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IMPROVING THE PERFORMANCE OF THE LOHN MANUFACTURING PROCESS: APPLIED STUDY IN THE LEATHER GOODS INDUSTRY

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Abstract: The paper presents an applied study on the optimization of the production process within a company in the leather industry organized in the Lohn system. The research aims to identify the main losses in the technological flow, with a focus on the leather cutting operation, considered the main source of non-conformities, additional times and high operational costs.The methodology used includes process analysis through Value Stream Mapping (VSM), equipment performance evaluation through the OEE indicator, cause-effect analysis for the prioritization of critical factors. The results highlight a reduced utilization of production capacity, high waiting and transfer times, as well as an overall equipment efficiency of 75%, below the level considered optimal in the industry. The proposed solution, the implementation of an automated cutting machine, led to a reduction in total production time by 27.7%, an increase in OEE to over 85%, and a uniform production flow. The study confirms the efficiency of applying Lean Manufacturing principles in an industrial environment specific to Lohn production and highlights the significant impact of automation on operational performance.

Keywords: Lohn, VSM, OEE, automation, production optimization.

1. INTRODUCTION

Lohn processing is an international subcontracting arrangement in which the manufacturer processes raw materials and supplies supplied by a foreign company (the customer) to create a finished product [1-2]. The customer retains ownership of the raw materials and retains the right to market the product. This system is a form of outsourcing, in which the manufacturer provides the labor, equipment, while the customer provides the design, raw materials, and work instructions.

In the definition given by Prof. Univ. Dr. Alexandru Puiu, Lohn processing "consists of an international economic business carried out on a contractual basis between two companies from different countries in which one executes, against a remuneration in money or in kind, a custom-made product according to the models, drawings, usually with the raw materials and materials of the other company, which retains the right to market the respective product under its own brand", [3].

After 1990, Romania, like Poland, the Czech Republic and Hungary, became an important center of Lohn production, attracting companies interested in low labor costs. The model was taken from the German practice (Lohnfertigung), where companies transfer raw materials and technology to local producers, remunerating only labor. In Romania, the system initially focused on the textile and automotive components industries, contributing to the integration of the economy into global value chains, but generating a dependence on foreign partners, [4].

Comparatively, European studies show that Central and Eastern European countries follow the same path: using the Lohn system as an intermediate stage of industrial development, followed by the transition to higher value-added models such as complete production and, respectively, in-house design and production. While Poland and the Czech Republic have already started to reduce their dependence on Lohn, Romania is still in an adaptation process, trying to transform the accumulated experience into its own innovation, design and local brand capabilities [2].

In this context, the application of Lean Manufacturing principles [5] and the use of tools such as Value Stream Mapping [6], OEE [7-8], Pareto analysis or Ishikawa diagram represent internationally validated approaches to eliminate waste, reduce variations and improve operational performance. This form of

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cooperation is often found in the textile, automotive, electronics and furniture industries, where the share of labor costs is significant [9].
Therefore, the analysis of the cutting process is part of the modern trends of continuous improvement, being supported by both the specialized literature and international good practices in the leather goods and fashion components industry [9-10].

2. RESEARCH OBJECTIVE

This research aims to optimize the production process in a company in the leather industry operating under the Lohn regime, with a focus on improving the leather cutting operation, considered a critical point in the technological flow.

3. METHODOLOGY

The case study analyzes the production process of a company in the leather goods industry that operates predominantly in the Lohn system, an economic model that is based on contractual collaboration between external partners and the local contractor. Within the company, the main activities are carried out in two departments, namely: cutting and sewing, where raw materials provided by external partners are processed into semi-finished products and then exported.
The main objective of the study is to identify and reduce non-conformities in the production flow, with a focus on optimizing the leather cutting operation, which is the major source of time and cost losses. The research was conducted over a three-month period and used both operational data collected directly from the processes and internal audit reports.
The research methodology combines direct observation, process analysis, and continuous improvement tools [11], such as:

- Value Stream Map (VSM) to visualize the current flow, identify waiting times, bottlenecks, imbalances between operations, highlighting both value-added activities and losses;
- The OEE (Overall Equipment Effectiveness) indicator, for evaluating the performance of equipment through three critical components: availability, performance, quality. It was calculated for the leather cutting operation using the formula
  OEE = Availability * Process Efficiency * Quality
- The cause-effect diagram was used to structure and prioritize the main causes that generated long process times and non-conformities;

4. PRODUCTION PROCESS

4.1 Description of the production process

The production process takes place in two sections, namely the cutting and sewing sections, which are equipped and organized according to criteria required for production efficiency. Regardless of the category of manufactured products, the production process includes work operations that determine the transformation of raw materials, each operation being divided into phases.
Production activity is coordinated by technicians sent by external partners to verify the quality of finished products, based on technical assistance contracts.
To ensure the necessary production flow, the share of leather surfaces to be processed is 94%, and the share of leather surfaces to be shipped to partners as semi-finished products is 6%.

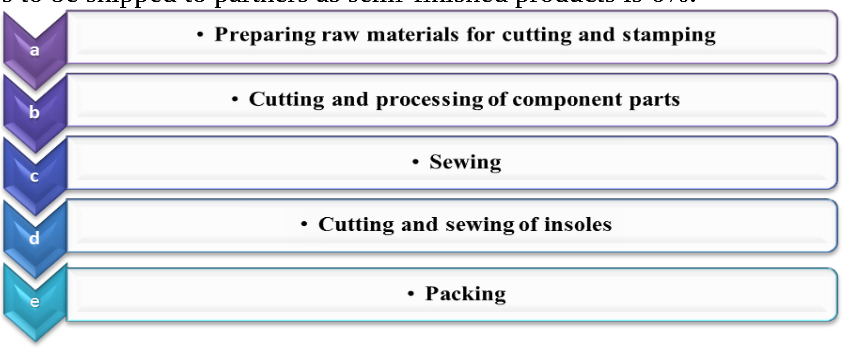

Figure 1: Main operations of the technological process

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Stages of the production process:

a. Preparation of raw material for cutting and stamping - represents the first stage of the production process in which the raw material is controlled in terms of quantity and quality. From a qualitative point of view, if the raw material has defects greater than 50%, it will be sent to the tannery for a decision on material return.

The supply of raw materials and materials is mainly from external suppliers, materials that are processed and re-exported to external partners.

The raw materials provided by the clients the company works with can be:

- natural leather (ostrich, python, calf, pony, crocodile) or synthetic material is used for the component parts;
- Goat, calf or pig leather is used for the lining.

After sourcing and checking the raw and auxiliary materials, they are brought to the cutting department, based on an order form, where the production process begins.

b. Cutting and processing of component parts - represents the second stage of the technological process (table 1) and is the stage in which the basic raw material is transformed into faces.

Table 1: Operations in the cutting department

No. Crt.	Operations	Description	Machine name	Operation time	Number of employees
1	Cutting	Leather cutting operation, lining	Simple, manually operated folding arm punching machine	90 seconds	3
2	Technical quality control	Checking the cut components on the stamping machine.	Manual operation	60 seconds	1
3	Equalize	The equalization operation is carried out with the aim of obtaining a uniform thickness over the entire surface of the tanned leather.	Leveling machine	25 seconds	2
4	Thin	Based on a customer catalog, adjustments are made to perform the thinning operation. The procedure is performed based on the required width, thickness and length, on thinning machines.	Thinning machine	60 seconds	2
5	Drilling (reaming)	It is performed using the client's knives.	Drilling machine	20 seconds	2

At the end of the operations, the semi-finished products (leather and lining) are distributed into carts, with the order form.

c. Sewing – is the third stage of the technological process, carried out in the sewing section and is the stage in which the semi-finished product is transformed into a "finished" product (table 2).

Table 2: Operations in the sewing department

No. Crt.	Operations	Description of operations	Machine name	Number of employees
1	Painted	Each component part is painted on the edge of the cutout.	The operation is performed manually.	2
2	Anointed	The corn, tongue and rind are greased with tick at 45°.	The operation is performed manually.	1
3	Launch into the band	The order is launched in the band by sizes	The operation is performed manually.	1
4	Sewing a strip	-The first row of batting is sewn -Apply tape to the hooves -The lining strip is greased and installed -Sewing the second row of slats	Single-needle column machine.	2
5	Collar sewing	-Apply grease and tape to the collar; -It is sewn on the corners. -The collar is sewn around; -Perforated for hand sewing.	Single needle column machine	2
6	Applying straps	-Sew the small straps in 2 rows -The straps are greased and padded	Single needle column machine	2
7	Sewing insole	Sew the insole in a zigzag pattern.	Flatbed zigzag sewing machine	1
8	Sewing the tongue	Sewing the tongue of the shoe upper	The operation is performed manually.	1
9	Control	Final inspection is carried out after hand stitching	The operation is performed manually.	1

After completing the operations in both sections and technical control, both quality and quantity, the products are packaged and the order is prepared.

4.2 Process analysis

From the processes and activities specific to the production process presented, we can identify some non-conformities that occur in the performance of operations for this purpose. These can lead to a decrease in the quality of the processes running in the production line and, thus, can lead to unwanted costs.

Within the production process there are areas where action can be taken to reduce manufacturing time, but also unplanned interruptions. The creation of a value stream map (VSM) allowed the clear identification of losses and bottlenecks, providing a basis for the implementation of Lean Manufacturing principles, figure 2.

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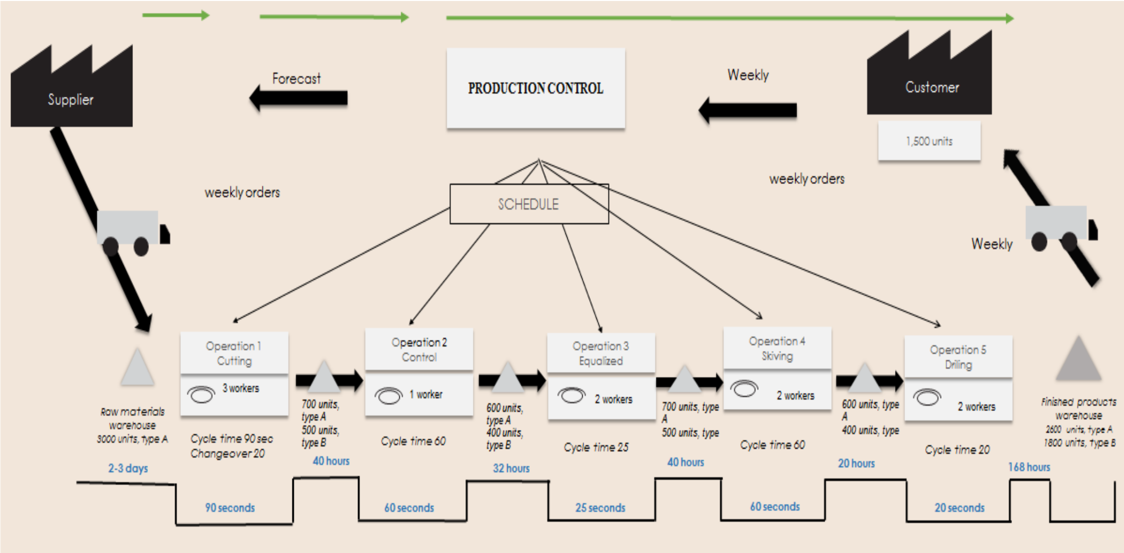

Figure 2: Current value stream map - tailoring section

Analyzing the technical time norm, it is observed that the longest time encountered in the first operation that of cutting leather and ticking, of 4.30 min, is made difficult because the operation is carried out with the help of six simple stamping machines, with a folding arm, which are operated manually (figure 3). Uniformity of the flow is important for maintaining production, and to achieve this, the production time for each operation must be leveled relative to each other, in order not to risk a blockage, a delay in the work phases.

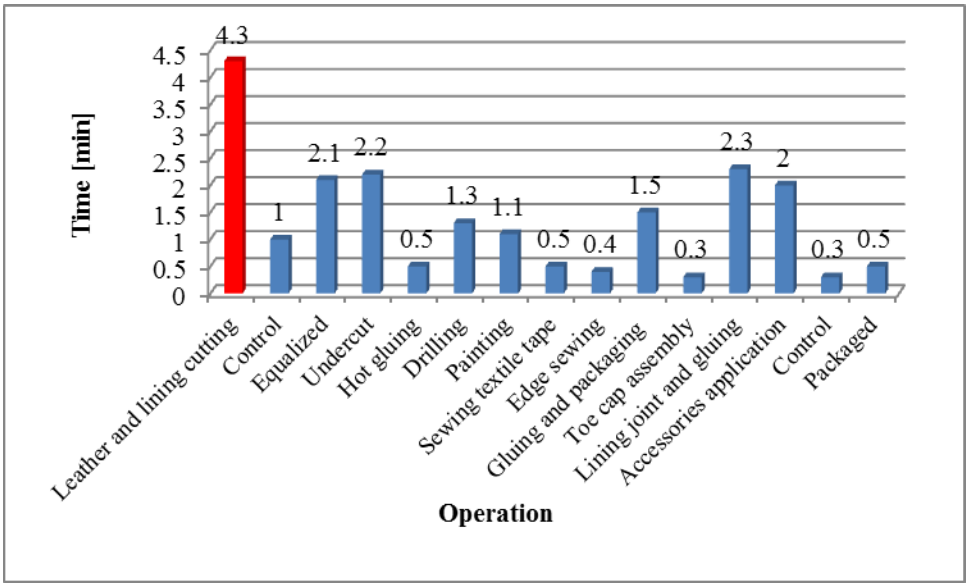

Figure 3: Graphical representation of the technical time norm (min)

Following the analysis of issues related to process quality, manufacturing time and activities within the production line, the following were identified:

- Delay of raw materials;
- Inconsistent quantity of raw material;
- High transfer time of raw materials to production;
- High production time in the leather cutting operation;
- High change-over time;
- Finished product not in accordance with the execution drawing;

Using the alternative evaluation matrix, the problems were evaluated from 1 to 5 (1 option less important, 5 option very important), according to the criteria presented in Table 3:

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Table 3: Alternative selection matrix

Complete the problem assessment matrix										
Criteria / **Problems**	**Chronicity**	**Importance**	**Term**	**Impact**	**Expedite**	**Risk**	**Resistance to change**	**Success**	**Measurable problem**	**Total**
Raw material delay	4	3	5	2	2	3	3	3	5	30
Inconsistent quantity of raw material	5	4	5	3	5	4	3	3	5	37
High transfer time of raw materials to production	3	5	5	5	5	2	4	4	5	38
High change-over time	5	3	4	3	2	4	4	3	3	31
High production time in leather cutting operation	4	4	5	3	5	5	4	4	5	39
Finished product NO - Not in accordance with the execution drawing;	4	4	4	3	3	2	2	3	4	29

The alternative evaluation matrix identified the high production time in the leather cutting operation as the priority problem, so it became a priority. The high production time in the leather cutting operation leads to non-compliance with the terms of the contract, to increased manufacturing costs and, implicitly, to increased expenses. These directly lead to a reduction in the company's profit, image and market position. Thus, the goal is to identify all the causes leading to this non-compliance of the process, to provide corrective measures and apply them in order to reduce by at least 50% for the following months.

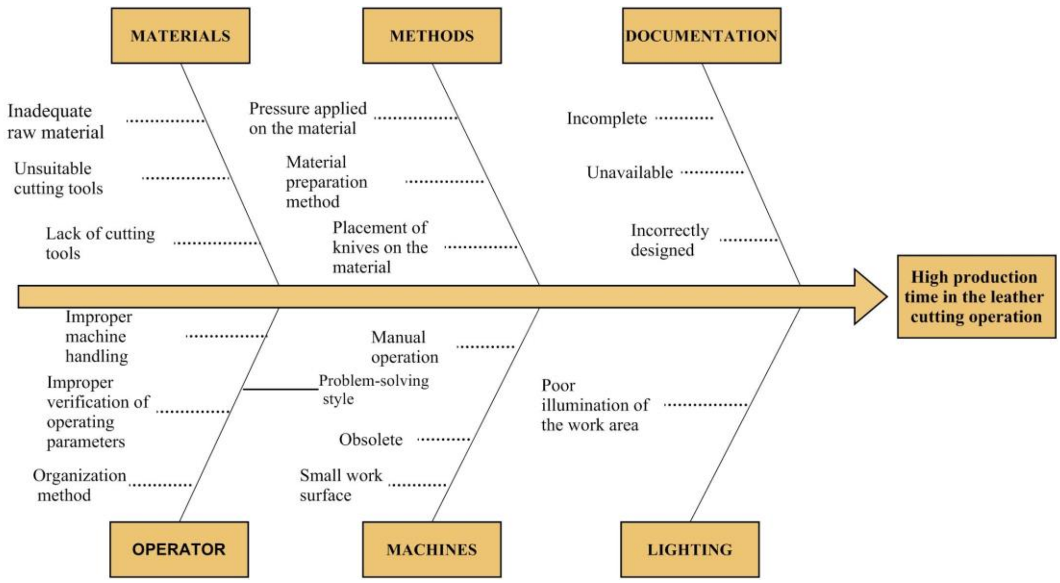

Figure 4: Cause-effect diagram of the identified non-conformity

The analysis and measurement took place based on the reports from the process audit conducted over a period of 3 months, recorded in a standard form for each issue. The data was extracted from these forms and processed, based on which the cause-effect diagram and Pareto analysis were created.
To identify, organize and present the possible causes of these problems, a brainstorming session was conducted with the production line logistics staff and the causes shown in Figure 4 were determined.
For the Pareto analysis, the causes identified in the cause-effect diagram were used, based on the criteria of the results from 3 consecutive months of observation, as shown in Figure 5.

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Table 4: Data for creating the Pareto diagram

No.	Cause	Frequency of cases	Cumulative	Percent	Cutoff
1	Obsolete equipment	28	28	17.61%	80.00%
2	Small work surface	26	54	33.96%	80.00%
3	User manual	19	73	45.91%	80.00%
4	Material preparation method	11	84	52.83%	80.00%
5	Improper handling of the machine	10	94	59.12%	80.00%
6	Improper handling of landmarks	8	102	64.15%	80.00%
7	Documentation unavailable	8	110	69.18%	80.00%
8	Pressure on the material	7	117	73.58%	80.00%
9	Out-of-date documentation	6	123	77.36%	80.00%
10	Placing the knives on the material	6	129	81.13%	80.00%
11	Superficial visual dimensional check	5	134	84.28%	80.00%
12	Missing knives	5	139	87.42%	80.00%
13	Inappropriate knives (SDVs)	5	144	90.57%	80.00%
14	Organizational style	4	148	93.08%	80.00%
15	Incorrectly designed documentation	3	151	94.97%	80.00%
16	Problem-solving style	3	154	96.86%	80.00%
17	Inappropriate raw material	2	156	98.11%	80.00%
18	Incomplete documentation	2	158	99.37%	80.00%
19	Poor lighting of the work area	1	159	100.00%	80.00%

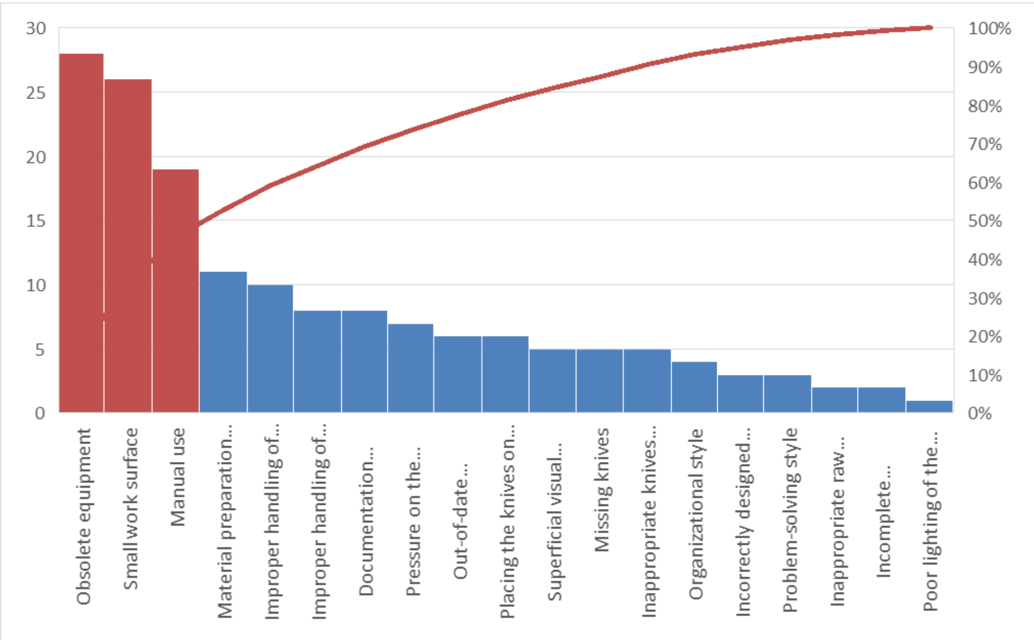

Figure 5: Pareto diagram

In view of the improvement process, the most important resulting causes were selected, the necessary resources were determined and the implementation status was determined for each selected improvement. These are:

Obsolete equipment- purchase of automated equipment, replacing the six hydraulic presses;

Small work surface- the need for a larger surface area for placing the material for a work cycle;

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Manual use- replacing the operation performed manually on hydraulic presses with automation.
159 non-conformities were analyzed, based on which the Pareto diagram was built. The main causes that accounted for 80% of the problems were determined: outdated equipment, small work area, high degree of manual operation, and based on these results, the introduction of an automated cutting machine was proposed and evaluated.

4.3 Results and discussions

The analysis of the production process highlighted the need to modernize equipment and introduce automation to increase competitiveness on the foreign market.
The results of the analysis highlighted the following aspects:

- The manual leather cutting operation with simple hydraulic presses results in high production time and inefficient material consumption;
- Old equipment and manual use of the process generated an OEE yield of 75%, a value below the optimal threshold (85%);
- The lack of automation and an adequate work surface led to blockages and flow losses, affecting production capacity and meeting delivery deadlines.

The results were compared in two stages: before and after the installation of the automated machine. The following indicators were measured:

- total monthly production time,
- during each operation,
- the number of operators required,
- OEE efficiency,
- the level of defects,
- transfer times and intermediate stocks.

Table 5: Comparison of performance indicators before and after automation

Indicator	Before automation	After automation	Effect / Improvement
Total production time (month)	498 hours	360 hours	−27.7%
Cutting operation time / piece	4.30 minutes	0.75 minutes	−82.5%
Number of presses / machines	6 hydraulic presses	1 automated machine	infrastructure reduction
Number of operators required	6 operators	2 operators	4 operators relocated
OEE efficiency	75%	>85%	10% increase
Non-conformity level	high	reduced	quality improvement
Intermediate stocks	increase	LOW	MUD

Thus, it is proposed to reorganize the equipment by replacing the six electro-hydraulic presses with an automatic cutting machine. By replacing the six hydraulic presses, significant improvements were achieved:

- Reduction of production time from 498 hours to 360 hours/month (−27.7%);
- Reducing the number of workers required for the cutting operation from 6 to 2, with the rest being relocated to activities with higher added value;
- According to the technological characteristics of the purchased equipment, it is observed that the time for the first operation, that of cutting leather and ticking necessary to manufacture a product, decreases after the investment from 4.30 minutes/piece to 0.75 minutes/piece, which leads to a uniform flow, a time gain of 3.55 minutes/piece and automatically to an increase in production.
- Increasing process efficiency (OEE > 85%);
- Reducing inventories and transfer times between departments by standardizing the production flow.

5. CONCLUSIONS

Production process management is a dynamic system, constantly oriented towards improvement and efficiency. These objectives can only be achieved by clearly establishing strategic directions and by continuously adapting operational structures so that they support change and optimization of the technological flow. In the selection of the optimal equipment for the implementation of the improvement

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plan, several factors were analyzed, such as:
– production system indicators that affected performance;
– the operating mode of the equipment;
– operational limitations and resource availability.

The redesign of the production flow and the integration of agile production principles contributed to making the system more flexible, reducing non-productive times and increasing overall productivity. The results of the study show that the main source of inefficiency was represented by the manual leather cutting operation, carried out with conventional hydraulic presses. From the perspective of production systems theory, optimization is not determined only by the introduction of a new machine, but by the synchronization of technological, human and informational factors in a coherent operational architecture.

The obtained conclusions confirm the research hypothesis that automation and flow redesign lead to a significant increase in the overall efficiency of manufacturing processes. In addition, the analysis demonstrates the applicability and usefulness of Lean Manufacturing tools in the Romanian Lohn production industry, contributing to the alignment of local practices with international standards.

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