectively).

Once the four dimensions considered critical were presented to the company's management, the software was identified as a limitation because it is managed centrally and there is no possibility of testing or making improvements through this project, as it is a more sensitive area and would inevitably have an impact on all the stores. To complement the conclusions drawn from the process mapping, the root cause diagram makes it possible to direct the effort of the implementations that will be carried out further in this project for the dimensions of work area, movement and unavailable items.

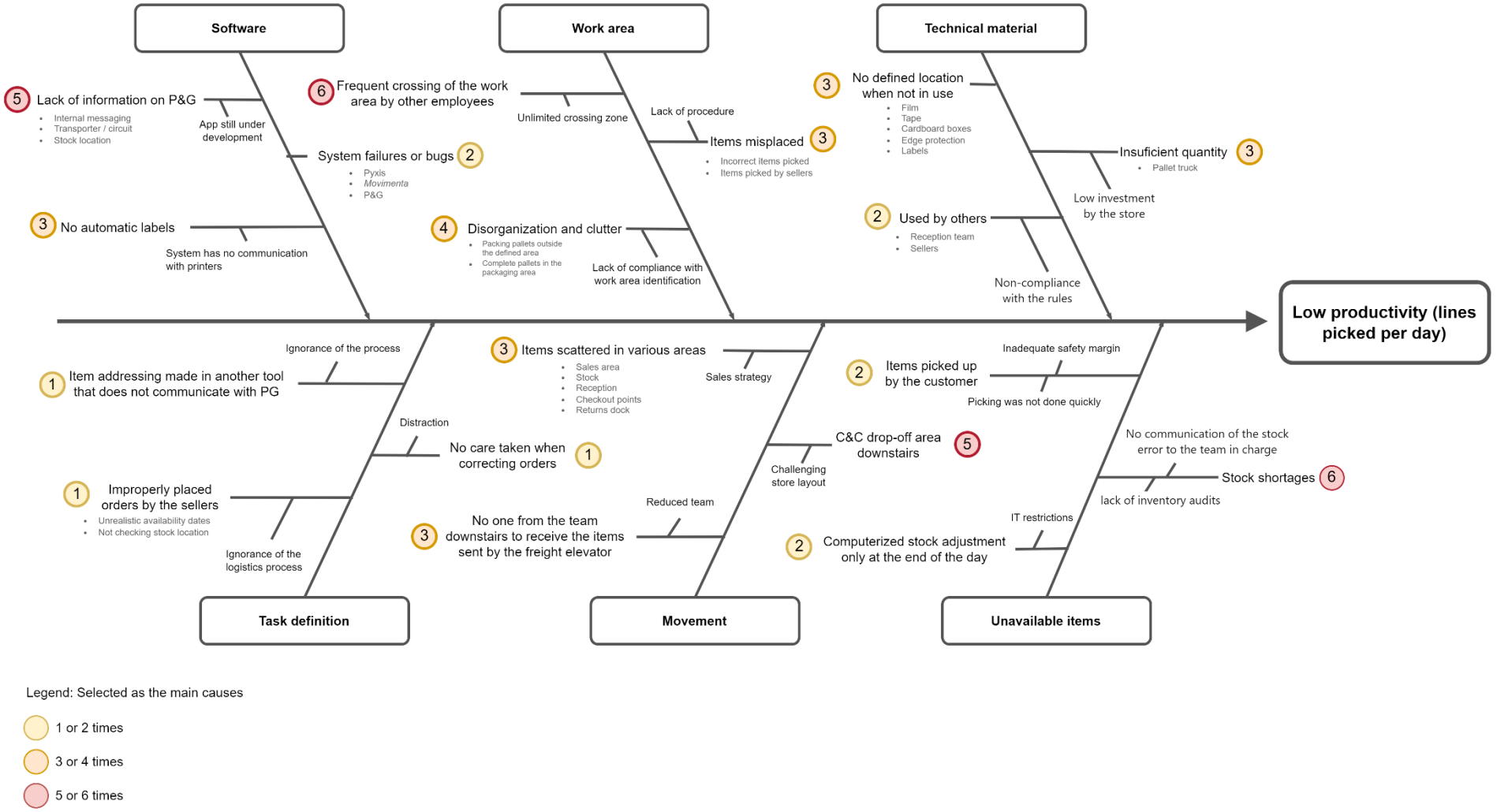

Figure 4.6. Cause-effect diagram

4.5. Actions

This step is where the pain points find the actions that are expected to improve the process. All the necessary stages and planning are presented here so that these actions can later be brought to life through the implementation step.

4.5.1. Action research cycles D.1 to D.4 – Define and develop the actions to improve

The more in-depth analysis done with the lean management tools presented in chapter 4.4 enables the identification of the areas with opportunities to develop improvement points, i.e. how and with what actions we are going to tackle the problems that have the most significant impact on low productivity. This subchapter will focus on developing the actions for improvement and determining the responsibilities. It will be designed to create an inspiring vision of a future state by planning the actions defined above. An ARC will be used to present and explain each action.

D.1: *Layout*

Diagnosing

According to the cause-effect diagram, the work area is the most significant pain point felt by the workers. The main causes for this are:

- Disorganisation and clutter, and misplaced items that happen essentially because there is no compliance with the work area identification. This is a matter of commitment on the part of employees, which is currently being worked on through the huddle meeting. In addition, the intervention of logistics managers is crucial for the team to feel responsible for their actions.
- Frequent crossing of the work area by other employees, happening due to bad habits and because there have never been any clear rules about where to cross the warehouse.

Planning action

The Figure 4.7 shows the layout of the warehouse, more precisely from the floor where the in-store picking team works, at the start of this project (Some photos taken at that time can be found in Annexe G). The ground floor of the warehouse is shared with other teams, including the stock team (which works both inside and outside the warehouse) and the goods reception and dispatch team (which works outside the warehouse), and it also serves as a walkway for all the other teams that want to move between the shop and the warehouse, represented in orange in Figure 4.7. This figure shows in blue the areas used by the in-store picking team daily (administrative work, packing pallets or items, locating small volumes, etc.).

A meeting was held with the logistics managers to determine the objectives for the ground floor of the warehouse in the next few years and to identify the challenges faced by the other logistics teams. It led to the following conclusions:

- It is an objective of the store to remove all the stock from the ground floor so that all the stock is located only on the lower floors, in order to centre this entire operation in the same place.
- The shipping lines outside the warehouse are exposed to rough weather conditions, leading to product damage when it rains.
- People passing through the warehouse occurs due to a lack of rules and limitations, as it is possible for the other teams to access the warehouse only through doors 3 and 4, releasing doors 1 and 2 for in-store picking team use only.

After the meeting, a moment of observation of the in-store picking operators' movement flows within the warehouse took place to understand the most critical areas and which resources are interdependent. This resulted in a spaghetti diagram presented in Annexe H carried out with three different operators for a total period of 4.7 hours. The main conclusions drawn from this analysis regarding the layout are:

- Several movements to access the computer to get information unavailable in the PG, to the waste garbage can (there is only one for the team) and to the packing table to pick up labels.
- They need to move pallets in order to pack their pallet or access a particular area.

Therefore, after several discussions with the logistics managers, the best way encountered to deal with the difficulties, would be to change the layout of this area of the warehouse.

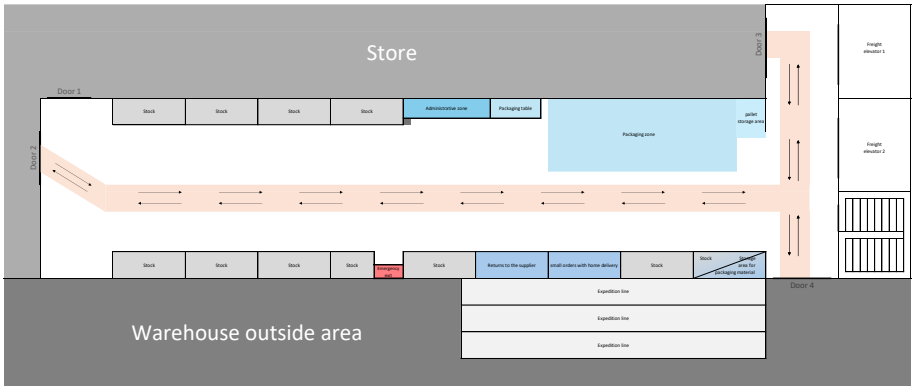

Figure 4.7. Ground floor plan of the warehouse at the start of the project.

Taking action

Considering the conclusions reached and the and logistics managers' input, a proposal was made for the new layout, shown in Figure 4.8. This proposal assumes the removal of almost all the stock from the ground floor (only one rack of stock remains, as requested by the team), allowing the dispatch lines to be moved inside, and presents a new arrangement of the areas, considering their interdependence observed during the spaghetti diagram. The administrative area, which previously consisted of one station with four computers, has been divided into three stations. One of them, with one computer, is located next to door 1 to be used by pickers to consult information not available in the PG, another

station with two computers remains on the same wall but closer to the packing area, and the last computer is moved to the opposite wall. This distribution of the administrative areas throughout the warehouse aims to reduce the long distances that operators move just to obtain information.

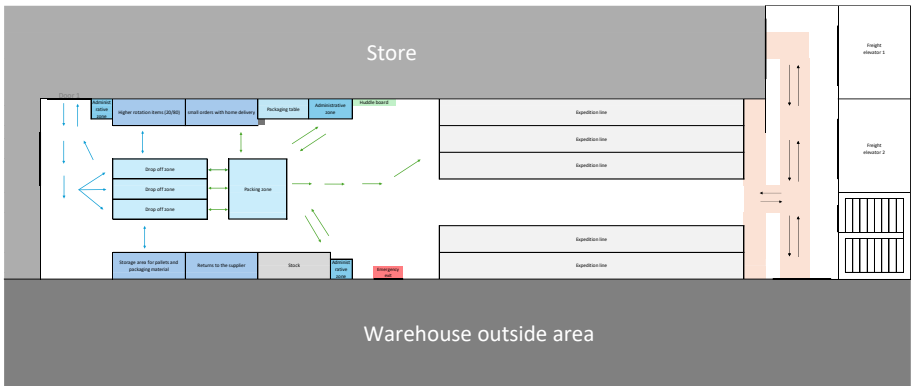

Figure 4.8. Proposed layout change for ground floor of the warehouse.

This new layout foresees the division of the process into two phases (as will be explained below), picking and packing, with the people allocated to packing staying only inside the warehouse (green arrows) and the people allocated to picking moving between the store and the warehouse (blue arrows), without crossing flows. In this layout proposal, a picking stock area of 20/80 has been added, where the most in-demand items can be picked. However, this analysis will not be carried out during this project and is left as a suggestion for future work.

Evaluating

This layout change, approved by the managers, aims to increase productivity (lines picked/hour/FTE), reduce costs and standardize processes. Later on, in the implementation phase, through new activity sampling, it will be possible to understand whether the new layout has any impact on the percentage of time spent on each task by reducing those sub-tasks that are not value-added.

D.2: Restructuring the team

Diagnosing

Another pain point identified with the cause-effect diagram is the excessive movement caused by:

- Items scattered in various areas; since it is a store, the items may be in more than one location (e.g. in the checkout line, in the returns area, stored in the warehouse, in the reception area, etc.) Regardless of the location, the computer stock only indicates whether the item is in the store and does not specify the exact location.
- CC drop-off area downstairs and no one from the team to receive the items sent by freight elevator. This means that all the operators handling urgent orders need to move between floors several times a day, taking the stairs and using the freight elevator for the items.

Planning action

To better understand the problem of movement, the operators were observed for a week to see where the high volume of commuting was concentrated (beyond their work area in the warehouse) and the reasons for it. It was observed that, on average, operators move 12 times a day between floors and that it takes them an average of 16 minutes (15 minutes of tasks + 1 minute of moving), which is equivalent to around 192 minutes a day, or more than 3 hours. In addition to the time wasted moving around and waiting for the freight elevator, moving between floors causes much physical effort, interrupts tasks and means that the worker has to move around in an unfamiliar area (the stock team's work area). This observation confirmed that the main reasons for commuting are to place orders for CC and to sort items for home delivery. With this knowledge, some possible solutions were discussed with the TL and the logistics managers, such as including the stock team in the process, placing a trolley for transporting small items on the freight elevator and creating waves for removing the items, and restructuring the picking team to reduce movement.

Taking action

The logistics managers consider that the only viable option, given the resources needed and the unavailability of other teams, is to restructure the picking team. A proposal for the division of the team was made and is shown in Figure 4.9. This proposal assumes that there will only be one person in charge of picking up stock and placing orders for collection in the store and that they will be assigned to this role during peak hours (defined daily) and not for the whole day since resources are limited. Regarding store picking and packing, the proposal assumes that for every two people picking, there should be one person packing (The number of icons representing people in Figure 4.9 is figurative only.). Although packing is the most time-consuming task, as observed with the activity sampling, picking is the sum of various tasks such as walking, transporting, searching, PG, etc., and takes longer than packing. In addition, during the night shift, because there is only one employee, or at any other time when the number of employees is low, this person will do both picking and packing (it is assumed that there is no stock picking during the night for reasons of efficiency and that there is no placement of orders for collection because the store is closed). This should be the basic plan for allocating people to each workstation. It should be emphasized that in order to promote versatility, which is one of the company's pillars, there should be a great deal of rotation between the workstations, even if there are people with more aptitude for a particular task because everyone needs to be able to do all the tasks.

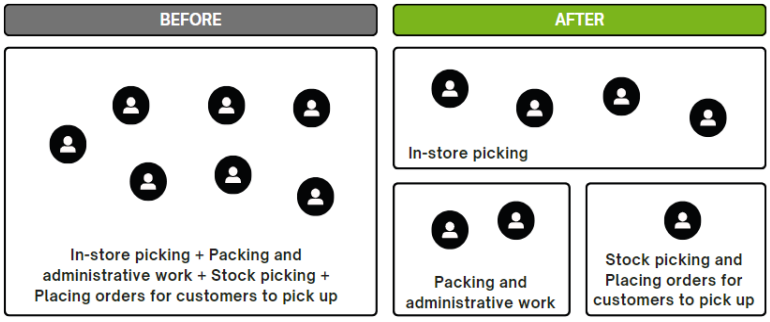

Figure 4.9. Current team structure and proposed new structure.

Evaluating

This action has an impact in terms of reducing time that is not used directly for the picking task. In the activity sampling analysis, the time spent moving between floors was considered in the "walking" activity, so verifying the impact through this analysis is not easy. Therefore, another way of evaluating this is to see how much time employees spend on average moving around and whether this has been reduced since this action was implemented. By reducing the time spent on excessive movement, more time is available for tasks that add value to the customer, such as picking and packing.

D.3: Procedure for missing items

Diagnosing

The other pain point considered, related to missing items, has the following causes:

- Items picked up by the customers; usually problematic with items with little stock on display, as the customer may pick them up before the operator gets there to do the picking. It was not considered relevant by logistics managers.
- Computerized stock adjustments are done at the end of the day, and as it is managed centrally, no improvements can be made in this field in the context of this project.
- Stock shortages mainly occur because there is no visibility on the part of the team responsible (reliability team), so there was no stock correction in these cases.

Planning action

The major difficulty in this case is the lack of communication between the teams and the lack of visibility of the situation on the part of the reliability team. To understand how communication can be improved, a meeting will be held with the TL of the stock reliability team to draw up a process that will be the main form of communication between the two teams and to understand the availability of the stock reliability team to do it at the frequency that will be defined.

Taking action

During the meeting, the following points were raised:

- It is in the team's interest to have good stock reliability, so it would be valuable to create a way of communicating and a database of items identified as missing by the in-store picking team.
- The reliability team has several tasks that often require priority, so they must have autonomy to carry it out when and by whom it is most convenient.

It was defined that this new process would involve the creation of a single file to be used by the reliability team. Anyone on the team must have access to the file. This will just be a guide for the team to indicate which items need to be checked for stock as well as the approach taken to each case.

Evaluating

Between November and March (before implementation), 14.4% of the items searched for were registered as missing, which is equivalent to around 29 lines per day (the average number of lines picked during this period is 197 lines/day) and around 3.86 hours were spent looking for items that do not exist on the shelf (according to the average of 8 minutes per line in that period). Stricter stock correction will increase the reliability of the stock, which will increase productivity as less time will be spent looking for missing items. Therefore, the percentage of missing items will be analysed by comparing the values registered before and after the action was implemented.

D.4: Standard work instructions for packaging

Diagnosing

Although not mentioned in the cause-effect diagram, observation of the process during the mapping revealed another problem considered to be a driver of low productivity:

- Uniformity in the process caused by the lack of compliance with some established rules and the existence of subjective decision points. This is notable in the case of packaging, where rules and good practices are transmitted between colleagues and no procedures are documented.

Planning action

To understand the scope of this problem, a meeting was held with the customer satisfaction team where it was found that customer satisfaction is affected by poor packaging. In addition to the customer experience, poor packaging jeopardizes the safety while handling the orders. In a survey conducted by this team, it was concluded that 18.3% of the people had received a package with visible damage upon delivery. Moreover, the orders received by customers with damage are usually returned to the store. When it happens, it is also the in-store picking team that has to spend its time to deal with this situation, so there are fewer hours available for picking. What is more, in most cases, it ends up being necessary to pick these items again, which means there is a duplication of work.

A few questions were made do operators to understand the differences and inconsistencies in packaging, such as: "Have you received any specific training on how to pack items correctly? If so, what was it like?"; "Have you ever received feedback or guidance on the quality of your packaging? How

was it given and in what context?" and "Do you have access to the right materials and tools to pack items consistently? If not, what do you think is missing?". The answers were similar, standing out:

- No training has ever been given on how to pack, when someone takes on the job, they learn how to do it by observing another operator.
- Occasionally, the receiving/dispatching team alerts the picking team when they are handling a poorly packed pallet, but often the information does not reach all the team members.
- Packaging material is usually available because great care is taken by those who replenish it, and there are never any shortages of packaging material.

These conclusions were presented to logistics managers in order to develop a solution and act on this problem. It was concluded that it would be helpful to develop standard work instructions for how items should be packaged.

Taking action

The survey conducted by the customer satisfaction team in the previous year gives information about the types of items with a higher number of incidents, data that can be found in Annexe I. This information shows that large items or those that are difficult to handle are more likely to be delivered with damage due to poor packaging. Given the attached data, the ten items for which it is felt necessary to create detailed work instructions are: Skirting boards, Ceramics, Solar panels, Sanitary ware, Kitchen furniture, Plasterboard, Complementary products, Worktops, Chairs and loungers, and Heat pumps. Regarding packaging materials, the company has already defined rules by which all stores must have the following packaging materials: bubble wrap, blue foam, cardboard corners, transparent film, envelopes, strapping, cardboard boxes.

Evaluating

The plan presented to the logistics managers was considered beneficial and feedback was that it would make sense to start with the items mentioned but that in the future it would be interesting to cover a greater number of types of items, ensuring complete standard work instructions for this process.

This measure may not have a direct impact on productivity, but it will ensure that the process is standardized, which is also one of the objectives of this project. Also, in the long term it is expected to verify a reduction in rework, since returns caused by poor packing are expected to decrease.

4.6. Implementation

This stage aims to bring to life the actions presented before to achieve the desired results, i.e., increasing productivity, guaranteeing compliance with the customer's due date. The implementation process and verification of the results are presented in this subchapter using an ARC for each of them.

4.6.1. Action research cycles E.1 to E.4 - Implementation of planned activities

E.1: *Layout*

Diagnosing

Since the proposed layout presented to the logistics managers, who were delighted with it and showed interest, was accepted, it is therefore crucial to plan how the layout change will be made without affecting the operation, since it is not an option to stop it. This change was presented to the store committee to ensure that no problems were raised during the change. To complete the diagnosis of the implementation of this improvement, it was verified with the company that physical and monetary resources existed. It is important to note that in the store, there is a team responsible for all structural changes, so that they will be part of the process, along with the picking team.

Planning action

Before making any changes, it is crucial to include the team in this process, so a small meeting was held (at the time of the huddle meeting) where the new layout was presented as well as the reasons for it. Then, because there is a structural change team, the logistics managers, the TL and the researcher met with the head of this team to explain what is wanted. All the necessary timings are defined, given that the logistics managers' goal is to complete the change in 2 weeks.

The structural team will be responsible for all the changes in terms of removing racks and changing electrical connections for the new administrative areas, while the organisation of the work area according to the established plan will be carried out by the in-store picking team. It will also be necessary to involve external entities to mark out the areas on the floor and to create identification signs to ensure visual communication of the spaces. This will happen after concluding all the structural. The plan was put together, and teams were lined up to start this intervention in the last week of March.

Taking action

As planned, the structures team completed all the removal of stock and dismantling of racks during the first week. In the second week, the changes to the electrical connections began, but ended up being delayed, finishing in mid-April. This was followed by the intervention of the external entities to delimit the spaces by identifying the floor and to create and assemble the identification signs for the spaces (Annexe J) which was only achieved at the end of April. Some photos taken after the full change can be found in Annexe K. Throughout the layout change, close monitoring was carried out by both the researcher and the managers to see if the requirements and defined plan were being met.

Evaluating

The layout change was considered to have been completed as of May. A Gemba walk carried out by the researcher and the managers ensured that the layout was in line with what had been planned and that the operators were comfortable with it. To understand if the new layout had impact on the

percentage of time spent on each task, by reducing those that are not value-added, a new moment of activity sampling was carried out. This time, only 6 employees were observed for a total of 6.74 hours. This was due to a greater lack of availability and a reduction in the team for external reasons. The records can be found in Annexe L, and the data obtained is found in Table 4.4

ACTIVITY	% of time (before layout change)	% of time (after layout change)
Assemble and pack pallet	21.02%	22.13%
Walking	17.80%	20.83%
Transporting	10.16%	10.72%
Place item on the cart	8.02%	8.82%
Others	6.74%	8.76%
Pick and Go	9.04%	7.77%
Seach for place, technical material, or items	11.37%	6.92%
Administrative work	5.81%	5.46%
Ask for help/communicate	5.00%	5.26%
Waiting for free space/information/material	5.04%	3.13%

Table 4.4. Percentage of time spent on each in-store picking activity after layout change

The main conclusions that can be drawn from these figures is that, in fact, the time spent waiting and searching for items, materials, places or people has decreased which may be due to the fact that the workspace is more organized and better identified. In other words, the activities that don't really add value for the customer have been reduced, while the time spent on activities that do add value for the customer, such as packaging, has increased.

E.2: Restructuring the team

Diagnosing

Bearing in mind the intention to reorganize the team in the form of workstations, and having already defined the plan for this, as soon as the most relevant part of the layout change has been completed (excluding the identification signs and floor boundaries) this action was implemented.

Planning action

It was established with the TL that after completing the major structural changes to the layout, they would adopt this new method of work allocation. It consists of everyone doing everything up until the huddle, and during this moment, usually around 10 a.m., the work plan for the day will be defined by the TL, allocating people to the different sub-teams and ensuring that people rotate through the tasks over the days. The plan to be followed is the one presented in ARC D3 in subchapter 4.5.1.

Taking action

During that week, the TL began allocating workers to the different sub-teams. The operators welcomed this way of distributing work, as they felt that long-distance travels had a significant impact on their

productivity. However, during that first week, the TL experienced some difficulties in allocating people since the schedules and the number of people on each shift were not constant, as well as the variation in the number of people working each day due absences such as vacations, sick leave or days off. It was also necessary to make changes to the work plan several times during the day, which resulted in more interruptions. These changes were due to unforeseen increases in workflow or the need to carry out other tasks requested by managers.

Evaluating

After a week, it was decided by everyone that there was no point in continuing with this method of working as it was having negative impacts, especially as the TL was unable to provide the necessary support and the team wasn't being able to have autonomy in managing task allocations. In this regard, it was not even possible to measure the benefits of this action because many of the workers did not comply with the rules, moving unnecessarily between floors. However, it is believed that this is a measure that could be better structured and implemented at a time when there are not so many recent changes, as was the case.

E.3: Procedure for missing items

Diagnosing

With the approval of the improvement identified to increase communication between the picking team and the reliability team, it was checked whether this would be the ideal time to introduce a process in the stock reliability team, and it was concluded that it was. However, the first step is to create the file and for that it will be necessary to understand the data provided as well as the intended output of the file.

Planning action

When an item is reported as missing, the following information is visible on a corporate dashboard: Order number, item reference and name, the section it belongs to, the quantity that was reported as missing and the date of this action. With this information, the stock reliability team can visualize the information about the item and look for it in all the possible locations in the store, then correcting the stock in the system. To avoid repetition of work, a field should be created in the same file to record the name of who is acting on each item, as well as what treatment has been carried out. Figure 4.10 visually explains this. Since this action mainly impacts the work of the stock reliability team and has no impact on the work of the picking team, it will be implemented at the same time as the others, namely the file that was developed during the month of March will begin to be used in the first week of April.

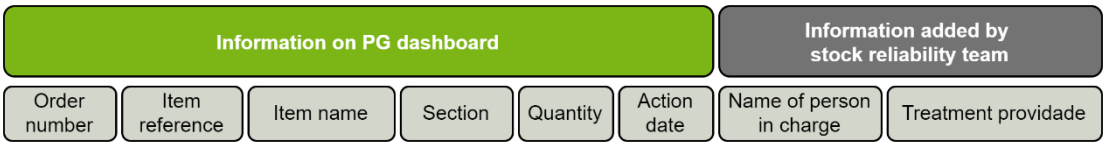

Figure 4.10. Structure of the document of analysis of the missing items.

Taking action

To start the process, a team meeting was held with both the stock reliability team and the picking team, where the TLs explained what changes were going to be made. In the case of the stock reliability team, a training session was also held so that everyone knew how to use the file. This file began to be used by the team on April 1st and after a week all doubts had been cleared up and the task was carried out daily without much additional effort. Annexe M shows a print screen of the file.

Evaluating

It is known that until the implementation date (and since November), the average value of missing items was 14.4%. As of July 1st, three months after the file was launched (and since April 1st), the average number of missing items is 14.2%. This difference is not significant enough to conclude that this action will increase stock reliability, leading to an increase in productivity. However, it is considered that the time that has elapsed since the implementation of the file is too short to see results since they will only appear when all the items with incorrect stock are ordered once, followed by the identification of the anomaly and, in turn, the correction of the stock. It is not possible to know how many items are in the store with incorrect stock, nor when they can be ordered by customers. Therefore, to see the results of this action, we would need to wait a longer time and then carry out a proper analysis, which is not possible in the time frame for this project.

E.4: Standard work instructions for packaging

Diagnosing

Having learned that poor packaging has an impact not only on customer satisfaction but also on the productivity of the picking team, as it generates waste related to rework, it's time to develop these work instructions to increase productivity.

Planning action

It was observed how the pallets and items were packed over a few days, reinforcing that not all the workers performed this task likewise. During this observation period, some errors were identified in line with the company's view, namely: areas not covered by film, corners not protected, items of various sizes mixed up, items without identification of fragility, etc. In addition, it was noted that sometimes items are packed with just one layer of film and other times with several layers. The packaging instructions will be carried out for a certain number of items as they are the ones that have

been identified as the most likely to have incidents due to poor packaging, as mentioned in ARC D4 in sub-chapter 4.5.1.

It’s known that some stores have already been through this transformation and although they don't have a documented procedure, they have changed the packaging process to make it more uniform. As such, some visits were made to these stores, that worked as a reference of the good practices. To create these documented procedures, various experiments will be carried out with the in-store picking team to find out which solutions are most suitable. Once completed and approved by the logistics managers, these instructions should be printed out and placed near the packing area for quick access. It will be the TL's responsibility to ensure that the document is updated and always available.

Taking action

During the visit to two reference stores in the packaging of items, questions were asked to understand the criteria behind the standards followed and several photos of good practices were taken (later used in the work instructions). It emerged that the first step is to pack the item itself so that it can be moved between pallets, if needed, and then to ensure that the item is secure on the pallet. At the Alfragide store, photos were taken of incorrect packaging. For items where it was not possible to analyse the packaging in the stores visited, such as plasterboard and toilets, the team tested the most effective way of packing, following the same rules as previously presented.

After a survey of good practices and incorrect gestures regarding the packaging of items was completed, the document with the standard work instructions was developed in early March. For each type of item previously identified, the correct way of packaging was explained, ensuring that the item itself is protected, well packaged and secured. It was also explained which gestures and forms of packaging are incorrect, according to the company's perspective on this subject. The final document, after being analysed by the logistics managers, can be found in Annexe N. Note that it is in Portuguese because all the workers are Portuguese speakers. Finally, a few copies of the document were printed and placed in the packaging area, followed by an explanation to the team of the new work instructions to be followed.

Evaluating

The whole team quickly began to follow the packing instructions without difficulty or resistance. In just 3 months the number of incidents detected in proportion to the number of orders delivered from the Alfragide store, went from 4.82% (March 2024) to 0.4% (June 2024). In addition, as the logistics manager mentioned, the change in layout had a major impact on this measure, as the team's working conditions were greatly improved, highlighting the fact that the packaging material and the necessary resources were now easily available and closer to the packaging area.

4.6.2. Implementation consolidation and results

In short, four actions were taken to improve the in-store picking process with a view to increasing productivity. The layout change aims to reduce interruptions, reduce travel times between the various stations and reorganize the arrangement of equipment and materials to create a continuous flow in the task. The restructuring of the team, although not carried through for the reasons given above, envisaged a reduction in wasteful movements between floors. The procedure for missing items aims to take action on items that are missing, correcting the stock and preventing it from happening again, i.e. spending time looking for items with the wrong stock. The standard work instructions for packaging aim to standardize the process, improve the quality of the product and reduce the waste associated with rework. Regarding implementation, Figure 4.11 shows the timetable of implementation. Some were carried out simultaneously, especially the procedure for missing items, which had an impact on the stock reliability team rather than the in-store picking team. We tried to carry out the remaining actions in stages, but it wasn't always possible because it had to be aligned with the store's availability.

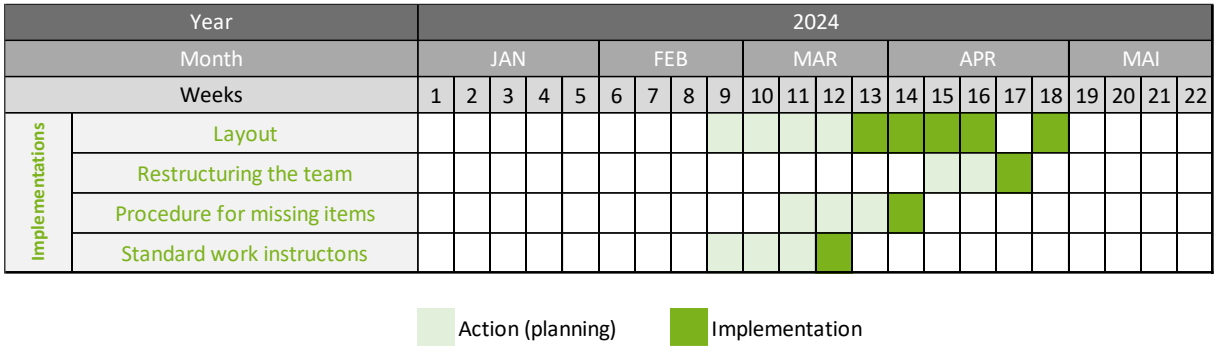

Figure 4.11. Schedule of implementation of improvement actions

The main focus of this project was to increase the productivity of the picking team without ever compromising the customer's due date. In fact, throughout the project, there was always great concern about meeting the customer's due date, so the activity never stopped completely in favour of focusing more on improvements, thus fulfilling the company's objective.

In addition, after a few months of working with the improvements implemented, it is possible to analyse the evolution of productivity. Figure 4.12 shows the productivity of the in-store picking team recorded since the beginning of September. In this figure, it can be seen that in the first few months of data collection, productivity was quite low and constant, at around 30 lines/hour/FTE, as presented in section 4.2. However, there was an upward trend as soon as the team began to be involved in the project, namely through training and the implementation of the huddle board. Subsequently, after implementing the proposed actions, which took place mainly in March and April, productivity grew even more sharply, with average productivity from May onwards being 66.4 lines/hour/FTE.

This increase in productivity was achieved not only due to the increase in the number of lines picked on time but also by reducing the number of FTE allocated to tasks each day. After the improvements were implemented, an average of 304 lines were picked per day. In contrast, until the end of April (i.e. until all the implementations were completed), this value was around 219 lines. The number of FTE allocated to the task fell from an average of 5.9 FTE per day to 4.7 FTE per day. Employees now have more time to dedicate to other tasks within the store's logistics activity without the in-store picking task being compromised. In addition to the developments observed in productivity, there were also improvements in other indicators. The time spent on activities with low added value for the customer, such as time spent searching or waiting, fell by 4.45 and 1.91 percentage points respectively. The number of incidents of poor packaging in orders sent from the Alfragide store also fell from 4.82% to 0.4% in just three months.

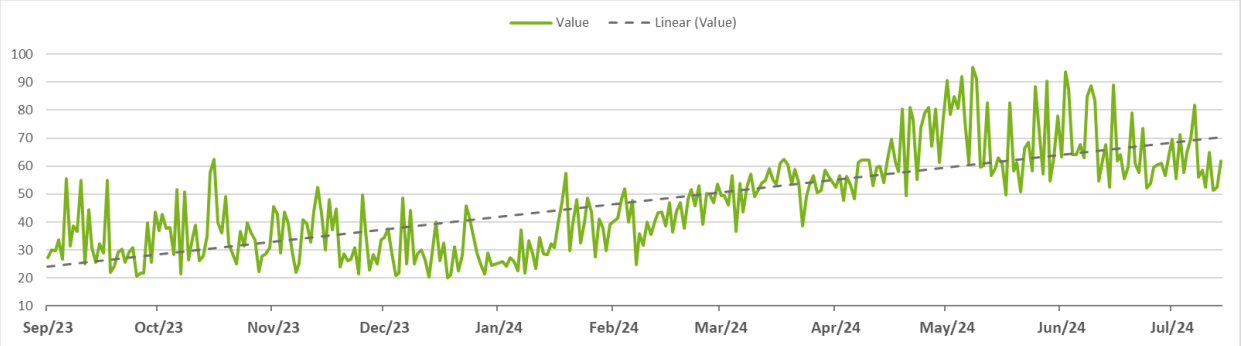

Figure 4.12. Evolution of productivity during the project period.

Finally, these changes and their impact were highly appreciated by the operational logistics manager at regional level, who stated that:

> *The improvements in picking following the development of this project are noticeable. The teams work with the space adapted to their real needs as well as the needs of the business. The productivity of the picking process has increased significantly, from 30 to 65 lines per day per FTE. Another point that brought major improvements in terms of home delivery incidents was the packaging book that was developed, with clear rules to mitigate problems when transporting items. The Alfragide team is very grateful for the project developed over the last few months.*

4.7. Sustainability

Lastly, the embodiment of this framework will only be realized when sustainability is attained, and new work routines are created. Otherwise, the improvements implemented would soon be lost, and the workers would go back to their old routine because it was their comfort zone. Some measures were then developed to ensure the sustainability of what was developed, which are presented and explored in this chapter.

4.7.1. Action research cycle F.1 – Top management support and commitment towards lean transformation

Diagnosing

During the process, it was felt that the operators were always seeking approval from the managers to do things differently and according to the new guidelines. It is believed that without regular follow-up from managers, the initiatives developed over the last months will quickly fall by the wayside.

Planning action

To prevent the changes from being jeopardized and to guarantee their sustainability, it is necessary to create and ensure a continuous review of the methods and tools applied. As Ferreira et al. (2023) propose, one of the ways to do this is through a checklist with various activities to be carried out by managers, varying the frequency depending on the monotony of the task. This checklist must include at least one activity to ensure compliance with each of the improvements implemented. Other generic activities that ensure the team follows lean principles can also be included.

Taking action

The checklist was created by the researcher, taking into account the knowledge of the routine of a logistics manager and their availability, including activities related to layout changes, standard work instructions for packaging and the procedure for missing items. The checklist is presented in Table 4.5.

Activity	Frequency
Gemba walk (ensure compliance with the new layout)	Daily
Attend a huddle meeting	Weekly
Performance discussion + problem-solving sessions	Weekly
Check if the standard work instructions are updated	Monthly
Meeting with the reliability team manager to check the process of missing items	Monthly

Table 4.5. Lean implementation sustainability checklist

When the checklist was presented to the logistics managers, a small meeting was also held to understand their long-term vision of what has been implemented, determining that they believe in the importance of a lean vision to continuously achieve the team's objectives.

Evaluating

The opinion of the logistics managers was that the tasks presented on the list made sense for monitoring the implementations. However, they showed concern about their ability to fulfil the expected frequency. It was then decided that for the first three months, starting in July, they would follow the plan presented and that after that, they would review whether the frequency presented made sense or should be changed. The subject was then raised that even if the frequency is changed,

none of the tasks should be allowed to fall by the wayside because the workers will no longer feel the importance of the associated implementation, and the progress achieved so far could be lost.

4.7.2. Action research cycle F.2 – Consolidate and extend results

Diagnosing

Another way of guaranteeing project's sustainability is by motivating employees for the task. Ever since the huddles began, it was clear that productivity monitoring was encouraging and fostered the desire to do more and better. However, the visualization of productivity was only daily, and they could only see data for the week itself because the values on the board were erased at the end of the week. Thus, a mechanism was needed to make this data accessible over time.

Planning action

Given the team's daily routine, the most appropriate way to consolidate this data is in digital format, as it is safer and more flexible to consult. In discussion with the logistics managers and the TL, it was agreed to create a "monitoring file" based on the following principles:

- Having an intuitive base (with simple instructions) for TLs to enter data daily.
- Analysis of the evolution of data over time, especially productivity
- Support in decision-making by logistics managers and to serve as a reference for future actions

Taking action

Following the above, the monitoring file was then created, and a screenshot of it can be found in Annexe O. The TL was involved in creating the file in order to adapt it to their needs and the data available. Afterwards, the file was presented to the team in a huddle and the reasons behind its creation and its usefulness were explained. It was necessary to emphasise that this does not mean more work but that it is a working tool and a facilitator for analysing performance indicators. Although it is the TL's responsibility to fill it in, the operators were also taught how to use it so that the system does not halt when someone is absent.

Evaluating

The monitoring file proved to be very useful as soon as it was implemented. As it was easy to replicate, the store logistics director requested its replication for all stores of the same size and, subsequently, for smaller stores. This allows a centralized view and analysis of store logistics as a whole. However, as the data is entered manually and the file could be more robust, there is much room for improvement as there was always a need for follow-up by the person responsible for the file to correct errors and clarify any doubts.

5. Conclusion

Given the company's proactive stance in acknowledging the inefficiency of the in-store picking process, particularly at the Alfragide store, the project was met with open arms. The picking process at the Alfragide store was notably less productive than in other stores, with significant waste identified throughout the process.

In order to meet this challenge and answer the research question presented, a study was carried out into what had already been covered in the literature on the subject, concluding that the picking process in the warehouse is a widely studied subject. However, when it comes to the picking in the store, there is a significant gap in the number of studies carried out. It was also investigated which methodology is more suitable, considering the use of lean management tools. Considering the reality of the project, an adapted version of a lean implementation methodology was created, integrating it with the action research methodology.

To answer the research question “How to increase the productivity of the in-store picking team, guaranteeing compliance with the customer due date at Leroy Merlin?,” several moments of direct observation and brainstorming sessions were done with various stakeholders. In addition, because this research utilises the lean methodology, including process mapping, cause-effect diagrams, spaghetti diagrams, among others, were also applied to identify the main causes of this team's low productivity and possible solutions to address these causes. Various improvements were implemented, such as changing the layout, standardising processes and creating a new process that did not exist. The team's restructuring was also tested, although it was not implemented due to various impediments. These improvements and the team's involvement in the project and with the lean management concepts had a prompt impact on productivity. It went from an average daily value of 30 to around 65 separate lines per day per FTE (116.6% increase).

The impact of the project was immediate, primarily attributed to the layout change and the shift in the team's mindset. The other improvements are expected to have a long-term impact, particularly in terms of customer satisfaction. In addition to the boost in productivity, there was a noticeable increase in employee satisfaction. They began to feel empowered to suggest small improvements that could significantly impact their daily work, a result of the regular monitoring of results and daily huddles.

With the positive results obtained, the company has expressed a strong interest in expanding the project and replicating successful actions in other stores. This commitment not only aims to increase individual store productivity but also to enhance the company's overall efficiency. Despite the setbacks and the significant investment required, the project's success and its significant impact on the company's operations are undeniable.

Despite the success and knowing that no process improvement project is perfect, some limitations were found during this work. Right from the start of the project, there was a lot of resistance and disbelief on the part of the employees when they still did not understand the objectives, especially on the part of the TL, which delayed data collection and implementation. In addition, the fact that the picking tasks were created using a central computer system and defined in the APP meant that no changes could be tested. It was often difficult to get the necessary information, or it was not possible to access it, which meant that a lot of data had to be collected manually, slowing down the process. Finally, the lack of availability on the part of the logistics managers and the pressure imposed on the employees to meet deadlines were also limitations in getting people together at the necessary times.

Although the desired results were achieved, there is still, and will always be, room for improvement. That is why a few ideas have been put together for future work related to the company and the topic. During the project, the idea of analysing the items with the highest demand in in-store picking was discussed to create a stock area for these items, possibly reducing the number of movements made. This proposal for future work involves a detailed analysis of a wide range of items, considering their stock rotation, seasonality and available space. The restructuring of the team has not been taken forward, but there is an opportunity for it to be rethought and better studied because although the TL has raised many limitations, and it is something that the logistics managers believe could improve the employees' work. Another idea is the intervention through 5S actions because, despite all the reorganisation of the space, there are still opportunities for improvement, particularly regarding compliance and identification of spaces and cleanliness. Finally, a more targeted study of the application that displays the picking tasks (Pick&Go) is proposed, testing the best combination of parameters for grouping items in a task and the possibility of customisation by each store to better adapt to each reality.

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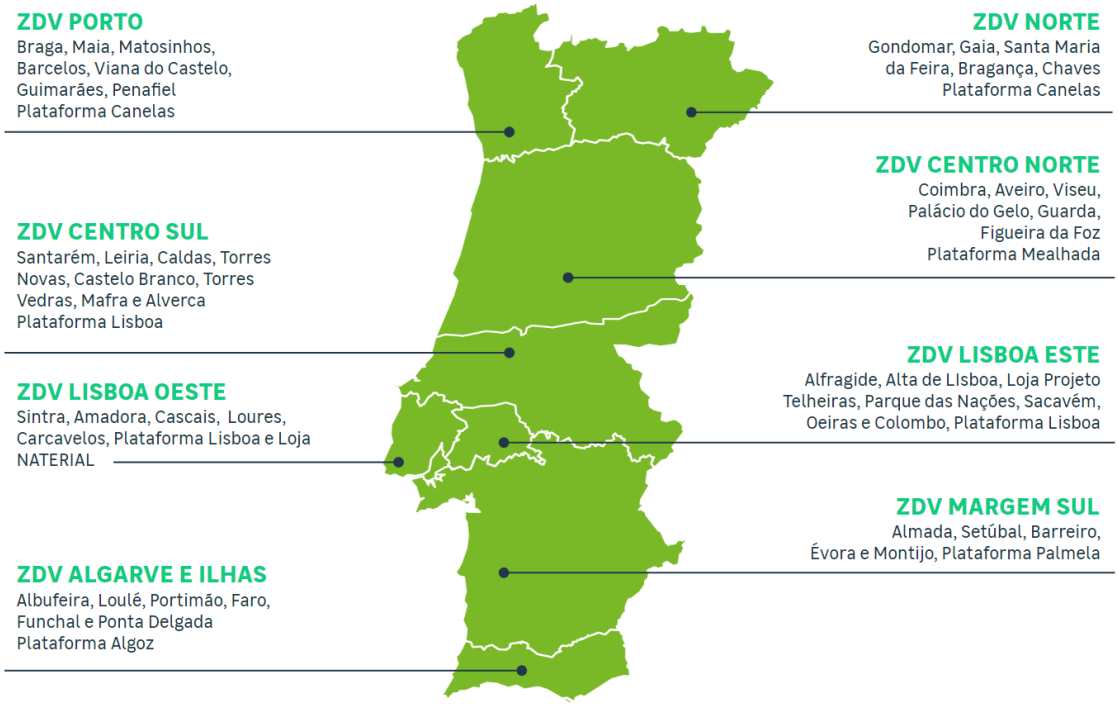
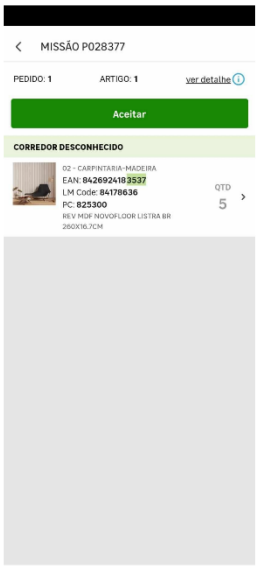
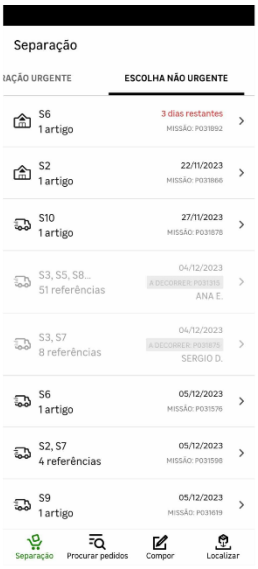
7. Annexes

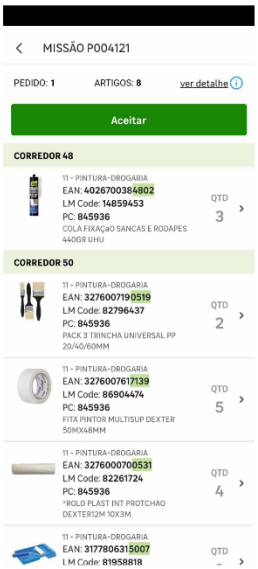
Annexe A - Geographical distribution of the stores



Annexe B - PG screenshots





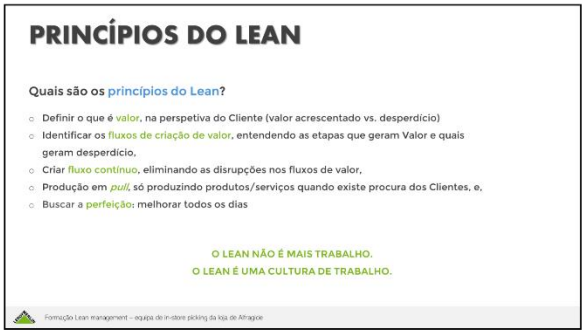


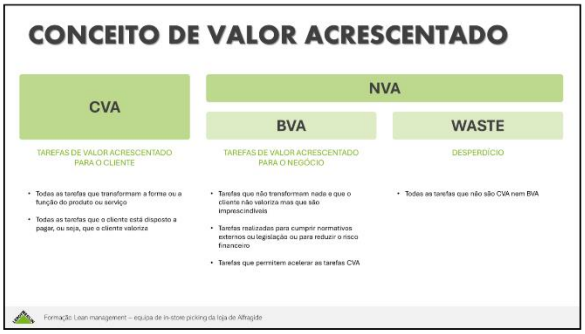
Task	Description
Walking	Moving either in the store or in the warehouse, on empty to get to a specific location. When in the store, it is considered "Walking" when the movement between two picking points is made in the opposite direction to the warehouse, even if material is being transported.
Transporting	Moving either in the store or in the warehouse to transport the load (picked items) from one place to another. There may be tasks to be carried out between two transport periods, for example, assembling and packing supports.
Search for place, technical material or items	It is usually associated with physical movement (walking or transporting), but it is considered "searching" due to the uncertainty of the location to be moved to. In the case of picking items, the search consists of checking the product's characteristics, price, and reference.
Pick&Go	Checking the PG application to scroll through available and running tasks, checking the items to be picked and their properties, accepting and stopping tasks, etc.
Place item on the cart	Remove item from shelf, scan barcode, pack item (where necessary), label (if applicable) and put item on the cart. Performed in-store.
Assemble and Pack pallet	Move items from the stand to the support (normal pallet, double pallet, T pallet, cage...), pack them safely, film the pallet and apply a label. Performed in the warehouse.
Administrative work	Using the computer to analyse orders (checking internal messages or the delivery circuit), printing pallet inventories for dispatch, etc.
Ask for help/communicate	Communicate, in-person or by cell phone, to obtain or pass on information.
Waiting for free space/information/ material	Time when no other task is being carried out because something or someone is waiting, usually blocking the next task from being executed.
Others	Tasks that are not part of a picker's job description but are unavoidable or necessary to carry out their duties.

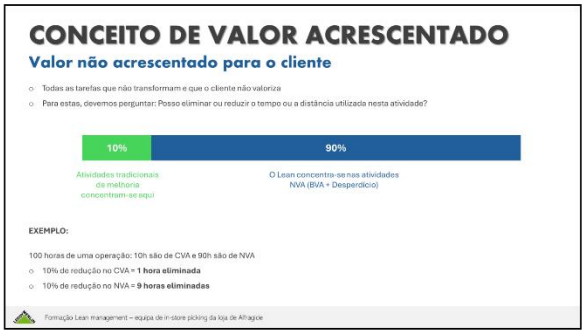
Annexe D - First activity sampling records

Nº		OBS1	OBS2	OBS3	OBS4	OBS5	OBS6	OBS7	OBS8	OBS9	Total
Registers		473	467	919	876	596	731	597	513	626	
Activities	Walking	92	88	201	125	79	130	82	95	140	1032
	Transporting	58	43	85	65	55	63	79	52	89	589
	Search for place, tecnical material or items	70	59	129	82	45	72	74	61	67	659
	Pick&Go	24	52	45	74	68	73	52	55	81	524
	Place item on the cart	20	48	46	42	43	86	72	65	43	465
	Assemble and Pack pallet	85	89	145	388	108	171	90	94	49	1219
	Administrative work	54	23	83	11	18	26	48	39	35	337
	Ask for help/communicate	45	15	49	25	75	19	23	14	25	290
	Waiting for free space/information/material	13	28	18	31	45	23	52	28	54	292
	Others	12	22	118	33	60	68	25	10	43	391

Annexe E - Slides used for the training







TIPOS DE DESPERDÍCIO

PRODUÇÃO EXCESSIVA

Produção ou processo não estão ajustados à procura

TIPOS DE DESPERDÍCIO

DEFEITOS

Não conseguir realizar a tarefa bem à primeira

EXEMPLOS DE FERRAMENTAS LEAN

5S

Aumento da Produtividade dos Ambientes Físicos e Virtuais

(Armazéns, Lojas, etc)

SALA OBEYA / QUADRO EQUIPA

Aumento da Comunicação e Alinhamento das Equipas

(Operações + Sede)

EVENTOS KAIZEN

Aumentos drásticos e rápidos no nível de desempenho de Problemas

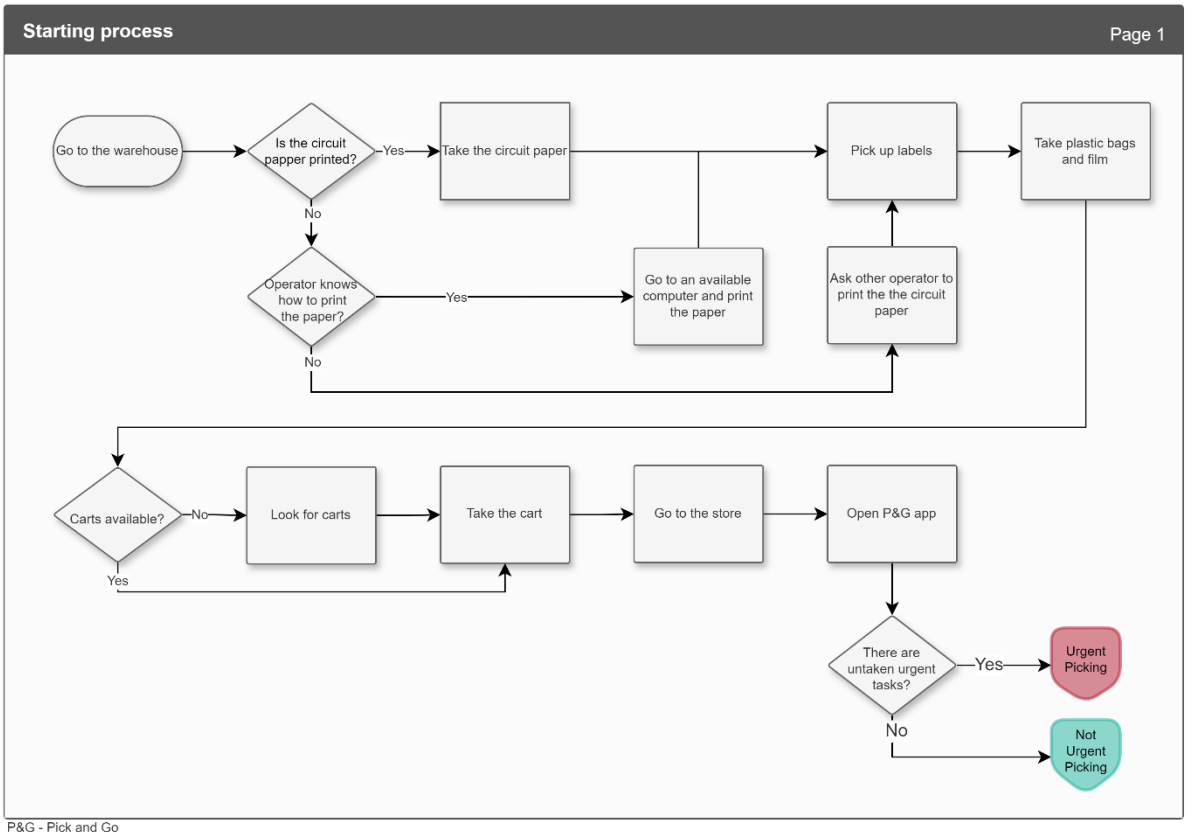
(Operações + Sede)

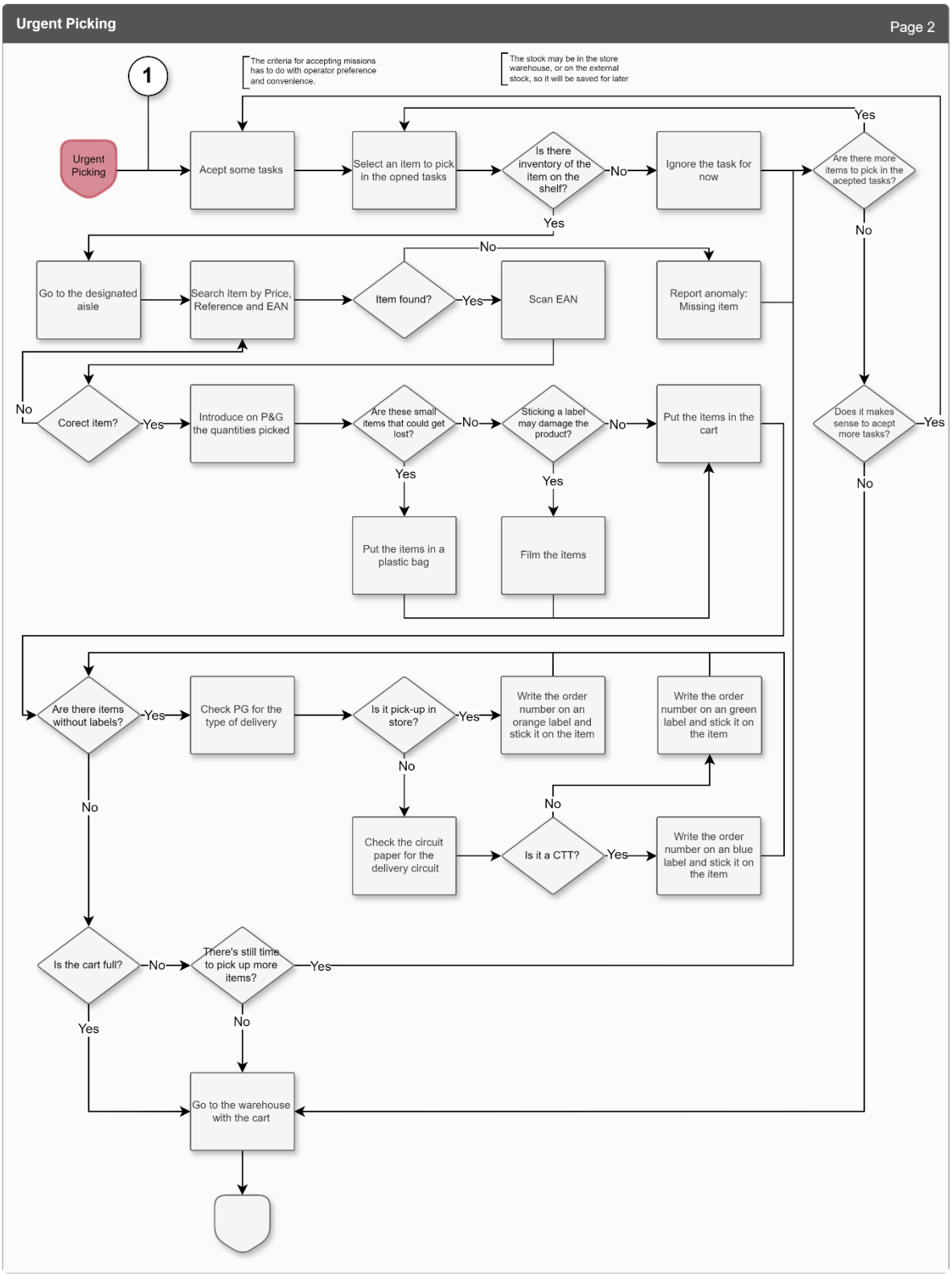
MELHORIA CONTÍNUA

"A melhoria contínua é uma abordagem sistemática que procura realizar mudanças graduais e incrementais em processos, produtos ou serviços ao longo do tempo. Destaca-se pela recolha de dados, participação dos colaboradores e adaptação contínua às exigências do mercado, visando melhorar a eficiência, qualidade e desempenho global da organização."

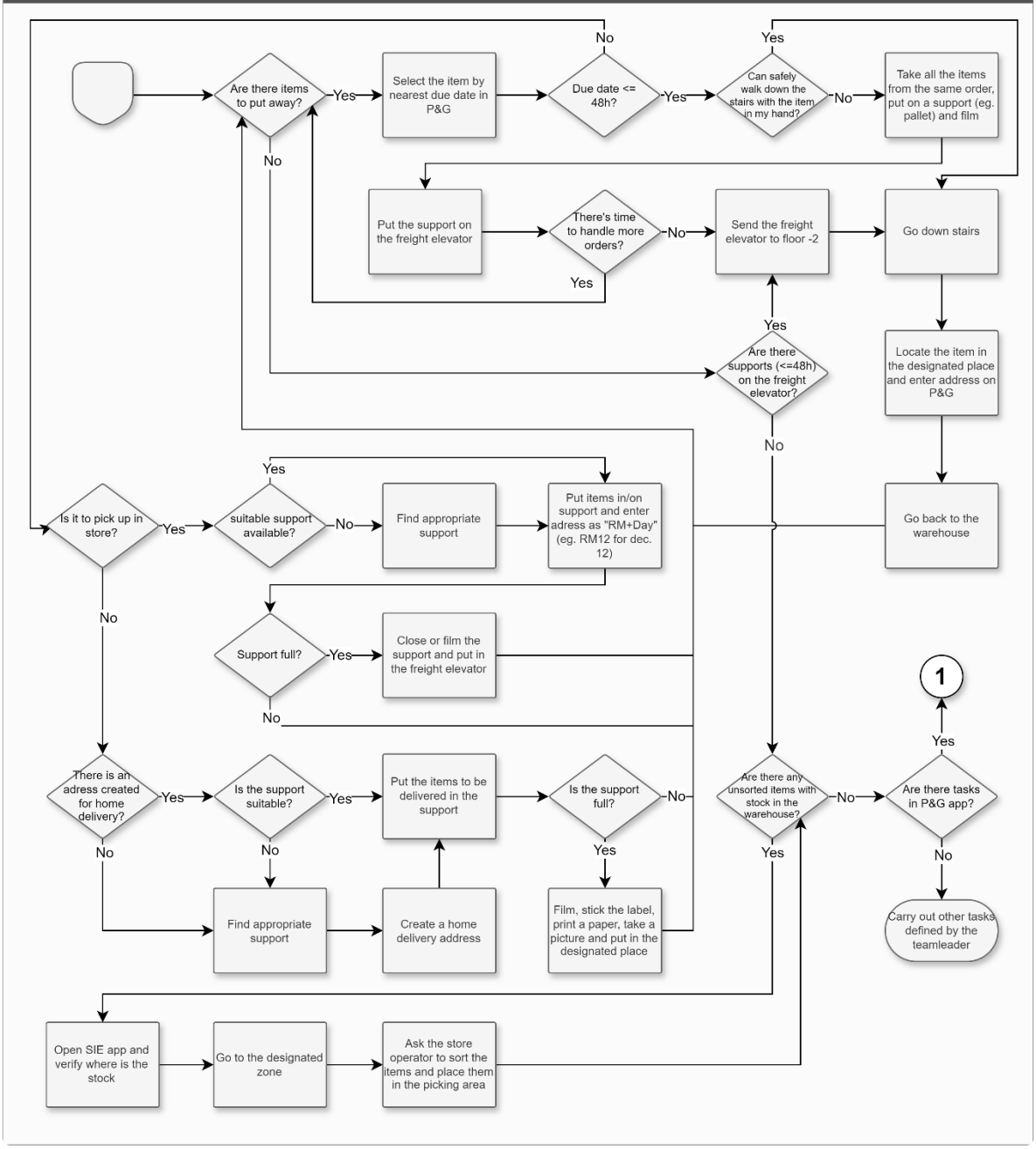
- Melhorar as coisas aos poucos
- Pequenas melhorias todos os dias são melhores do que uma grande melhoria de uma só vez.
- Melhorias com impacto para a empresa, para a Logística Loja e para o cliente

Annexe F - Process mapping

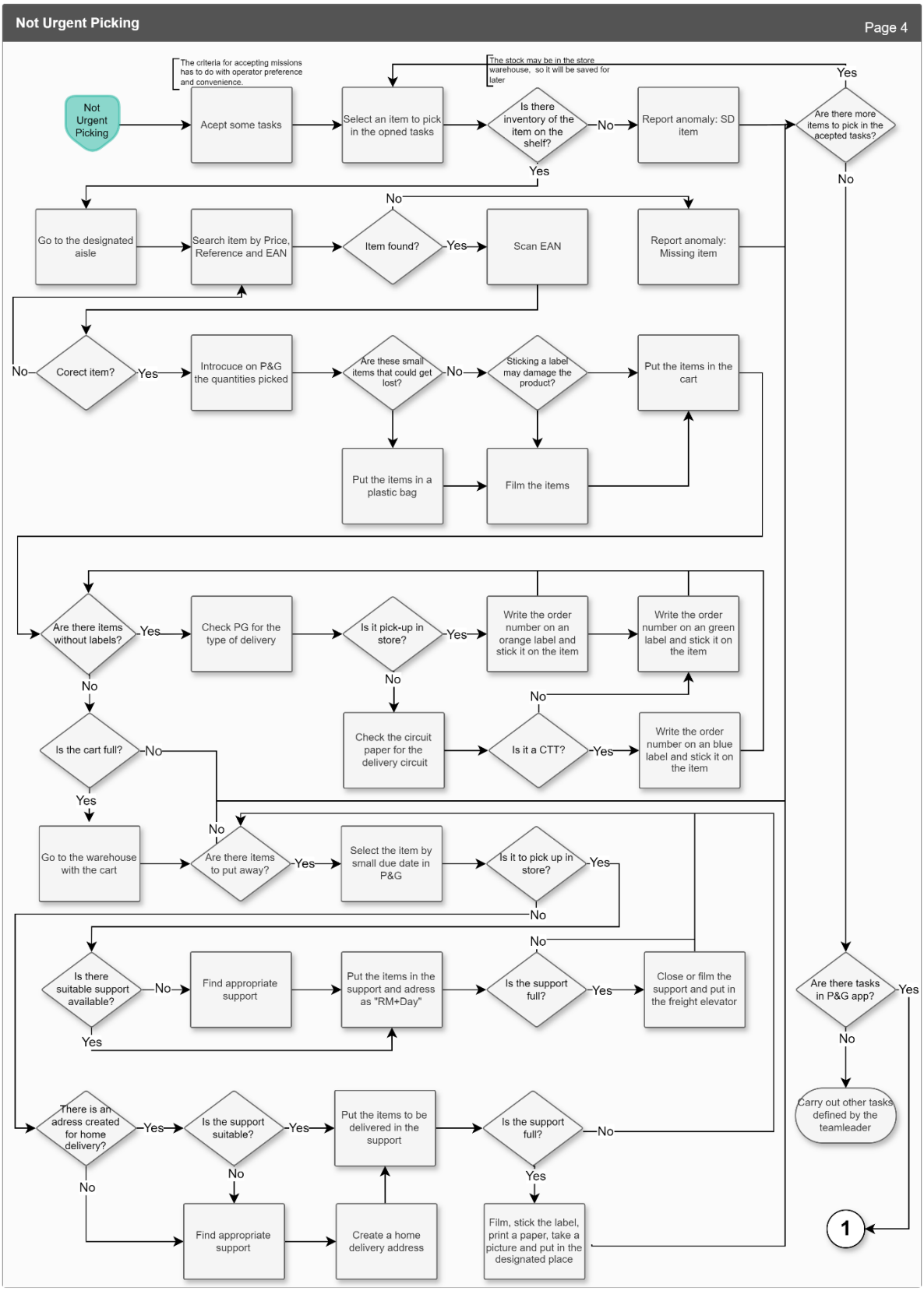




P&G - Pick and Go
EAN - European Article Number
CTT - Correios de Portugal, S.A. [Portuguese postal service]

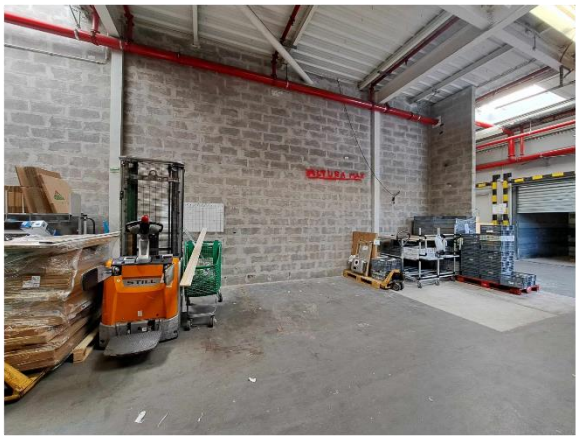


SIE - Stock It Easy



P&G - Pick and Go
EAN - European Article Number
CTT - Correios de Portugal, S.A. [Portuguese postal service]

Annexe G - Warehouse at the start of the project



Observation 1

Time of observation: 1h48

Notes: Both urgent and non-urgent tasks were carried out

Observation 2

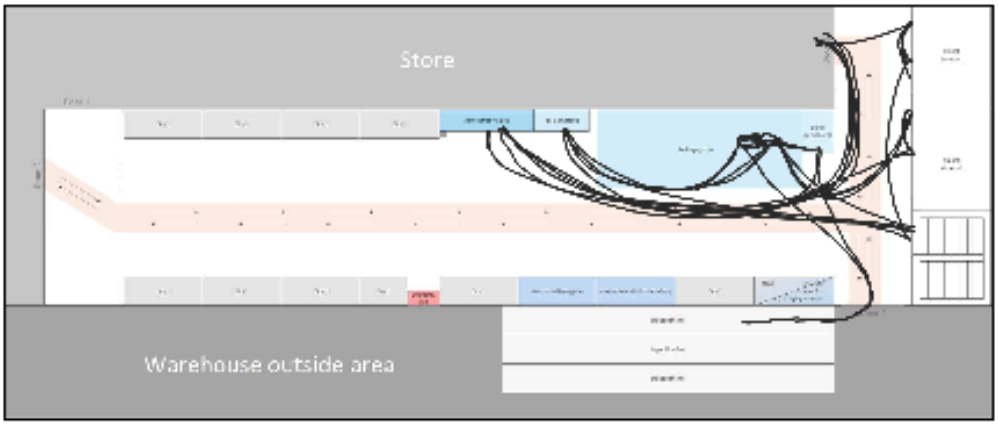
Time of observation: 1h33

Notes: Both urgent and non-urgent tasks were carried out

Observation 3

Time of observation: 1h21

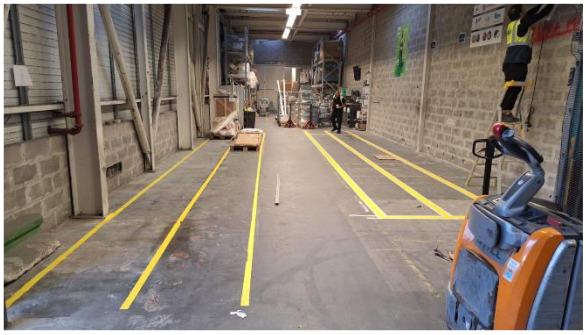
Notes: Only urgent tasks were carried out

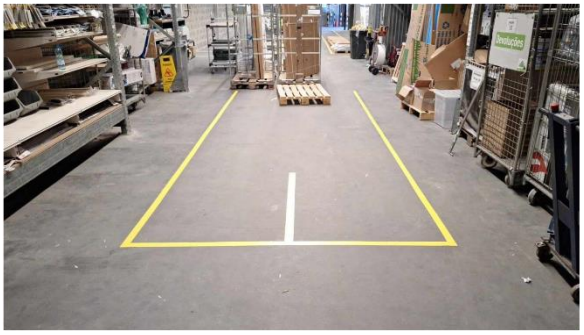


Annexe I - Results of the customer satisfaction survey on order incidents

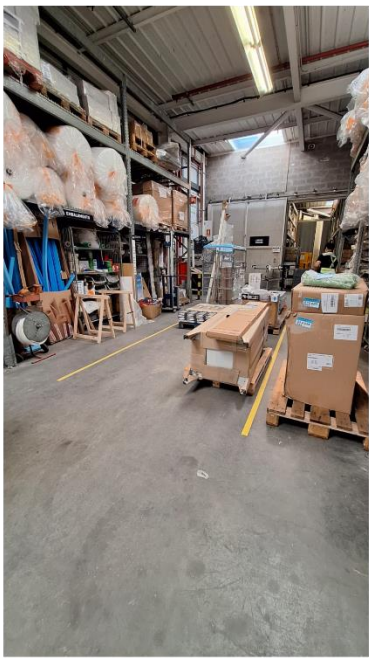
Item	N. of incidents	% in total
Skirting boards	21	13,5%
Ceramics	18	11,5%
Solar panels	17	10,9%
Sanitary ware	16	10,3%
Kitchen furniture	16	10,3%
Plasterboard	12	7,7%
Complementary products	11	7,1%
Worktops	10	6,4%
Chairs and loungers	9	5,8%
Heat pumps	9	5,8%
Others	6	3,8%
Building material	4	2,6%
Grass	3	1,9%
Decorative items	1	0,6%
Lamps	1	0,6%
Wood	1	0,6%
Paints	1	0,6%
Total	156	100,0%

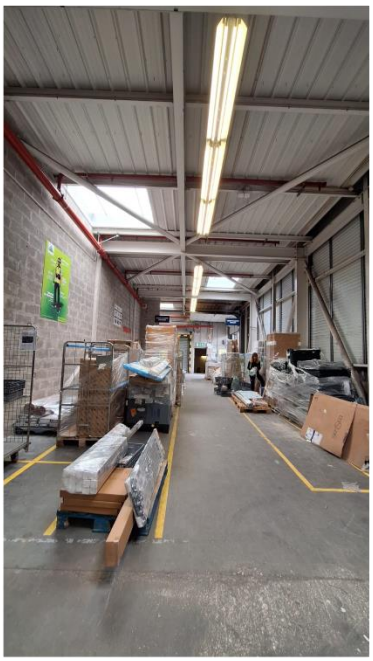
Annexe J - Floor identification after layout change





Annexe K - Layout after the change

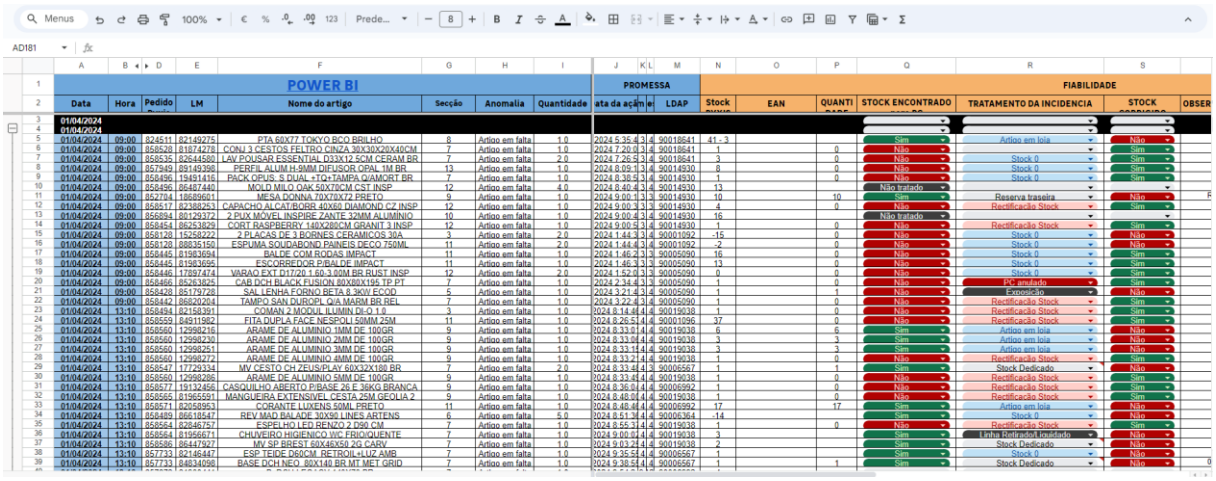




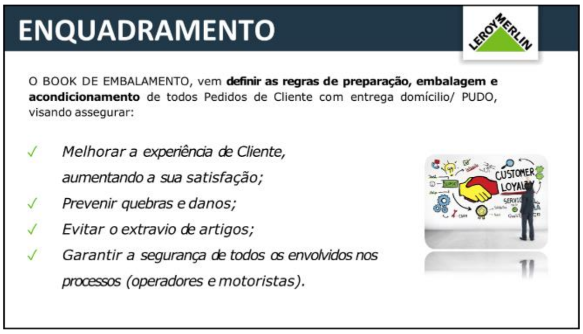
Annexe L - Second activity sampling records

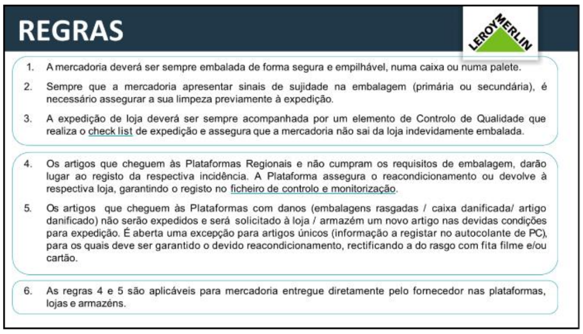
Nº		OBS1	OBS2	OBS3	OBS4	OBS5	OBS6	OBS7	Total
Registers		670	883	766	513	459	685	877	
Activities	Walking	134	239	157	102	92	153	134	1011
	Transporting	92	73	42	56	65	90	102	520
	Search for place, tecnical material or items	34	92	18	36	43	46	67	336
	Pick&Go	67	104	43	30	36	32	65	377
	Place item on the cart	52	90	65	43	45	41	92	428
	Assemble and Pack pallet	156	68	240	110	94	139	267	1074
	Administrative work	64	24	43	5	47	50	32	265
	Ask for help/communicate	22	76	43	45	12	27	40	265
	Waiting for free space/information/material	9	33	23	12	8	45	22	152
	Others	40	84	92	74	17	62	56	425

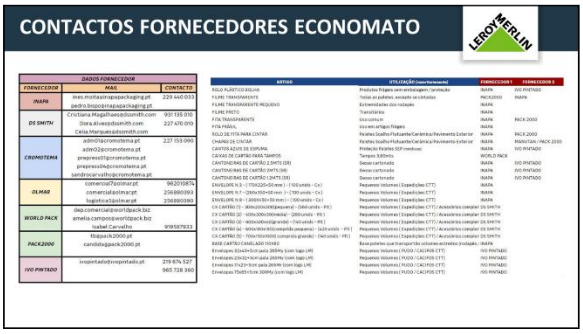
Annexe M - Screenshot of the monitoring file for missing items



Annexe N - Standard work instructions for packaging







COMO EMBALAR TAMPOS

Devemos assegurar o embalamento da seguinte forma

1. Devemos embalar os tampos com embalagem de cartão canelado
2. Em alternativa, garantir que colocamos espuma azul em todas as arestas do tampo, garantindo também a aplicação do plástico bolha em toda a superfície
3. A superfície visível do tampo não deve ser colocada em contato com a palete (garantir que vem para cima)

Return

COMO NÃO EMBALAR TAMPOS

NÃO ENVIAR MERCADORIA ASSIM

1. Sem qualquer proteção
2. Superfície não deve vir em contato com a palete
3. Não devem ser enviados tampos sobrepostos sem qualquer proteção entre eles

Return

COMO EMBALAR CERÂMICA

Devemos assegurar o embalamento da seguinte forma

1) As caixas devem ser sempre colocadas na vertical (cutelo)
2) Quando temos várias referências para a palete, a base da palete deve ser feita sempre com o Pavimento (mais resistente e depois o Revestimento
3) Devemos utilizar cintas para garantir a estabilidade dos artigos
4) Aconselhamos que o peso total de cada palete não deve exceder os 950kg

Return

COMO NÃO EMBALAR CERÂMICA

NÃO ENVIAR MERCADORIA ASSIM

1. Sem estabilidade na palete
2. Sem estar paletizada no suporte adequado
3. Apenas nos "tacos" do fornecedor

Return

COMO EMBALAR GESSO CARTONADO

Devemos assegurar o embalamento da seguinte forma

1. As arestas devem ser protegidos **na sua totalidade** com cartão rígido ou espuma azul
2. Por suporte não deve ser ultrapassado o condicionamento do fornecedor (42 unidades)
3. Devem ser transportados sobre estrados americanos / paletes duplas

Return

COMO NÃO EMBALAR GESSO CARTONADO

NÃO ENVIAR MERCADORIA ASSIM

1. Sem proteção
2. Sem estar paletizada no suporte adequado
3. Apenas nos "tacos" do fornecedor

Return

COMO EMBALAR PAINÉIS SOLARES

Devemos assegurar o embalamento da seguinte forma

1. Todas as laterais devem estar protegidas com espuma azul;
2. Os painéis devem ser embalados individualmente e com espuma de proteção na frente do painel para não raspar)
3. O painel deve ser transportado na vertical e em forma de cutelo
4. Na sobreposição de painéis, garantir que os pontos de contacto estão protegidos

Return

COMO NÃO EMBALAR PAINÉIS SOLARES

NÃO ENVIAR MERCADORIA ASSIM

1. Sem qualquer embalamento
2. Sem proteções nos cantos
3. Painéis sobrepostos sem qualquer proteção
4. Não deve ser sobreposta qualquer outro tipo de mercadoria junto aos painéis
5. Não devem se transportados painéis deitados nas paletes

Return

COMO EMBALAR BOMBAS DE CALOR

Devemos assegurar o embalamento da seguinte forma

1. Todas as laterais devem estar protegidas com espuma azul;
2. As bombas devem ser transportadas na vertical / deitadas
3. No caso de bombas com embalagem em cartão, garantir que o cartão é mantido no transporte.
4. Não acondicionar outro tipo de produtos na mesma palete da bomba de calor.

Return

COMO EMBALAR SANITÁRIOS

Devemos assegurar o embalamento da seguinte forma

1. Garantir que colocamos plástico bolha em volta da superfície (mínimo 2 voltas)
2. Evitar sobreposição de outros artigos
3. Suporte adequado ao transporte (quantidade e tamanho da loiça sanitária
4. Acondicionar as sanitas em meias paletes

Return

COMO NÃO EMBALAR SANITÁRIOS

NÃO ENVIAR MERCADORIA ASSIM

1. Os sanitários sem embalagem de cartão, mais suscetíveis a quebra, devem ser sempre embalados
2. O embalamento não pode ser apenas fita filme
3. Não pode ser transportado em contato direto com a palete

Return

COMO EMBALAR COMPLEMENTARES

No caso de um artigo em que temos uma referência LM, mas é composto por 2 objetos / caixas

1. A expedição do artigo deve ter em conta se a expedição é composta por 2 ou mais objetos
   a. Neste caso os objetos /caixas devem estar cintados e/ou fita filmados entre eles e com uma labell exterior colada que identifique o objeto
2. Caso a expedição seja em vários objetos / caixas, cada caixa deve estar identificada com uma labell
3. Nenhuma caixa deve ser expedida solta ou sem qualquer labell
4. O artigo deve estar paletizado e consolidado na encomenda total do cliente

Return

COMO EMBALAR COMPLEMENTARES

Sempre que um pedido de cliente tem artigos de pequena dimensão, os mesmos devem:

1. Estar devidamente identificados com a referência do nº do pedido de cliente
2. Acondicionados no interior de uma caixa de cartão, mono pedido, não selada (fluxo da loja para a plataforma Regional)
   a. Na entrega ao transportador, a caixa deve ser selada com fita cola.
3. O artigo deve estar paletizado e consolidado na encomenda total do cliente

Return

COMO NÃO EMBALAR COMPLEMENTARES

NÃO ENVIAR MERCADORIA ASSIM

1. Unidades soltas e misturadas no meio da palete
2. Sem qualquer identificação que não se associe ao cliente

Return

COMO EMBALAR CADEIRAS/ESPREGUIÇADEIRAS

Devemos assegurar o embalamento da seguinte forma

1. Base da palete com proteção de cartão à medida (proteção das pernas das cadeiras/espreguiçadeiras
2. Mercadoria devidamente cintada/filmada à palete
3. No caso das espreguiçadeira, é obrigatório virem sobre paletes duplas

Return

COMO EMBALAR PORTAS

Devemos assegurar o embalamento da seguinte forma

1. Portas embaladas na totalidade com Filme Bolha
2. SEP metálica com proteções espuma azul (aplica-se o mesmo no caso das paletes T)
3. Base do suporte protegido com cartão

Return

COMO EMBALAR COZINHAS

Devemos assegurar o embalamento da seguinte forma

1. Entre os móveis e as paletes, deve ser utilizada uma base que proteja os mesmos dos pregos das paletes
2. Móveis da cozinha cintados às paletes

Return

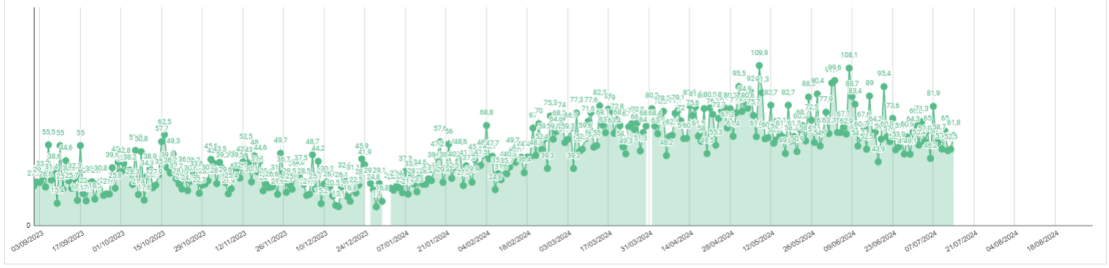
MANY
Thanks!

Annexe O - Monitoring file

Year	Nº month	Month	Week number	Day of the week	Day	Date	FT	PT 30h	PT 25h	PT 20h	Total de FTE	Lines Picked and adressed	Productivity (lines/hour/FTE)
2024	6	June	25	4	20	20/06/2024	3	0	1	0	3,6	346	95,4
2024	6	June	25	5	21	21/06/2024	4	1	1	1	5,9	358	60,9
2024	6	June	25	6	22	22/06/2024	3	0	1	0	3,6	209	57,7
2024	6	June	25	7	23	23/06/2024	2	0	0	1	2,5	184	73,6
2024	6	June	26	1	24	24/06/2024	3	2	1	1	5,6	293	52,1
2024	6	June	26	2	25	25/06/2024	5	1	0	0	5,8	310	53,9
2024	6	June	26	3	26	26/06/2024	4	1	1	1	5,9	350	59,6
2024	6	June	26	4	27	27/06/2024	4	1	1	1	5,9	289	49,2
2024	6	June	26	5	28	28/06/2024	3	1	0	1	4,3	259	60,9
2024	6	June	26	6	29	29/06/2024	6	0	0	1	6,5	319	49,1
2024	6	June	26	7	30	30/06/2024	3	0	0	0	3	193	64,3
2024	7	July	27	1	1	01/07/2024	3	0	0	2	4	279	69,8
2024	7	July	27	2	2	02/07/2024	4	0	0	2	5	277	55,4
2024	7	July	27	3	3	03/07/2024	3	0	0	0	3	214	71,3
2024	7	July	27	4	4	04/07/2024	4	0	0	0	4	231	57,8
2024	7	July	27	5	5	05/07/2024	4	0	1	1	5,1	333	65
2024	7	July	27	6	6	06/07/2024	4	0	1	1	5,1	237	46,2
2024	7	July	27	7	7	07/07/2024	2	0	1	1	3,1	256	81,9
2024	7	July	28	1	8	08/07/2024	4	1	0	1	5,3	295	56,2
2024	7	July	28	2	9	09/07/2024	4	1	0	1	5,3	308	58,7
2024	7	July	28	3	10	10/07/2024	4	1	1	1	5,9	309	52,6
2024	7	July	28	4	11	11/07/2024	5	0	1	1	6,1	398	65
2024	7	July	28	5	12	12/07/2024	3	1	1	1	4,9	251	51,5
2024	7	July	28	6	13	13/07/2024	6	0	1	2	7,6	400	52,5
2024	7	July	28	7	14	14/07/2024	3	0	1	2	4,6	286	61,8

Productivity

Year: Tudo
Month: Tudo
Week number: Tudo



Ano 2024

PICKING	JANEIRO	FEVEREIRO	MARÇO	ABRIL	MAIO	JUNHO	JULHO	AGOSTO	SETEMBRO	OUTUBRO	NOVEMBRO	DEZEMBRO
Média diária de FTE	5,9	5,1	4,3	4,2	4,6	5,1	5,0	5,1				
Total de linhas separadas	6009	7460	8711	9704	9711	9080	9020	4374				
Média diária de linhas separadas	200,3	257,2	281,0	323,5	313,3	302,7	291,0	312,4				
Média de linhas RSS por separar no fim do turno	519,9	460,4	467,1	599,8	566,6	509,1	654,9	496,0				
% de linhas com artigos em falta	13,6%	14,4%	16,0%	15,2%	14,3%	65,3%	16,0%	145,1%				
Produtividade	34,9	50,8	67,9	80,6	75,9	62,8	60,8	62,8				