

# INDUSTRIALISATION OF THE CURTAIN MANUFACTURING PROCESS

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**ABSTRACT** 

In this Final Degree Thesis the industrialisation of a small family business, Sactelyer, has been put into

practice. With the aim of industrialising the manufacturing process of making curtains.

Previously, the company's current manufacturing process is analysed to find the shortcomings and waste

it has. And it makes known the production capacity, the annual turnover, the manual tools and artisanal

methods it has.

Subsequently, the choice of equipment renewal and Lean Management as methodologies for improving

the company's competitiveness is justified and an analysis of the techniques and general components

thereof is carried out.

Once the different methodologies are explained, a study of the current textile market in Spain is carried

out, to see which trend is following and if it is the ideal time to invest in this sector.

Next, a study of the type of industrial machinery that will be implemented within the manufacturing

process is developed in order to increase production capacity tenfold, without the need to hire any

additional workers or to train employees.

Finally, three new industrial machines have been selected for production in Sactelyer. The specifications

of each of the machines and the effect they have on the speed of production have been studied. A 3D

model has been created to visualise the layout of the machines in space. Once the new machines are

implemented, the production speed is estimated and the results have shown an increase of 88.3% in

relation to the previous state. This increase in production speed will lead to a higher net profit for

Sactelyer, compared to the profit under the traditional manufacturing process.

**Keywords:** Industrialisation, Confection, Machine, Process, Capacity, Methodology

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#### 1. INTRODUCTION

This project aims to devise solutions for enhancing the competitiveness of the curtain manufacturing process within the established family company, renowned for its extensive experience of over 35 years in designing and producing a wide range of curtains and tapestries. Located in Barcelona, this esteemed artisanal enterprise comprises a dedicated team of 12 skilled workers.

Presently, the company primarily relies on manual tools and traditional techniques for crafting curtains and tapestries, resulting in extended processing times compared to its industry counterparts. Consequently, the primary objective of this endeavour is to stimulate demand for the company's production by integrating cutting-edge tools and machinery into its manufacturing procedures.

To accomplish this goal, an exhaustive analysis will be undertaken, encompassing diverse sectors, processes, tools, and machinery prevalent in the textile domain. Such a comprehensive assessment will pave the way for the seamless implementation of effective enhancements, ultimately yielding the desired outcomes.

Furthermore, a meticulous examination will be conducted to ascertain the practical feasibility of incorporating state-of-the-art machinery within the company's operations for curtain and tapestry manufacturing. A comprehensive evaluation of various income streams and associated costs will also be conducted to ascertain the company's profitability.

Drawing upon authentic data provided by the company, their unwavering commitment to the project, my engineering acumen, and the invaluable insights of an industry expert, the ultimate aspiration is to ensure the economic viability and efficacy of this innovative and transformative process.



#### 2. ORIGIN OF THE PROJECT

Originally, the notion of industrialising an artisanal process was initially centred around producing bespoke seat covers for competitive motorcycles, a niche offering within the family business. However, as we evaluated the various types of machinery required to meet the anticipated demand, it became apparent that the market projection for such customised covers was not substantial.

Nevertheless, the idea of technologically innovating a section of the workshop persisted. Upon comparing the two integral segments of the company, namely upholstery and clothing, it was noted that while both yielded similar individual profits, the clothing process exhibited a greater degree of repetition and standardisation across most designs. Therefore, this project for technological industrialisation primarily focuses on the clothing sector.

In addition to the integration of new machinery, an assessment of the current manufacturing process is also intended to be conducted. This evaluation aims to identify any existing losses or inefficiencies and develop viable solutions to optimise operations. It is crucial to establish a solid manufacturing foundation prior to the implementation of technology, ensuring preparedness for this new production approach.

#### 2.1. Sactelyer's History

The inception of SACTELYER can be traced back to its founder, Manuel Rey Piso, who discovered his true calling in the upholstery trade within the automotive sector of Estrada, his beloved hometown in Galicia.

After immersing himself in an extensive apprenticeship under the tutelage of esteemed master craftsmen in countries such as Brazil and Uruguay, Manuel embarked on a remarkable journey that led to the establishment of his own workshop in the vibrant city of Barcelona: King Upholstery.

Harnessing his unparalleled expertise amassed over a remarkable span of 35 years, King Upholstery solidified its position as a distinguished upholstery workshop. However, its unwavering pursuit of excellence drove the company to embark on a transformative path, culminating in the incorporation of clothing products under the distinguished brand, SACTELYER. This strategic rebranding ushered in a new era for the family workshop, rejuvenating it with a harmonious blend of tradition and innovation.



At the heart of SACTELYER's vision lies a deep-rooted motivation:

- To rekindle the essence and allure of upholstered furniture.
- To exalt the intrinsic value of noble and natural materials.
- To craft diverse textures that embellish every conceivable space.
- To salvage and repurpose discarded pieces, thereby contributing to the noble cause of sustainable production and consumption [1].

With an unwavering commitment to progress, SACTELYER is poised to embark on a technological frontier, spearheading innovation in the realm of clothing production. As the company paves the way for this exciting chapter, it strives to remain at the forefront of the ever-evolving technological landscape.

#### 2.2. Definition of the company

The company is an artisanal tapestry and textile product manufacturing workshop. As a tapisser, it is a skilled craft that involves covering or repairing furniture and other objects using materials such as fabrics, leather, foam, and other filling materials. This profession is in high demand due to the recent closure of numerous upholstery companies in recent years.

Upholstery work requires exceptional skill in measuring and cutting the appropriate materials, as well as executing precise cuts and embroideries tailored to each piece of furniture. Beyond providing an aesthetic touch to furniture, upholstery also serves to protect it from wear and abrasion. Tapissers possess the ability to create distinctive designs for their work, along with the expertise to restore damaged furniture by replacing worn upholstery with new materials.

Conversely, a tailoring workshop is responsible for the production of textile items including curtains, sofa covers, cushions, carpets, blankets, and more. This profession necessitates dexterity and proficiency in selecting suitable materials for each project, as well as executing precise cuts and seams required to complete each product. The tailoring workshop offers an extensive range of fabrics, leathers, faux leathers, and other materials to fulfil the diverse needs of their clientele.

These artisans must possess substantial knowledge of fashion principles to design and manufacture products that align with current trends. Furthermore, they must possess a profound understanding of upholstery materials and their characteristics to ensure the durability and longevity of the products.



#### 2.2.1. Target group

Owing to the extensive range of services they offer, upholsterers and tailoring workshops cater to a diverse clientele. The following is an overview of the clients and the specific services they require:

Individuals: Individuals engage the services of upholsterers and tailoring workshops for furniture restoration and the production of textile items for their homes. These customers seek products that align with their personal tastes, style, and requirements.

Interior decoration companies: These companies enlist the services of upholsterers to create custom furniture and textile products tailored to their projects and catalogues.

Furniture designers and manufacturers: Furniture designers and manufacturers engage upholsterers to craft distinctive and long-lasting products for their product lines. This collaboration allows for the customization of specific items within the production range to cater to discerning customers.

Retail stores: Retail stores often employ the services of upholsterers to produce high-quality and exclusive items for their product lines. This enables them to offer unique and premium products to their customers.

Offices: Offices frequently enlist the expertise of tailors and upholsterers to create bespoke curtains and furniture for their workspaces. By doing so, they obtain top-notch, comfortable, and ergonomic products that enhance the overall ambiance of the workplace.

Bars and restaurants: Bars and restaurants commonly engage upholsterers to manufacture superior products for their spaces, such as custom sofas and curtains that complement the overall decor. This allows them to acquire fashionable items for their establishments while catering to the specific needs of their customers.

Hotels: Hotels typically rely on upholsterers to produce high-quality textile products, including furniture, curtains, cushions, and more, to ensure a cohesive style throughout their rooms. This serves to create a unified aesthetic and enhance the overall ambiance of the hotel.



#### 2.2.2. Mission, value and vision

- <u>Mission</u>: Recover the essence and beauty of upholstered furniture and give it a second useful life. Through textile production, create more comfortable and harmonious spaces for our customers.
- <u>Value</u>: Search for the best experience for customers, offering personalised products that are perfectly adapted to the needs of users and spaces.
- <u>Vision:</u> Commitment, quality, guidance and advice service for the customer, guaranteeing the comfort of upholstered products, diversity of raw materials to meet all needs and professionalism.

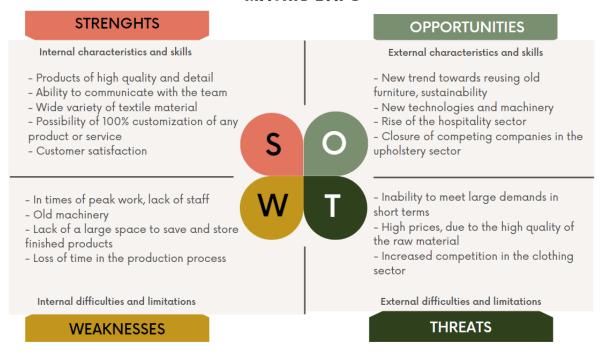
#### 2.2.3. SWOT analysis

The SWOT analysis represents a comprehensive assessment of both internal and external factors that impact a company. Through a meticulous examination of its strengths, weaknesses, opportunities, and threats, the organisation gains valuable insights necessary for formulating effective business strategies.

By conducting a SWOT analysis, the company gains a holistic perspective of its internal capabilities and external environment, enabling a thorough understanding of its current position within the industry. It is essential to acknowledge that a SWOT analysis reflects the company's overall state during a specific period, as market conditions, both internal and external, are subject to frequent fluctuations [3].



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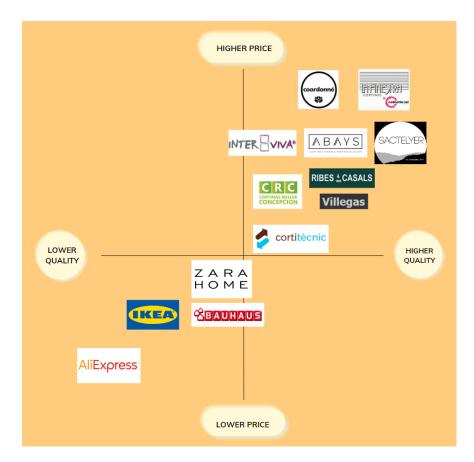
Source: Self-generated analysis derived from data provided by Sactelyer.

#### 2.2.4. Positioning map

The positioning map is a chart used by market researchers and companies to describe and understand the landscape of a brand or product with respect to the competition from the customer's point of view. In other words, the positioning map helps visualise what alternatives customers have with respect to a specific product or brand. In this graph, the X and Y axes are exposed to discuss the qualities to be compared between a company and its respective competitors [4].

In the positioning map of curtain manufacturing companies, the Sactelyer company is located in the upper right, next to all its direct competition.





Source: Own elaboration based on information from Sactelyer

The companies depicted on the positioning map operate within the Barcelona market. Among these companies, both direct and indirect competition exists. Direct competition encompasses companies that offer similar products or services with minimal variations in terms of price and quality compared to Sactelyer. These companies specialise in custom textile products, allowing customers to choose the desired size and fabric type.

The direct competitors include the following companies: ABAYS, INTERVIVA, VILLEGAS CORTINAS, COORDONNE, LA FINESTRA, LA CONCEPCIÓN, and RIBES & CASALS.



Fig 1: Logos of indirect competition



On the other hand, indirect competition comprises companies that fulfil a similar need, albeit with different products than Sactelyer. Within this category, there are well-established companies such as Zara Home, Bauhaus, Ikea, and AliExpress. These companies offer a wide range of products, including standard curtains, where customers have limited options to choose from various sizes, textures, and colours available in their catalogues. Generally, the products offered by these companies are cheaper and of lower quality compared to Sactelyer's offerings.



Fig 2: Logos of indirect competition

#### 2.3. Current Manufacturing Process

#### 2.3.1. Machinery and production staff

Firstly, prior to delving into the current manufacturing process, it is essential to introduce the machinery, tools utilised, and the production personnel responsible for proficiently executing textile manufacturing.

Situated within a 125m2 premises, our establishment employs three skilled professionals in the field, each assigned a designated role.

The Cutter: This individual is entrusted with the critical tasks of measuring, cutting, and preparing all fabric pieces to ensure accurate sizes. To fulfil these responsibilities, she utilises a spacious table, scissors, a tape measure, and an assortment of pencils for marking. Once the pieces are cut, she strategically places reference markers for the subsequent worker to proceed accordingly.

The Sewer: The Sewer is responsible for crafting the curtains, incorporating ribbons, Velcro, and creating various types of edges as per the designated design. To finalise the curtain's height, it is draped onto a precisely machined hanger, where the length is marked and the bottom edge receives its finishing touches.

The Ironing Machine Operator: This dedicated individual specialises in meticulously ironing the curtains, eliminating any imperfections such as loose threads, and affixing the necessary hooks for installation. She assumes the pivotal role of finalising the manufacturing process, meticulously packaging and sealing the curtain together with the accompanying rail.



#### **Utilised Machinery and Equipment**



Fig 3. Sewing machine.



Fig 5. Curtain hanger.



Fig 4. Steam iron.



Fig 6. Scissors, tweezers and metro.

#### 2.3.2. Company services

At Sactelyer, customers will find a comprehensive range of services in the textile sector, including a tailoring workshop, upholstery workshop, and installation service. The company prides itself on offering expert guidance and assistance in dressing various spaces, from individual rooms to large-scale hotels and bars.

The company is divided into two workshops, with the tailoring workshop specialising in the creation of custom curtains, blinds, Japanese panels, cushions, quilts, and bedspreads for both indoor and outdoor use. The upholstery section focuses on the restoration and production of sofas, chairs, armchairs, wall coverings, headboards, pouffes, benches, custom covers, as well as catering to nautical and automotive upholstery needs.



A detailed explanation of the step-by-step manufacturing processes employed in these workshops will be provided, as these sections generate a significant volume of work and contribute significantly to the company's economic success [1].

#### **Curtains section:**

Curtains play a pivotal role in interior decor, serving as vital components that ensure privacy, regulate the influx of natural light, and contribute to the aesthetic appeal of any given space.

The ensuing explanation outlines the meticulous manufacturing process followed by the workshop to create a curtain.

In the initial stage, highly skilled professionals visit the customer's residence to measure the precise dimensions of the window. Both the width and height of the window are carefully assessed to determine the exact specifications required for the curtain.



Fig 7. Dimensions of the width of a window.

The client is provided with expert guidance and recommendations regarding the selection of fabric and style, tailored to their specific requirements and the intended functionality of the space. Subsequently, upon finalising the fabric choice, the workshop proceeds to place an order with the designated supplier to procure the selected material.



Fig 8. Catalogues displayed in the Sactelyer showroom.



The selected textile is carefully laid out on a sturdy wooden table with a flat surface, ensuring optimal work conditions. Skilled craftsmen utilise precision scissors to meticulously cut the material according to the precise measurements previously obtained. This stage of the manufacturing process is of utmost significance, as it demands careful attention to detail to ensure a straight and flawlessly executed cut. To maintain accuracy, a measuring tape is employed to ensure the fabric is measured precisely.



Fig 9. Scissors cutting clothes.

Multiple sewing machines are required in the workshop, each serving a specific purpose based on the desired stitch type and finish. The selection of sewing machines depends on the specific requirements of the curtain being manufactured. To ensure optimal results, a variety of threads are available for use, with a particular emphasis on employing strong and durable threads for achieving robust and secure seams. This approach guarantees the longevity and resilience of the final product.



Fig 10. Set of threads for the sewing machine.

The commencement of any curtain style marks an important stage, and now we shall delve into a detailed examination of the prescribed process for the two most sought-after styles: conventional curtains and bundles or blinds.

Conventional curtains: The functionality of this curtain style revolves around a six-fold horizontal gathering, which is expertly guided by either rails or bars.

A crucial aspect to consider is the quantity of fabric required, as it directly impacts the desired level of pleating or opulence. Additionally, careful attention must be given to the appropriate finishing touches,



which typically include a top tape, side hems, and a bottom edge. These elements collectively contribute to the overall aesthetic and structural integrity of the curtains.







Fig 11. Upper tape where the hooks and lateral and upper curbs go.

The upper tape serves as a pivotal component in securing the curtain to the designated rail or bar. Various finishing options are available, including a smooth ribbon, perfect wave, paddles, eyelets, or an assortment of pleats, each lending its distinct visual appeal.

Likewise, the bottom edge offers a range of finishing possibilities, such as a wide hem, medium hem, double or triple layers of fabric, a simple edge, or the incorporation of a weighted element. As for the sides, they are typically adorned with a slender one-finger-wide trim.

Blinds or bundles: In contrast, blinds or bundles operate on a vertical propulsion mechanism, featuring a Velcro profile that securely holds the curtain in place.





Fig 12. Upper part of a blind, with the velcro and the rail.

For the production of these curtains, a Velcro strip is initially affixed to the top portion. The sides are constructed using double layers of fabric, each measuring 9 cm in width, and are meticulously sewn together in parallel. Additionally, vertical tapes are incorporated, equipped with rings through which the threads of the operating system pass. These threads are responsible for the controlled elevation and descent of the curtain.







Fig 13. Blind, thread system to raise and lower the blind.



The lower portion of the curtain is finalised with a double border, providing an aesthetically pleasing finishing touch. Additionally, a weight plate is strategically positioned to provide the necessary weight and stability to the curtain.





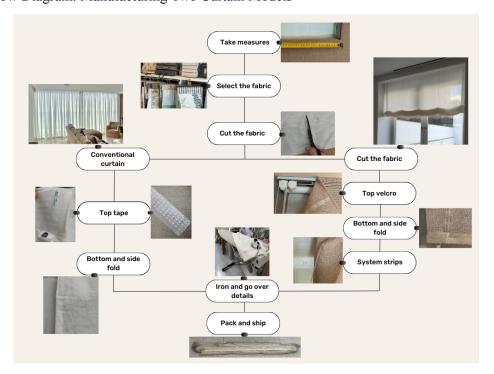
Fig 14: Placement of Weight Plate at the Bottom of the Blind

Once the manufacturing process of both conventional curtains and blinds is completed, a thorough inspection is carried out to eliminate any excess threads, wrinkles, or imperfections. The seams are carefully ironed to ensure a smooth and flawless appearance. Finally, the curtain is meticulously packaged together with the appropriate bar or rail for its seamless installation.



Fig 15. Three blinds finished and packaged.

Process Flow Diagram: Manufacturing Two Curtain Models



Source: Self-generated based on information provided by Sactelyer.



Exhibition of Authentic Photographs Depicting Successfully Executed Installations of Various Curtain Styles within Customers' Residences

#### - Conventional curtains:





Fig 16. Conventional curtains installed at the customers' home.



#### - Blind:



Fig 17. Blinds installed at customers' homes.

#### - Japanese curtains:



Fig 18. Japanese curtains installed in the customers' home.

#### **Upholstery Section:**

In the upholstery workshop, we are dedicated to the restoration and renovation of upholstered furniture. The process begins with the evaluation of the furniture to be restored. The condition of the furniture is carefully examined and the type of work that needs to be done is determined. This includes assessing the structure of the furniture, the quality of the materials used in the upholstery and the amount of wear and tear it has undergone.

Once the furniture has been assessed, the old upholstery begins to be removed. This is done carefully so as not to damage the structure of the furniture. Old upholstery materials are separated and disposed of responsibly.





Fig 19. Armchair in the process of removing the upholstery.

After removing the old upholstery, we start working on the structure of the furniture. Broken or damaged parts are replaced, weak areas are reinforced and glue is applied to ensure that the structure is strong and stable. Once the structure of the furniture has been restored, you can start working with the filling.



Fig 20. Furniture repair using white glue.

The upholstery filling plays a crucial role in bestowing both form and comfort to upholstered furniture. Situated between the lining and the structure, this component comprises materials such as foam, plant hair, feathers, or wadding. Renowned for their durability and resistance to wear, these materials ensure that restored furniture retains its quality and longevity for an extended period of time.



Fig 21. Vegetable hair and synthetic foams.



Once the filling has been properly positioned, the next step involves affixing the new upholstery fabric using tools such as a compressed air stapler, manual stapler, or upholstery tacks. Meticulously attending to detail, the process concludes with the addition of finishing touches, such as welt cords or trims, which effectively conceal any visible staples or imperfections, resulting in a polished and refined appearance [1].



Fig 22. Different types of upholstery finishes, living, studs and panelling.

Below, a showcase of completed projects from the diverse range of services provided by the upholstery section is presented, exemplifying the craftsmanship and attention to detail that define the company's commitment to delivering exceptional results.

#### - Armchairs and chairs:







Fig 23. Armchairs finished and delivered to the customer.



#### - Banks:



Fig 24. Benches finished and delivered to the customer.

#### - Headers:



Fig 25. Heads finished and delivered to the customer.

#### - Sofas:



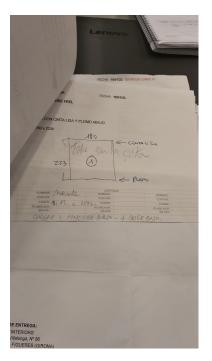
Fig 26. Sofas finished and delivered to the customer.

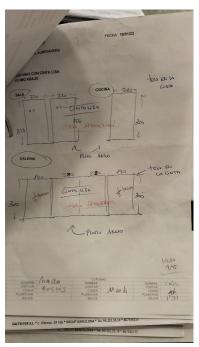
#### 2.3.3. Production capacity

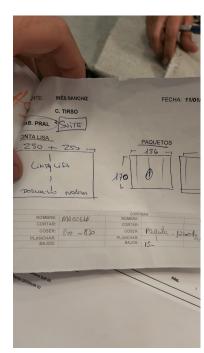
The production capacity of Sactelyer is a reflection of its ability to efficiently utilize available resources to produce a maximum level of goods or services. In determining the company's productive capacity, a standard working week of 40 hours has been employed as a reference time frame.



As part of this endeavour, tracking sheets have been implemented to record the time invested by workers in each stage of the manufacturing process. This meticulous tracking enables the company to accurately assess the time required for curtain production. Presented below are a few illustrative examples of such records:







VAS	CORTIN	-	
,	NOMBRE:	MARCELA"	NOMBRE:
	CORTAR:		CORTAR:
Parula - 12:00	COSER:	800 -830	COSER:
100.00	PLANCHAR:	0.0	PLANCHAR:
15-	BAJOS:		BAJOS:

Fig 27. Forms filled out by Sactelyer workers.

The documentation comprises blank sheets containing a curtain sketch and a table with three columns at the bottom. These columns require the worker to provide their name and record the time spent on various production processes, including cutting, sewing, ironing, and folding.

Leveraging these comprehensive records and their accumulated expertise, Sactelyer ensures that, within a standard workweek, they can produce approximately **30 to 40 curtains.** However, as Sactelyer is not exclusively dedicated to tailoring and also accommodates an upholstery section, the weekly output is limited due to seamstresses' engagement in other tasks besides curtain production.



Operating for 11 months annually, Sactelyer, with an average production rate of 35 curtains per week, accomplishes around 140 curtains monthly and an annual tally of **1,540 curtains**.

#### 2.3.4. Billing data

Based on the billing data provided by Sactelyer, average prices for curtains have been derived, allowing for an estimation of the company's annual revenue in 2022.

Sactelyer offers a wide range of curtain styles and sizes, making it challenging to provide an exact estimate due to variations in fabric type and dimensions. It's important to note that the installation cost of the curtains, a service provided by Sactelyer, has not been included in this analysis, as the focus is solely on the manufacturing price.

For the most affordable curtains, featuring economical textiles and standard dimensions (200 cm x 260 cm), prices hover around 150€, with a manufacturing cost of 80€. On the other hand, the highest-priced curtains can reach 600-700€, reaching heights of up to eight meters and crafted from expensive fabrics. The manufacturing cost, including labor and materials, ranges from 200-250€.

However, the majority of curtains, both conventional and blinds, fall within the price range of 300-350€, with a manufacturing **cost of 140**€.

By multiplying the average price per curtain by the approximate number of curtains produced in 2022, we can derive an estimated average profit generated by the curtain-making section. With an average price per curtain of 325€ and a production volume of 1540 curtains per year, Sactelyer's total revenue for 2022 amounts to 500,500€.

Considering a manufacturing cost of  $140\epsilon$  per curtain, the net profit per curtain is  $185\epsilon$ . Thus, Sactelyer's net revenue for 2022 is **284,900** $\epsilon$ .

#### 2.4. Methodology for improving company competitiveness

The adoption of business methodologies is aimed at enhancing the efficiency and productivity of a company. These methodologies play a crucial role in enabling organisations to identify and streamline production processes, minimise costs, enhance customer service, and elevate product quality. Moreover, they foster a culture of continuous improvement and establish long-term objectives. Additionally, these methodologies facilitate improved internal communication, heightened employee motivation, and enhanced decision-making capabilities within the company.



In the following sections, various types of methodologies will be introduced, accompanied by real-life examples of companies that have experienced notable improvements subsequent to their implementation. These examples will serve as reference points in determining the most suitable methodology for implementation within Sactelyer.

#### 2.5. Automation / Renovation of equipment

Automation and equipment renewal are closely interconnected as both processes aim to enhance productivity, product quality, and customer satisfaction within a company [5]. Automation primarily focuses on simplifying repetitive tasks through the integration of technology, thereby enabling time and cost savings by reducing the need for manual labour. On the other hand, equipment renewal involves upgrading or replacing existing machinery with advanced technology, which can significantly improve production efficiency and reduce operational expenses. In summary, both automation and equipment renewal share the common objective of optimising productivity, product quality, and customer satisfaction.

The benefits of automation within a company are manifold:

- 1. Increased productivity: By automating routine tasks, employees can devote more time and attention to critical responsibilities. Automation enables quicker and more accurate execution of repetitive tasks, resulting in enhanced productivity and the ability to produce more within a given timeframe.
- 2. Cost reduction: Automation eliminates the need for additional staff to perform certain tasks, leading to substantial long-term cost savings once the machinery is amortised.
- 3. Improved product quality: Automation minimises the potential for human error, thereby enhancing product quality. By reducing reliance on manual labour for repetitive tasks, companies can ensure consistent and high-quality output.
- 4. Streamlined decision-making processes: Automation facilitates faster data collection and processing, enabling expedited decision-making. This enables companies to respond promptly to opportunities and make informed choices.



- 5. Enhanced security: Automation enables secure storage and protection of sensitive data, guarding against unauthorised access. This ensures improved security measures, safeguarding the company against external threats.
- 6. Increased customer satisfaction: Automation enables faster and more accurate delivery of products and services, resulting in an improved customer experience. This contributes to an enhanced brand image and an increased customer base.

Companies like Amazon have already embraced automation by utilizing drones for delivery, leading to faster and more precise shipments. Similarly, Apple has automated its manufacturing processes through the implementation of robots, ensuring greater precision and efficiency in product assembly. These examples demonstrate the tangible benefits that automation brings to companies across various industries.

#### 2.6. Methodologies for organising production

#### 2.6.1. Industry 4.0

The Industry 4.0 methodology is an operational management approach that revolves around the digitization of production processes. Its primary focus lies in the connectivity of devices and process automation, aiming to enhance efficiency and productivity. By connecting devices, automating tasks, monitoring real-time production processes, and utilising data-driven decision-making, the Industry 4.0 methodology strives to optimise production efficiency [6].

To successfully implement the Industry 4.0 methodology, understanding its five fundamental elements is crucial:

- 1. Connectivity: Establishing a network that interconnects all devices to enable real-time monitoring of production processes. Technologies such as the Internet of Things (IoT) and Edge Computing play a vital role in achieving this connectivity.
- 2. Big Data: The collection, processing, and analysis of data generated by devices to improve production processes. Employing tools like Big Data analytics, Machine Learning, and Business Intelligence enhances data utilisation.
- 3. Automation: Automating processes to enhance productivity and efficiency in production. Embracing automation technologies streamlines operations and optimises resource utilisation.



- 4. Simulation: Utilising simulation technologies to facilitate decision-making and proactively address potential issues. Employing simulation tools like process simulation, discrete event simulation, and network simulation aids in optimising production processes.
- 5. Artificial Intelligence: Leveraging artificial intelligence technologies to enhance decision-making capabilities. Utilising tools like deep learning, natural language processing, and predictive analytics improves the accuracy and speed of decision-making.

Siemens is a real-world company that has embraced the implementation of the Industry 4.0 methodology. As one of the largest technology companies globally, Siemens offers a wide range of products and services across various sectors, including energy, industrial automation, transportation, and healthcare. Siemens has established a network of connected factories aimed at improving efficiency and productivity. Through real-time monitoring of production processes, data collection from devices, and data-driven decision-making, Siemens has achieved notable advancements. Furthermore, Siemens has integrated automation technologies such as robotics, 3D printing, and process control into its operations [7].

#### 2.6.2. Methodology Kanban

Kanban is a Japanese word consisting of Kan, which means visual, and Ban, which means card. Therefore, Kanban refers to visual cards.

This methodology is very simple, it can be updated and work teams can take it on without a problem. Being a visual method, it allows the status of projects to be known at a glance and new tasks can be assigned very effectively. To apply this, a task board is necessary with which to improve the work and have a sustainable rhythm.

Create a dashboard that is visible and accessible to all team members. In the columns, the state of the flow of the tasks will be noted - as many states of the tasks exist from their beginning to their completion - and thus the state of each project will be determined.

Being a visual method, it allows the status of projects to be known at a glance and new tasks can be assigned very effectively.



It's a continuous board where the cards don't scroll, but as you move through it, new features, improvements, or incidents pile up at the beginning. Thus, they can be prioritised and placed in the most appropriate sections.

This method is based on incremental development, that is, on the division of work into different parts. Therefore, it is not about a task itself, but the production process is streamlined by dividing the work into different steps.

Each card, post-it or box in the spreadsheet that is used to apply the method is added to the board in the corresponding phase. The necessary information is added there so that the team knows the total workload that will be expected. The task and any type of observation is described.

In this way, the work is visualised correctly by each department, as well as the priorities and objectives. Again, being such a visual method gains in effectiveness at all levels [8].

In the 50s, Toyota implemented the kanban system to improve the efficiency of its production processes. This allowed Toyota to reduce delivery times by allowing greater flexibility in production.

To implement the kanban system, he began by placing cards in the production processes. These cards were used to identify the materials and products needed for production. They were placed in a visual work queue, allowing teams to see which orders were completed and which were pending [9].

#### 2.6.3. QRM methodology

The QRM is focused on the total and systematic reduction of all dead times (queues, waiting, over-processes, etc.) of the company as a whole. It is a methodology that creates agile organizations by optimising their processes through four key elements:

- The power of time: Although many company managers do not pay too much attention to it, the QRM considers that delivery time is an important factor in the production process. Very long lead times lead to higher costs in areas such as planning, storage or forecasting. According to QRM theorists, these expenses can reach the equivalent of four or five times the cost of labour.
- The structure of the organisation: One of the innovations of this methodology is the transformation of traditional departments into the so-called QRM cells. The fundamental



characteristic of the latter is greater flexibility, in addition to granting more responsibilities to employees.

- For them to be effective, each cell must be composed of between three and ten workers. The assigned work cannot be too heavy, so that the processing time is short. The QRM cells are not specialised. On the contrary, the team must be multidisciplinary and even allow each member to take over the work of the others.
- The dynamics of the system: Once it has been possible to reduce delivery times, the next step is to promote actions that improve the operation of the company. These include investing in additional capacity strategically.
- Although, at the beginning, it may require a significant investment, it is proven that it recovers quickly thanks to the reduction of costs caused by the extended delivery times.
- Organisation-wide application: Rapid Response Manufacturing methods do not have to be limited to the logistics system and the shop floor. To get the most out of it, it is necessary to implement the methodology at all levels of the company, from administration to the supply chain.

QRM is not limited to just trying to solve these problems on the production floor, but aims to cover all areas of the company, from offices to distribution. One of the fundamental elements to achieve this is to adapt the equipment's capacity to any incoming demand [10].

One of the companies that has successfully implemented the QRM methodology is the construction materials company, Cemex. First, they started by identifying value for their customers through data collection and active customer engagement. Next, they identified the processes and activities needed to meet their customers' needs.

Then, they proceeded to eliminate unnecessary steps, reorganise processes and optimise resources to reduce delivery times. Finally, they established a production system in which products and services are produced only when they are needed. These efforts allowed Cemex to reduce delivery times and improve the efficiency of production processes [11].



#### 2.6.4. Lean Management

Lean Management is a business management model that seeks to improve the efficiency and quality of production processes by eliminating waste, unnecessary costs and all activities within the production process that do not add value to the product or service. It is based on the principles of "lean thinking", an approach to the continuous improvement of production processes. These principles are based on the reduction of cycle times, the elimination of waste, the continuous improvement of quality and the continuous improvement of production processes. The goal of Lean Management is to achieve an efficient, agile and flexible supply chain that allows the company to achieve a competitive advantage [12].

It is a process of continuous improvement within a company that aims to eliminate everything that is not productive such as:

- Waste of time Lean Management makes an analysis of the company's work and processes to optimise the time needed to carry them out.
- Unnecessary efforts. All the actions within a company will be subject to review to find the best way to be carried out, minimising the necessary effort.
- Expense control. All those expenses that are not related to an increase in productivity or profit, will be eliminated.

#### The Seven Wastes (TIMWOOD):

- 1. Transport waste (T): Unnecessary movement of raw materials and products from one place to another that does not add value to the product. This increases transportation costs, reduces efficiency and can decrease product quality.
- 2. Inventory waste (I): Accumulation of materials, components and products in warehouses throughout the production process. Thus increasing the costs of storage and administration, reducing the efficiency of the processes and decreasing the speed of delivery.
- 3. Movement waste (M): This type of waste includes movements of employees, machinery, transporting materials, tools or inputs without adding value to the product. This involves developing work that is not part of the manufacturing process.



- 4. Waiting Waste (W): This is probably the easiest waste to recognize. As long as goods or tasks are not moving, the waste of waiting occurs. It increases the uncertainty of delivery times, reduces the efficiency of processes and decreases customer satisfaction.
- 5. Overproduction Waste (O): Producing more means exceeding customer demand, which creates additional costs. Excess products or tasks require additional transportation, excessive movement, more waiting time, unnecessary stock, etc.
- 6. Over-processing waste (O): The excessive processing or handling of materials during production, i.e. products of an unnecessarily high level of detail. It increases production costs, reduces process efficiency and lengthens delivery times.
- 7. Waste of defects (D): Any type of errors in the quality of the finished products, causing re-work or direct loss of material, thus increasing repair costs and decreasing productivity [13].

A leading company like Nike in 2010-2011 showed a change in strategy. Its production system was transformed towards the management philosophy Lean Management.

The main advantage of this methodology consists in guaranteeing the highest quality of the product and eliminating the waste of time and raw materials. One of the most determining factors in the transformation process is the training of workers in the skills and abilities necessary to manage the production and solving problems in a team or individually.

The results he obtained when implementing the methodology were, among others, a 50% reduction in the defect rate, a 40% reduction in delivery time, a 20% improvement in productivity, etc. [14].

#### 3. CURRENT STATUS

To conduct the present study, two methodologies, Lean Manufacturing and Quick Response Manufacturing (QRM), have been thoroughly assessed and compared to determine the most suitable approach for implementation within the company. Additionally, as an outcome of this project, the company has already initiated the adoption of one of these methodologies, namely the equipment renovation, in an effort to enhance competitiveness.



Sactelyer recognized the need for investing in a new multifunctional sewing machine, as the existing one frequently experienced issues, resulting in significant time loss due to breakdowns. Presented below are images depicting both machines for reference.





Fig 28. Changing an old sewing machine for a latest generation one.

Lean Manufacturing is a work philosophy that revolves around enhancing production systems through the elimination of "waste," which encompasses processes that utilize more resources than necessary. The primary objective of Lean is to align production with demand, both in terms of timing and quantity, while concurrently reducing costs.

While Quick Response Manufacturing (QRM), as described by the QRM Institute, holds an intermediate position between being an evolution of Lean and a distinct methodology, both systems exhibit significant differences. Lean is specifically designed to cater to regular and predictable demands, typically associated with high production volumes. On the other hand, QRM is better suited for addressing irregular and fluctuating demands [15].

Based on the company's accustomedness to meeting regular and predictable demands, regardless of whether they are characterised by high or low production volumes, the decision has been made to implement the Lean methodology. Furthermore, Lean's comprehensive approach, aiming to maximise value across the entire manufacturing chain by eliminating superfluous elements, aligns well with the objectives of this study, which seek to optimise timings throughout the entirety of the manufacturing process.



#### 3.1. Market study

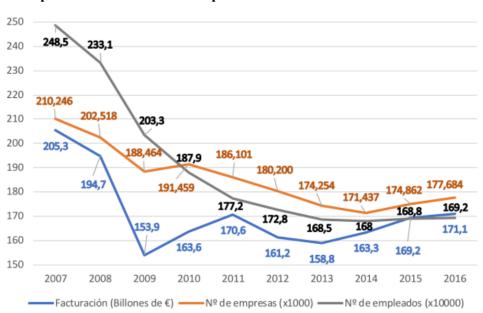
The worldwide curtain making market has become a profitable business in recent years. This is because there is a wide variety of styles and prices to choose from, giving customers the opportunity to find something that fits their needs and budget.

The textile sector has experienced constant growth in recent years due to the fact that there is a higher demand for textile products such as curtains, carpets and upholstery. Therefore there are more opportunities for textile manufacturers to expand their businesses.

In addition, the increased use of modern technologies such as digital printers has reduced the cost of manufacturing raw material for curtains and other textile products, making it easier for manufacturers to offer better quality products at more affordable prices.

Finally, the increased awareness of the importance of sustainability has also helped to boost the curtain fabric market. Many consumers are opting for products that are sustainable and respectful of the environment despite being able to have a higher price, made from recycled and ecological materials.

Below is the evolution of the European sector. Three variables have been included: the number of companies, number of employees and turnover of the sector between 2007 and 2016.



Graph 1: Evolution of the European textile sector between 2007 and 2016

Source: Elena Cacheda Pampín with data from Euratex [16]



This graph shows us how the most complicated year for the sector was 2008, where it suffered the biggest falls. From this year, until 2014, according to the available data, the sector begins with a gradual trend of balance, the percentage variation of the three variables is as follows: turnover falls by 25.72%, the number of companies do so by 22.65% and the number of employees suffers the sharpest drop with 47.92%.

It is not until 2014 where the sector and all the variables begin to improve until reaching 2016, the turnover increased by 4.78%, the number of companies increased by 3.63% and the number of employees improved by 0.7%.

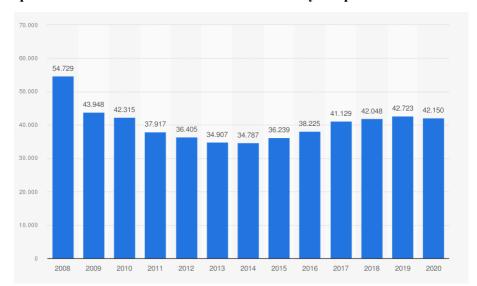
From 2016 the market follows a progressive upward trend, then we will carry out the study of demand in Spain, where we will see the upward trend discussed [18].

### 3.1.1. Analysis of Spain's demand

The garment textile sector in Spain represents an important part of the Spanish industry. The sector has been affected by the crisis, but it also received an injection of funding to help boost the sector.

Below is the evolution of workers in the Spanish industry from 2008 to 2020, we can see that just like in graph 1, we have a sharp drop in 2008, which does not begin to rise until 2014-2015 [17] [19].

The Y axis represents the number of workers and the X axis the chronology.



Graph 2: Number of workers in the textile industry in Spain from 2008 to 2020

Font: Eurostat



After the ascending part that takes place between 2014 and 2018, the following years remain quite balanced, without noticing any significant rise or fall [19].

The graph that we show below refers to the evolution of companies in the textile sector between 2000 and 2018 and as we can see, the trend of companies is related to that of workers, graph 2 [20].

40k

35k

30k

25k

20k

15k

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Graph 3: Evolution of the number of companies in the Textile Sector in Spain from 2000 to 2018

Source: Institute of Economic Development of the Principality of Asturias (IDEPA)

Below is the graph of the historical balance in Spain between 1995 and 2017.

Graph 4: Spain's Trade Balance

-30.000

-60.000

-90.000

1995

2000

2005

2010

2015

Source: Diari expansion 2017.



In Spain, the trade balance historically tends to be in deficit, that is to say, exports are lower than imports. Among all the goods and services exchanged in this trade balance, this graph has analysed the evolution it has had in both imports and exports.

20M

10M

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Exportaciones Importaciones Saldo

Graph 5: Trade balance of the Spanish Textile sector, from 2000 to 2017

Source: ICEX.

As can be seen by looking at graph 4, the textile sector also does not break the country's deficit trend, which means that the Spanish textile sector buys more fabrics and finished products in foreign countries than foreigners do in our country

However, we can see how from 2014, there is an increase in both exports and imports, due to the fact that the textile market is booming [20].

All the data seen previously have exposed data from the textile sector up to 2017. Then it will be analysed from 2017 to the present, since it is the most recent and interesting time period where we will see data that will tell us if it is a good time to invest in this sector.

According to the most recent data from the Spanish Ministry of Economy and Competitiveness, the garment textile sector in Spain generated a gross added value of 13.1 billion euros in 2017. This figure represents an increase of 4.1% compared to the previous year, which shows that the sector continues to be relevant to the Spanish economy.



The sector is one of the most relevant in terms of employment. In 2017, the garment textile sector generated more than 212 thousand direct jobs at national level, representing 3.5% of all direct jobs generated in Spain.

According to the Textile Report 2017 study carried out by the Center for Industrial Technological Development (CDTI) of Spain, the Spanish textile sector is led by medium-sized companies, with more than 70% of companies billing less than 10 million euros in the year. This shows that the sector is still dominated by small and medium-sized companies.

In addition, the report shows a growing trend in the demand for sustainable fashion products. According to the report, the Spanish sustainable fashion market had a turnover of 1.2 billion euros in 2017, which represents an increase of 22.2% compared to the previous year. This indicates that Spanish consumers are increasingly interested in sustainable fashion, which opens up new opportunities for local textile manufacturers.

In addition, the number of companies engaged in the production of clothing textiles has increased in recent years. Therefore we see that the sector is being supported by private investment.

Thanks to the data from the Spanish Textile Business Association (AETEX), we see that the Spanish textile sector generated an added value gross of 15.4 billion euros in 2018, an increase of 14.8% compared to the previous year.

According to the most recent data from the Spanish Ministry of Industry, Commerce and Tourism, the garment textile sector in Spain generated a gross added value of 14.9 billion euros in 2019. This figure represents a reduction of 9.7% compared to the previous year.

In 2020 the textile sector generated a gross added value of 15.8 billion euros, assuming an increase of 6.6% compared to the previous year. In 2021 it generated a gross added value of 16.9 billion euros, with an increase of 7.1% compared to the previous year. And finally in 2022, the garment textile sector in Spain generated a gross added value of more than 17.7 billion euros in 2022. This figure represents an increase of 5.3% compared to the previous year, which shows that the sector continues to be relevant to the Spanish economy.

In addition, the textile sector continues to be one of the main generators of employment in Spain. According to official data from the National Institute of Statistics (INE), the textile sector generated more than 239 thousand direct jobs in 2018, which represents an increase of 12.8%.

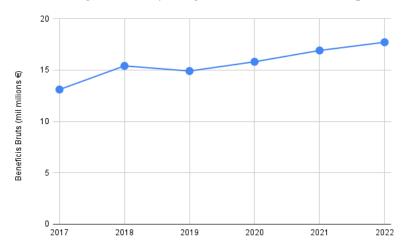


In 2019 it generated more than 239,000 direct jobs at national level, therefore the employment figure was maintained compared to the previous year. In 2020, the sector generated more than 249 thousand occupations, representing 4.2% more than the occupations in Spain the previous year.

In 2021, the sector generated more than 264,000 direct jobs at national level, i.e. 6.4% more than in 2020. And to end in 2022, the sector generated more than 279 thousand direct jobs at national level, which represents 5.8% of all direct jobs generated in Spain.

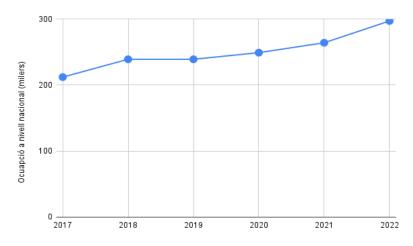
The following graphics show all the mentioned information visually.

Graph 6: Gross added value generated by the garment textile sector in Spain from 2017 to 2022



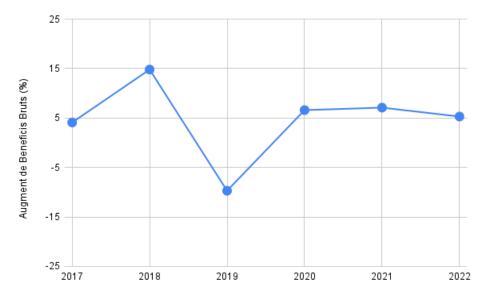
Source: Own preparation with data from the Spanish Ministry of Industry, Trade and Tourism and the National Institute of Statistics (INE)

Graph 7: Direct employment at national level in Spain from 2017 to 2022



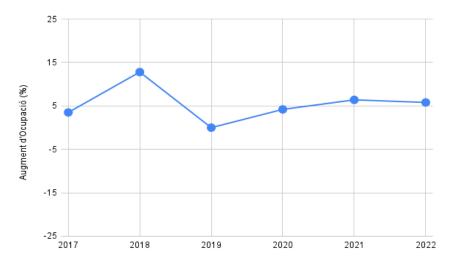
Source: Own preparation with data from the Spanish Ministry of Industry, Trade and Tourism and the National Institute of Statistics (INE)





Graph 8: Increase in profits generated by the textile and clothing sector in Spain

Source: Own preparation with data from the Spanish Ministry of Industry, Trade and Tourism and the National Institute of Statistics (INE)



Graph 9: Increase in direct employment generated by the textile and clothing sector in Spain

Source: Own preparation with data from the Spanish Ministry of Industry, Trade and Tourism and the National Institute of Statistics (INE)

The curtain fabric market has also benefited from the proliferation of social media which has helped manufacturers promote their products to a wider audience and allowed manufacturers to reach new customers and increase their sales. We have seen this proliferation applied to the same company Sactelyer, which thanks to its new Instagram and website, orders have increased.[1][2]



The graph below shows the exponential increase in online clothing sales in Spain, peaking in 2021.

12.000

12.000

10.000

9.190

7.894

4.238

4.000

3.455

2.000

2012

2013

2014

2015

2016

2017

2018

2019

2020°

2021°

Graph 10: Number of online buyers in the textile fashion sector in Spain

Font: Kantar Worldpanel

We can conclude that the clothing market has become a profitable business in recent years, with an average growth of 5.5% in profits and with an average growth of 3.4% in direct employment at national level. Therefore, the garment textile sector in Spain presents a good projection for local textile companies, with the possibility of growth and capacity to absorb new products. In addition, statistics show that using social networks companies can reach more customers, therefore, it is a factor to take into account to incorporate in less modernised companies.

#### 3.2. Analysis of current manufacturing proces

### 3.2.1. The seven wastes. TIMWOOD

The seven Lean wastes have the function of eliminating activities within the production process that do not add value to the product or service. These wastes or losses can reduce profitability, increase customer costs, decrease quality and even employee satisfaction. Next, they will be defined and identified in the curtain manufacturing process and we will analyse the root cause of the waste and its possible elimination. It will represent everything on the TIMWOOD table.



	Description	root cause	Proposed elimination/reduction
Т	Move the curtains to another workshop, when they are taller than they are in the fitting room.	Current premises with insufficient height.	Look for a system that allows the measurement to be carried out by adapting to the available space
I	Excess of leftover clothes.	The leftovers do not have a clear exit.	Make offers with clothing packs to give out the material.
M	Loss of tools and having to look for them.	There is no specific place for each worker's tools	Enable a common or individual space to store tools.
IN	Curtains that remain unmade for days.	Lack of personnel or machinery to produce faster.	Hire workers or introduce modern technology to speed up the process.
О	There is no overproduction.	Everything is made to order	-
О	Type of finish with invisible stitching and transparent tape that makes the product more expensive.	Give a more elegant visual finish.	Use of cheaper materials in certain cases or automate the process to be able to reduce the manufacturing time and consequently the price.
D	Let some piece of curtain be partially unstitched.  That the sizes are not correct.	Not all seams are checked before the product reaches the customer. Sizes are not always checked before delivery.	Make a worker responsible for checking all finished curtains or introduce industrial machinery that guarantees precision and good finishes.

Table 1: illustration of the seven wastes of the Sactelyer company.

The presented reduction proposals seek to improve the efficiency of the product manufacturing process through a reduction in the seven wastes that are included in Lean Management. Through a better distribution of space, a reduction in manufacturing time through the introduction of technologies, a review of materials, their responsible use and finally a review of all finished products to ensure quality.



One of the solutions to achieve greater efficiency is the introduction of industrial machinery that automates the manufacturing process guaranteeing precision and good finishes. These proposals will serve to achieve greater cost control in the production process.

#### 4. OBJECTIVES

The main objective of this project is to exponentially increase the amount of clothing products manufactured by the company by the end of the year. So that the result is that with the same number of employees, the company can produce ten times more curtains than the previous year. Sactelyer currently produces 1,540 curtains per year, so the goal is to produce 15,400 curtains annually. Guaranteeing customer satisfaction and at the same time improving the status and reliability of the company.

The project presents many potential setbacks, due to the fact that we have to start from the base that we already own a factory, and we have to adapt to the means we have, trying to modify the facilities and the number of workers as little as possible.

These products must replace the current models in the market, due to the fact that the quality and type of materials would be identical, improving the speed of production. From the customer's point of view, the customer would not notice the change made in the company, since the process of selecting clothes and installation will not change, and these are the only factors that the customer knows, as a result, the customer will remain satisfied and the company will be able to keep old customers and reach new ones.

To achieve the objective, a previous study of the manufacturing process, the type of materials and the customer's requirements must have been done, in order to have all the information and find an optimal solution.

### 5. PROPOSED SOLUTION

In order to attain the aforementioned objectives, it is proposed to introduce new machinery and upgrade existing equipment, including sewing machines, among others. The incorporation of updated technology is already underway within the company, as outlined in section 3: Current status. Upon commencing the research project, Sactelyer identified the losses incurred due to machine downtime resulting from technical failures. Consequently, the decision was made to initiate the first phase of new machinery integration. Moving forward, an evaluation of industrial machines will be conducted to compare and determine the most suitable options for the Sactelyer company.



### 5.1. Machinery market study

First, the 100% automated process carried out by leading curtain manufacturing companies is explained. In order to find the differences with the traditional process and see which steps or machinery can be introduced to the traditional process in order to automate parts of the process in the most efficient and economical way.

Automated curtain manufacturing involves several critical stages. First, rolls of fabric or materials are placed in the feed controller of the manufacturing machine. This machine then makes a quick and precise selection of the materials according to the design of the curtain. The feed controller also notifies users if any of the supplies are depleted. Once the material is selected, the machine begins the cutting and sewing process. The fabrics are precisely cut according to the design, then sewn to form panels and folded edges. The movement of the fabric through the machine is done with precision and speed. Once finished, the curtain will be removed and pressed to give it shape. This instance can be controlled automatically with pressurising machines regulated by computers.

Finally, the accessories, such as buttons, ribbons or rings, will be placed to join the curtain. All critical elements of the process are controlled by computers and images, which gives automated curtain manufacturing greater precision and speed than manual manufacturing.

Machines used for the automated curtain manufacturing process include:

- Feeding machines: These machines control the selection of materials. They use a program to choose the materials according to the design of the curtain. These machines also alert the user if materials are running low.
- Pattern cutters: These machines use pattern heads that move back and forth to cut fabric according to a design. This movement of the tool is controlled by specific software that directs the precision and speed with which the material is cut.
- Sewing machines: These machines sew the fabrics to form panels. They are equipped with various designs of needles, threads and bobbins, which allow sewing different curtain patterns at high speed for your success.
- Pressing machines: These machines press the curtain to give it shape. It is equipped with a control plate on which the curtain is mounted. This plate is operated manually and then regulated by the



computer. This reduces the time needed to fold and press the curtain. In a traditional process this machine replaces the conventional iron.

• Accessory machines: These machines place the accessories, such as buttons and rings, to join the curtain. These machines are equipped with high-precision accessory heads that move quickly to fix bras with precision.

The three most important steps in the making process are to cut the fabric, sew it and iron the curtain to remove wrinkles and finish giving it the right shape. Therefore, a market study will be carried out comparing the most modern current cutting, sewing and ironing machines, to minimise manufacturing times.

Only the incorporation of these three machines has been considered since they are not very complex machines that with basic training any employee can use correctly.

### **5.1.1.** Curtain making machines

#### Model ARB-COT-963

Company: Arbella

The Arbella company began its career in 1983 with Mr. Martin Arbella It started by automating machinery for the textile industry. Since then, it has been able to evolve by moving to the manufacture of its own machinery.

They are specialists in automation and the manufacture of machines for the textile industry, both in knitted fabric and in curl material, towels, tea towels, etc.

This machine is designed for the automation of the industrial curtain making process.



Fig 29. Industrial sewing machine ARB-COT-963.

The sewing machine has interchangeable heads to be able to do: straight stitch, rivet (overlock) and invisible stitch. The different processes of finishing curtains can be done: side seams, bottoms, ribbons.

All with a better finish and more productivity.

The sewing machine is mounted on a table with a conveyor belt that moves the curtain back and forth.

The feed speed of the tape and the drag of the needle are perfectly synchronised.

Sewing speed control can be automatic or manual.

**Characteristics:** 

Equipped with two folded funnels, one narrow to sew the edge and another wide to make the

bottom of the curtain.

Tension clamp that holds and tightens the fabric during the sewing process. A little before

reaching the funnel, a spring releases the fabric and the clamp is returned to its original position

by an automatic rewinder.

A drawer to store sewing tools and accessories.

Compressed air gun to remove threads easily.

The price ranges from 36 and 39 thousand euros depending on the type of stitch (straight stitch,

overlock or invisible stitch) [29].

- CCP 2300. Fast sewing of curtains

Company: Cetyc Consulting S.L.

It is a Spanish company specialising in textile machinery, of the highest technology. Cetyc Consulting is

a factory extension, for certain markets, of the prestigious Dutch firm: Eisenkolb.

Since 1992, he collaborates with customers and informs them how to make a modern installation, with

the best and most automatic machines that exist on the market.

Cetyc Consulting assumes the responsibility of evolving and developing at the same time as the market

of the sector. In this way we can always advise our customers so that they have the machinery that best

suits their business expectations.

47





Fig 30. CCP 2300 industrial sewing machine.

This automatic machine is used to sew bottoms and sides in curtains.

- Equipped with a straight stitch machine with upper, lower and puller and extra puller types.
- Table with synchronised conveyor belt 550 cm long with backward and forward movement.
- Attached supplement that allows the making of single and double folds using the same funnel.
- Easy maintenance and cleaning by simply removing the sewing section.
- Simple handling that guarantees maximum productivity thanks to autonomous operation.
- It has a stop and start system along the table.
- Optional:
  - Guide for joining fabrics.
  - Guide to making blind tunnels.
  - Guide to joining the black out.
  - Extra puller for making folds up to a maximum of 180 mm.
- Machine dimensions 550 x 160 cm.
- Specially prepared to sew fabrics of all thicknesses without the need for changes.
- Different models: Straight stitch, invisible, double needle or overlock.

The price of the machine is **58 thousand euros** approximately [30].

#### - Model Cronos 4.0

Company: MATIC

MATIC was founded in 1969 in Barcelona (Spain), to market machines for the textile sector. Designing and manufacturing comprehensive solutions, from cutting machines, welding, sewing, handling and storage equipment.



Committed to providing innovative products, cutting-edge technology and high-quality services, which contribute to the prosperity of customers and partners in the sun protection and digital printing industries.



Fig 31. Cronos 4.0 industrial sewing machine

- Twin needle sewing head
- Conveyor belt synchronised with sewing speed
- adherent conveyor belt
- Industry 4.0
- Wifi or LAN internet connection
- Working modes: manual, semi-automatic and automatic
- Machine length 2500mm (98")
- Machine width 1700mm (67")
- Machine height 1650mm (65")
- Pes 150kg (330lbs)
- Electrical voltage (EU/US) 220V F+N // 50-60Hz
- Air pressure 5-6 bar
- Complies with CE Safety manufacturing and safety standards

The price of the machine ranges from 45 and 50 thousand euros, depending on the type of stitch that is placed [31].



#### - Cronos Basic model:

Company: MATIC



Fig 32. Cronos Basic industrial sewing machine.

The Basic Cronos model has the same properties and characteristics as the Cronos 4.0, except for the table with the automatic textile transport system, which is half the size.

The price of the machine ranges from **55 and 60 thousand euros**, depending on the type of stitch we place [31].

### **5.1.2.** Cutting machines

#### - Model AGA 2300

Company: Cetyc Consulting S.L.



Fig 33. Industrial cutting machine model AGA 2300.

Vertical cutting machine for curtains.

- Lifting bar with different fabric fastening systems
- Simple operation through the independent console with multilingual LCD touch screen.



- Adjustable cutting speed and additional tension function for an optimal and exact cutting result.
- It is made to the requested size and in two versions depending on the available height:
  - Model 2300DP: For work spaces with sufficient height. Up to a maximum width of 1135 cm and a maximum height of 600 cm.
  - Model 2300DPX: For work spaces with low ceilings. Equipped with special technology that makes it possible to overcome the cut by 60% at the physical height of the ceiling.
- The machine is available with a wide range of options.
- Possibility of Double rail for the simultaneous cutting of curtain and lining (only available for the DP series).
- Marking of bases and blinds with ultraviolet ink for curtains and blinds.

The price of the cutter is 46 thousand euros[32].

#### - PCS 3000. Plotter

Company: Cetyc Consulting S.L.



Fig 34. Industrial cutting machine model PCS 3000.

Programmable X-I cutting machine with 3 cutting tools integrated in a single machine [33].

- The standard cutting width is 3.2 metres with the possibility of other measurements at the customer's request.
- Cutting length according to customer needs up to 10 metres.
- The laser, ultrasound and blade cutting system allows us to cut all types of fabrics. Possibility of manufacturing with a single cutting system.
- Optionally it is possible to easily link the operation of the cutting machine with the barcode scanning software or with the network.
- The PCS-3000 model is the most advanced multifunctional x-i cutting machine on the market.



- The automatic device collects the fabric on the table, which reduces time in the work cycle.
- Built with a rotating beam, this way the fabric does not have to be repositioned after it has been placed on the table.
- High cutting speed.

Cutter price: 85,000€

### - Raptor HI 2.5

Company: Cutting Trading International

Cutting Trading International is a renowned company specialising in the design, manufacturing, and distribution of cutting automation systems for various materials including textile fibres, synthetic fibres, PVC, plastic materials, carbon, kevlar, glass fibre, and more.

At the forefront of their product lineup is the HI Raptor system, renowned for its remarkable versatility. This cutting-edge system offers a wide range of adjustable tools, allowing for precise cutting heights tailored to specific requirements. With the basic machine and dedicated tools for each processing type, seamless transitions between different materials can be achieved swiftly and efficiently.

The robust structure and dependable movement of the cutting head, combined with exceptional cutting speeds and a powerful suction system, enable the attainment of heightened productivity and impeccable cutting quality. Cutting Trading International consistently delivers outstanding results while upholding the highest standards in the industry.



Fig 35. Industrial cutting machine model Raptor HI 2.5.



#### Technical characteristics:

- Static cutting table or with conveyor
- Useful modular
- High cutting speed of up to 1500 mm/s
- High cutting precision
- Smooth movements and reduced sound level
- DXF, HPGL, ISO format support
- Configuration of the software according to the materials
- Cutting with maximum thicknesses of 50 mm
- Powerful suction system
- Excellent cutting quality
- Communication with CAD-CAM systems
- Wide cut window

Cutter price: **63.310**€ not including packaging, shipping, assembly or training. Therefore, the final price amounts to approximately €73,000 [34].

#### - HI RAPTOR 2.5 XXL

Empresa: Cutting Trading International

XXL Hi Raptor 2.5 STATIC, an innovative solution for cutting large and very large formats capable of responding to the increasingly sophisticated requests of the customer and characterised by the possibility of customising the material cut. The possibility of customising the size, led us to the remarkable measurements of  $12 \times 8$  MT.



Fig 36. Industrial cutting machine model HI Raptor 2.5 XXL.



It has the same properties as the Raptor HI 2.5, but with larger dimensions. The price of the cutter is 120.000€ approximately [35].

- M1-PC. X-I cutting machine, using two rotary pressure blades.

Company: MATIC



Fig 37. Industrial cutting machine model M1-PC [36].

- Automatic cutting of the 4 sides
- Automatic fabric feeding
- Dynamic "0" cutting start point you can place the cutting start at any point on the table
- Transversal presser foot
- Multi-cutting programming
- Athenea software for workflow management, order entry, inventory control, cutting and welding
- 7" touch screen mounted on the bridge
- PC with 21" screen on adjoining table
- Software for the management of cutting orders.
- Software for inventory management.
- Athenea workflow management software
- Fabric cutting optimization using Athenea Workflow Management Software
- Motorised unwinding device.
- Motorised carousel for under table storage of fabric rolls
- Analog pressure regulation
- Marker pen with Software for Roman blinds
- Laser projector for fabric alignment



- Barcode or QR code reader
- Transversal marking device
- Motorised rolling device for cut fabric, with or without tube
- Label printer

### 5.1.3. Ironing machine

#### - Stella-R

Brand: Cetyc Consulting S.L.



Fig 38. Stella-R model ironing machine.

Ergonomic machine for ironing curtains [37].

- Advantages:
  - With forward and backward movement, facilitating the ironing of large curtains.
  - Ergonomic, with 6 degrees of inclination. It allows the operator to have the indicated position to avoid accidents.
  - Side trays to collect tissues.
  - Optionally, with a blower turbine for velvet and other textiles.
  - Equipped with fluorescent lights on top of the machine.
  - Equipped with wheels and brakes for easy movement.

Price of the machinery:14.720€



#### - Aura Ironing System

March: MATIC

Traditional curtain ironing table equipped with rotary conveyor belt, heated plate and suction. It is a qualitative solution to obtain a perfect finish.

Ergonomic design to obtain good ironing quality with an easy ironing system.



Fig 39. Ironing machine model Aura Ironing System [38].

#### Characteristics:

- Rotating conveyor belt that is activated by photocells
- Working methods: Position 0: Steam. Position 1: Steam and suction at the same time. Position 2: when the steam stops, the suction starts.
- Equipped with two photocells (forward and backward) to control the ironing tape
- Steam and suction time control using the push button on the iron
- Two suction engines.
- Two fabric baskets (front and back)
- Inclined ironing surface for easy pulling and ironing of the fabric
- Steam and suction control by time,
- Steam lung
- Suspender iron anti-fatigue
- iron
- Lighting system.

Ironing board price: 9.500€



#### - URANUS 98

Brand: M.Martín Rojas, s.l.

Rectangular ironing board specially designed for ironing curtains, blinds, curtains, as well as any piece that needs a large ironing board due to its dimensions.

There are different versions of this industrial ironing equipment that may or may not include a steam generator.

All models are aspirants driven by means of a lower pedal, this is how they heat the plate to facilitate ironing.



Fig 40. URANO 98 model ironing machine.

Suction power 1 0.5 HP motor, expandable to two 0.5 HP motors

The model with built-in boiler has a boiler of 6 litres and a power of 4000 w, advising to install a condensate separator, also available.

It is recommended to install the condensate separator to avoid possible water leaks due to the amount of steam tubes needed in this type of curtain ironing table.

Two measurements of the ironing board:

- 340 x 80 cm
- 295 x 80 cm



Iron price: **6.830**€ excluding VAT and shipping.

In the case of buying the ironing board without the boiler or the iron, the price is  $\in$ 5,210. Then you have to buy a separate iron and install it [39].

#### **5.2.** Selection of machinery

Of the sewing and cutting machines, the ones that best suit Sactelyer's needs are the **CCP-2300** and the **AGA-2300**. The main reason why it was chosen is that the company Cetyc Consulting is in Barcelona and they are the ones who will subsequently provide the technicians in the event of a breakdown of the machine. The problem with the other sewing machines is that despite having similar properties, when residing in Barcelona, the shipping raises the price a lot and then there is the disadvantage that in case the machine fails, the company's technician will have to travel to Barcelona and the price rises a lot for a simple repair.

In the cutting machines, the AGA-2300 model has been chosen for being the one with the lowest price and the one that takes up the least space, since it has a vertical cut. The high ones are more complex cutting tables that require technical knowledge, therefore some workers would have to be trained and this is much more costly for the company.

In addition, Cetyc is a leading company in the textile machinery sector, which has already supplied its machines to clothing companies that work properly, among them there are companies that are part of Sactelyer's direct competition such as ABAYS.

 $\rightarrow$  CCP-2300. Straight sewing machine to make the bottom and sides of the curtains and the top fold in the traditional curtain.



Fig 41. Industrial sewing machine CCP 2300 [40].

- This machine is capable of sewing both thin fabrics and thicker fabrics. It is very important to know this great versatility of the machine.



- Cus el **80%** of the curtain
- Equipment of 5.50 m length with conveyor belt of the clothes and with clamp that makes the sewing process extremely simple without the need for an expert operator.
- It uses unique pneumatic funnels, which can make single or double bottoms or sides, ensuring impeccable quality even on very fine fabrics.
- Production of **240 sheets** in a working day. Sew 100m in 15/20 minutes. Adjustable speed of the conveyor table.

#### **Price:**

Machine: 58,200€Packaging: 190€

- Optional. 2 Air funnels: 2,800€

### $\rightarrow$ AGA-2300. Vertical cutting machine.



Fig 42. Industrial cutting machine model AGA 2300 [40].

Three curtain hanging systems: Riell, clamps and lead.

With which you can cut several cloths at the same time.

- Maximum gross height, two options of 415 cm or 615 cm
- All net 346 cm o 546 cm
- Gross width of the machine 715 cm
- Ample net 600 cm
- Productivity of **400 sheets** in the working day

#### **Price:**

- Machine: 45,750€



- Packaging: 940€

- Options:

- Doble barra per black out

- Cutting height 70 cm

- Pneumatic clamps

- Marking ink unit

The ironing machine selected has been the **URANUS 98**, of the company M.Martín Rojas, s.l. It has been selected because it is the most economical and the only one that gives the possibility to buy the table with the iron separately, so in this way Sactelyer can take advantage of the current boiler and iron and incorporate only the larger iron table.

Rectangular ironing board specially designed for ironing curtains, blinds, curtains, as well as any piece that needs a large ironing board due to its dimensions.

#### → URANUS 98



Fig 43. URANO 98 model ironing machine.

From the two measurements of the plate for ironing:

- 340 x 80 cm
- 295 x 80 cm



The smallest measurement will be selected, 295 x 80 cm, with a price of: 5,210€ not including VAT, shipping or boiler and iron. With these dimensions, the manufacturer guarantees that in one working day, depending on the worker, they can be ironed between 400-500 sheets [39].

If the Sactelyer company buys the three machines, it would have to make an investment of 109,160€. For this amount, as a company, you could request a loan from the bank and obtain the credit without difficulty. If this is the possibility that the vast majority of companies do, it is a safe option, but there are currently subsidies and state aid that can facilitate the payment and incorporation of machinery for small and medium-sized companies.

### 5.3. Production capacity

In this section, the theoretical capacity that led to the introduction of the new technology at the Sactelyer company will be made known. It must be taken into account, as we have already commented in section 2.3.3. Current production capacity, that the company does not focus full time on the manufacture of curtains, since the tailoring involves other jobs such as making cushion patterns, sewing and cutting cushions.

Therefore, the time invested by the workers in making curtains thanks to the information provided by Sactelyer, we estimate that it is half a working day, 20 hours per week.

- The production capacity of the CCP 2300 industrial sewing machine is approx **240 sheets** in a working day (8 hours daily). Sew 100m in 15/20 minutes.
- The production capacity of the industrial cutting machine model AGA 2300 is approx **400** sheets in the working day
- The production capacity of the URANO 98 model ironing machine is approx **450 sheets** per working day.

With a half-day, the amount of cloth generated is half in all processes, so as we currently only incorporate three machines, the one that produces the lowest number of clothes is the sewing machine, which would 120 sheets.

Later, a new study should be carried out to incorporate another sewing machine, in order to generate more clothes and that the cutting and ironing machines would not have to be stopped.



In this half day, 120 cloths can be generated, but this is not exact, since the sewing machine only performs the **80% shade**, that is to say that the other 20% must be paid by the worker with a conventional machine, so here the process is lengthening.

This 20% is to place the upper tape or velcro, go over the finishes, make some lower edge, among others. This process can cost the worker **10 minutes per curtain**. If in half a day (4 hours a day) the machine generates 120 clothes, it will take the worker 2 hours to finish all these clothes.

If we put the machine to work for less than half a day, exactly 2 hours, it generates 60 cloths and the worker will have 1 hour to finish the curtains, that is to say, in practically half a day we can manage to manufacture 60 curtains a day, 300 a week and **1,200 curtains per month.** 

Simultaneously while the SEWER performs the work of sewing the 60 cloths per day, the CUTTER and the IRONER are doing their work respectively and as their machines work faster than the sewing machine, they will not have problems keeping up with the sewing machine.

To conclude, it is estimated that monthly Sactelyer would manufacture 1,200 curtains with this incorporation of machinery, annually (working 11 months a year) it would produce **13,200 curtains**.

### 5.4. Amortisation of machinery

If the Sactelyer company buys the three machines, it would have to make an investment of 109,160€, to this figure must be added the shipping, packaging and assembly if necessary, therefore it can increase approximately 2,000€ per machine.

- Industrial cutting machine model AGA 2300: 45,750€

- CCP 2300 industrial sewing machine: 58,200€

- URANO 98 model ironing machine: 5,210€

Therefore, the final investment price is estimated to be 115,160 €.

With the production capacity study it has been calculated that Sactelyer can manufacture 1,200 curtains per month and 13,200 curtains per year, without having to hire any more workers. If for each curtain the company Sactelyer earns €185 net on average, it will have a monthly net profit of 222,000€ i 2,442,000€ per year Therefore, the investment in the machinery would be amortized in the first month.

This calculation is an estimate, as it has been made with current curtain prices, taking into account manufacturing time and current machinery. In addition, the waste that may occur throughout the new



manufacturing process has not been taken into account either. However, the volume of products will increase exponentially, then the prices of the curtains will decrease as the manufacturing time will decrease, therefore, the profits will be lower than estimated.

However, if the new products have a good output and a good impact on the market, there is no doubt that in the first year the machines would be amortised.

### 5.5. Layout proposal

AutoCAD and Navisworks Manage were used to create the layout, these two software are currently being developed and marketed by the Autodesk company. AutoCAD is a computer-aided design software used to make 2D designs and 3D modeling.

AutoCAD is internationally recognized software for its extensive editing capabilities, which make it possible to digitally draw building plans, machinery, among others, or recreate 3D images from 3D drawings. It is one of the most used programs by architects, engineers, industrial designers and other professionals [41].





Fig 44. Logos dels software Navisworks i AutoCAD.

On the other hand, the Navisworks program is one of the most used 3D visualisation tools by AutoCAD users, since it allows you to open and combine 3D models, navigate through them in real time and review the model using a set of tools that includes comments, redlining, point of view, and measurements. It is an ideal program for reviewing and presenting 3D work and projects from 3D modelling software such as AutoCAD [42].

For the realisation of the 3D modelling, the 2D plan of the current premises of Sactelyer was used, the following figure shows the dimensions of the rooms that the workshop has.



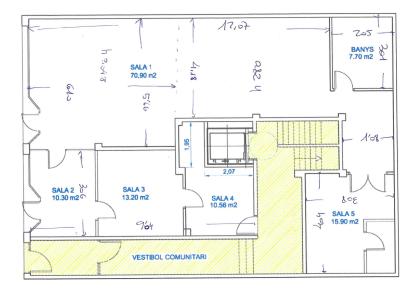


Fig 45. 2D plan of the premises provided by Sactelyer.

The places equipped to place the machinery are Room 1 and Room 5, Room 3 and 4 are offices, warehouse respectively and Room 2 is a small showroom.

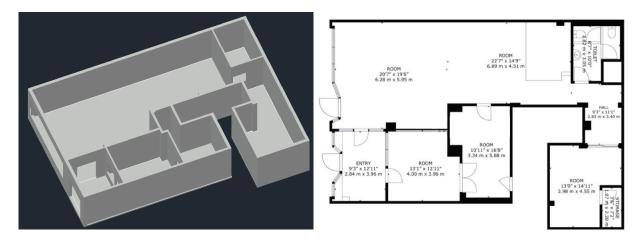


Fig 46. 3D representation of the 2D plane.

3D modelling of the selected machinery has also been carried out, with the specific sizes, in order to combine the modelling of the premises with the machinery in AutoCAD and recreate possible organisational scenarios.



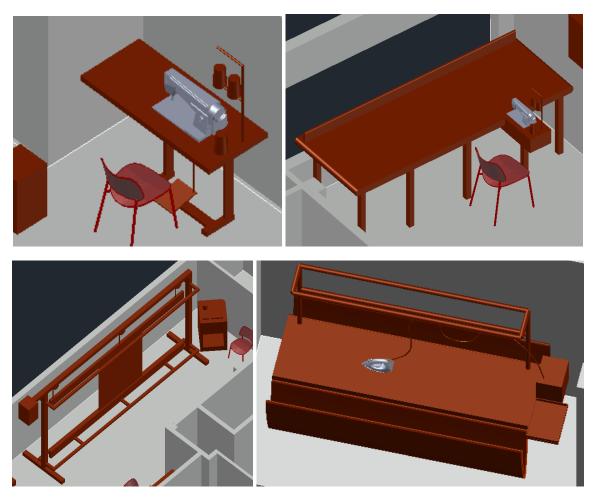


Fig 47. Representation of the machines necessary for the new manufacturing process.

Due to the large dimensions of the machines, the most efficient position for each worker to have their space while using it is as follows.

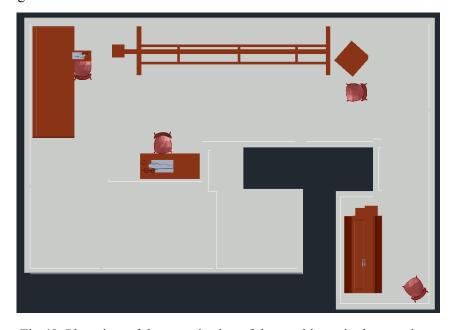


Fig 48. Plan view of the organisation of the machinery in the premises.



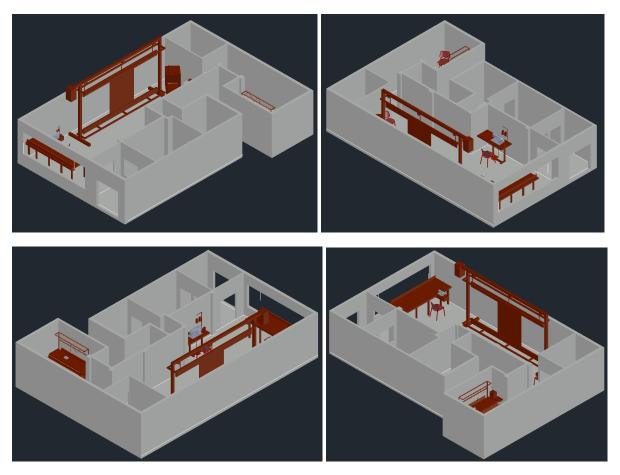


Fig 49. Orthogonal views of the organisation of the machinery in the premises.

With this arrangement, employees are provided with ample space to navigate freely within the workshop, without hindering the areas dedicated to machinery and other staff members. The workforce has been consolidated in Room 1, which serves as the cutting and sewing section, as these tasks require significant effort and meticulous attention. Consequently, the main room has been designated for this section, ensuring the constant presence of an employee.

Furthermore, the ironing machine has been situated in Room 5, a smaller yet sufficiently spacious area suitable for accommodating one worker, the ironing equipment, and a small inventory of curtains and garments awaiting the ironing process.



#### 6. CONCLUSION

In conclusion, this thesis contributes significantly to the advancement of Sactelyer's manufacturing process. The findings indicate that the investment in modern machinery to enhance production speed, quality, and flexibility is a strategic decision that will increase product output and market share.

By making this investment, the company will be able to achieve almost ten times the current curtain production, increasing from 1,540 to 13,200 units annually. Consequently, there will be a substantial rise in net profits, escalating from &284,900 to &2,442,000, representing an impressive 88.3% increase in profitability.

Although the initial investment costs are considerable, the competitive advantage gained through the incorporation of modern machinery ensures a swift return on investment within the first month. Therefore, it is evident that the investment in machinery brings substantial benefits to the company, enhancing productivity and generating a high return.

Furthermore, the current state of the textile sector, specifically the clothing industry in Spain, presents favourable prospects for local textile companies, offering growth opportunities and the capacity to accommodate new products. Over the past years, the textile market has experienced an average profit growth rate of 5.5% and a 3.4% average increase in direct employment at the national level. This suggests that the market is poised to absorb the increased quantity of products.

Despite the current thriving market for tailoring, Sactelyer must surpass its existing curtain models and develop new variations in design, incorporating standard sizes and more competitive pricing. This approach will enable the company to establish a competitive foothold in the market and expand its reach to a wider customer base.

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