

IMPLEMENTATION OF BASIC LEAN PRODUCTION PRINCIPLES IN THE BUSINESS ENVIRONMENT: A COMPARATIVE ANALYSIS BETWEEN ROMANIA AND EUROPEAN UNION

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Abstract

The paper aims to analyze the business environment in the European Union and Romania regarding the stage of implementation of basic Lean Production principles. The objectives of this research involve a comparative study of the parameters of a production process in an automotive factory in Romania, before and after the implementation of Lean Production. The results target the establishment of new strategies to facilitate Lean Production implementation in fields where it has previously been applied, as well as the identification of new areas where Lean Production could be successfully implemented

Keywords: Lean production, waste management, management

1. EFFICIENT PRODUCTION AND WASTE MANAGEMENT

The 21st century is characterized by an increase in industrial production and urbanization, two elements that have created an urgent need for effective waste management as waste quantities have trended upwards in recent decades. Urbanization has led to the expansion of industrial areas, fostering growth in production and consumption of goods and services. Waste management has been an ongoing issue, but recent years have intensified the need for new strategies and policies aimed at minimizing the impact of waste on human health and the environment. (Abd Rahman, Ismail, & Ariffin, 2016)

The concept of Lean Production emerged in the 1950s in Japan within the Toyota company. Lean Production was developed as a response to the mass production model and gained momentum in the manufacturing industry. This concept primarily aims to optimize production processes, reduce waste, and, ultimately, increase efficiency. (Mehri, 2019)

"Lean Production is a production organization that was put together by three American scientists James P. Womack, Daniel T. Jones and Daniel Roos between 1985 and 1991. They adopted the basic ideas from Japanese automobile companies from Toyota." (Womack et al., 2007)

Over time, the concept of Lean Production has been adopted by many countries and is now also known under other names, such as **Efficient Production** or **Enhanced Production**. Regardless of the name, Lean Production remains a method of managing production processes with the goal of eliminating waste and optimizing the use of all types of resources. As time has passed, the need to reduce losses has aligned with the desire to minimize resulting waste.

From its inception, Lean Production has focused on eliminating all activities that do not add value to the final product. The concept began with the idea of reducing inventory levels, optimizing workflow, and involving all employees in identifying and eliminating waste. Quality Management today embraces Lean Production

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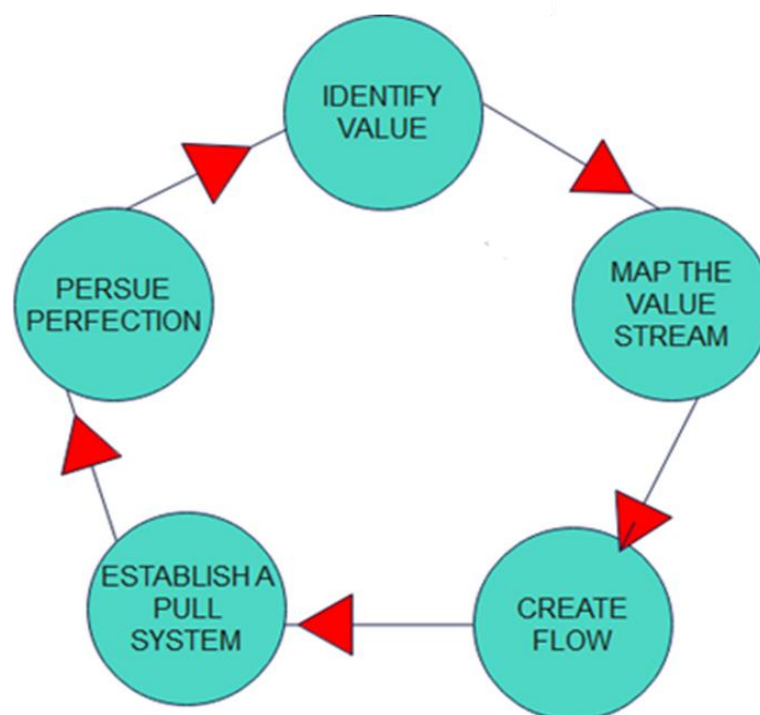
principles to improve product and service quality, minimize costs, and reduce delivery times to customers. Another important consideration has been maximizing flexibility to respond to the continual changes in the market.

"Lean production is a sub-area of the overarching 'Lean Management'. This is a complete corporate philosophy that aligns all areas of the company to avoid waste.

Unnecessary work steps should be avoided through intelligent organization. Lean management looks at the entire value chain. The Lean Production sub-area specifically examines production in a company.

The holistic production system is always considered here. Various process designs are available for lean production. In particular, "avoiding waste" is a long-term important component of lean production and is considered with every process change." (Morgan and Liker, 2006)

FIGURE 1 - KEY CONCEPTS OF EFFICIENT PRODUCTION



(Lean Production, n.d.)

The key concepts of efficient production include waste elimination, employee involvement in continuous process improvement, and workflow optimization are:

Avoiding Waste

First, it is essential to plan activities to eliminate those that do not create value, except for activities the company consciously decides to carry out even if they do not directly add value to the final product. An example of such activities would be those conducted in the research process. The main effect of minimizing non-value-adding activities is the reduction in the volume of resources used in the production process. (World Health Organization (WHO), n.d.)

Continuous Improvement Process

Long-term improvements will directly contribute to enhancing efficient production. To achieve this, the company will involve all employees who are responsible for analyzing processes and proposing improvements along with the tools needed to implement them.

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Standardization

Production often involves repetitive processes and the step-by-step organization of activities. For this reason, efficient production aims, firstly, to eliminate all ancillary activities that do not add value to the product and, secondly, to organize processes in a standardized and documented manner. This approach prevents fluctuations in production quality in any context, even when new personnel are hired.

Zero Defects Principle

By adhering to the "zero defects principle" at each stage of work, errors will be prevented from passing from one stage to the next, thereby maintaining a consistently high standard of product quality.

Flow Principle

Aiming for short production times, the company will create a rapid flow of material and informational resources in production, based on the flow principle.

Pull Principle

This principle refers to the production of parts to be processed, with production triggered by customer orders. In doing so, the company will eliminate overproduction and, by using effective supply chain management, will reduce inventory through the implementation of the just-in-time logistics concept.

Employee Orientation and Goal-Oriented Leadership

By encouraging all employees to think independently and participate in the continuous improvement of the production process, the company succeeds in transforming the traditional approach to the assembly line. This shift provides advantages such as enabling employees to identify and rectify their own errors or to recognize waste that they can manage to reduce their volume. (European Union, 2008)

Visual Management

Visual management aims to convert information, processes, specialized process flows, key figures, or high-level objectives into images and graphics. This approach enhances transparency in company management, making all changes immediately visible. (Marin et. al, 2021)

Lean production has become increasingly widespread globally and in the European Union. More and more companies in the EU have adopted or will adopt lean production and lean management principles and practices soon to remain competitive in the market and meet the increasingly complex demands of consumers. This lean production approach has become a standard in many industries, promoting operational performance optimization and reducing environmental impact through more efficient resource management. (Lean Production, n.d.)

Waste management refers to the process of collecting, transporting, treating, recycling, and disposing of waste in a responsible and sustainable manner, with the aim of reducing environmental impact and protecting human health. This process involves applying specific practices and technologies for efficient waste management, in accordance with legislation and environmental standards. (Eurostat, n.d)

Below is a brief classification of waste in the European Union and Romania at the production level.

a) Classification of Waste in the European Union: a) Generic Waste:

- Biodegradable Waste: food scraps, organic materials.
- Non-recyclable Waste: plastics unsuitable for recycling.

b) Hazardous Waste:

- Chemical Waste: toxic substances, solvents, flammable substances.
- Electrical and Electronic Waste (e-waste).

c) Recyclable Waste: paper and cardboard, plastic, metal, glass.

d) Construction and Demolition Waste: concrete, bricks, wood.

Classification of Waste in Romania: a) Municipal Waste:

- Household Waste: food scraps, paper, plastic.
- Bulky Waste: old furniture, appliances.

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b) Hazardous Waste:

- Electrical and Electronic Waste.
- Medical Waste: needles, syringes.

c) Construction and Demolition Waste.

d) Industrial Waste: waste from production processes (packaging, non-recyclable materials).

2. CORRELATION BETWEEN EFFICIENT PRODUCTION AND WASTE MANAGEMENT

Lean production promotes the adoption of waste management practices, particularly the promotion of recycling and the recovery of waste to minimize negative environmental impacts and conserve natural resources. With the goal of achieving cleaner production and generating less general waste within operations, lean production optimizes processes and minimizes losses of materials, energy, and capital, closely linked to waste management. (Kassem et al., 2024)

In an efficient production framework, the focus is on minimizing waste through methods such as reducing the consumption of raw materials, recycling materials, and optimizing processes to avoid the generation of unnecessary waste. By applying sustainable and responsible production practices, companies can contribute to environmental protection and reduce negative impacts on ecosystems. (Pérez-Naranjo et al., 2021)

Thus, waste management is a vital component of an efficient production strategy, as it helps reduce negative environmental impacts and promotes more responsible use of natural resources.

The correlation between Lean Production and waste management in the European Union, as well as in Romania, is an extremely relevant and timely issue given current concerns about the efficiency of industrial processes and environmental responsibility. From this perspective, we will analyze this connection and the impact of implementing efficient production principles on waste management in the EU and Romania.

Lean management arises as a correlation between waste management and quality management, and it can be easily defined by examining the end results related to improving the quality of final products and services while minimizing the volume of resulting waste. (Helmold et al., 2022)

If the minimization of waste volume is to be achieved through the minimization and optimization of resource use, recycling, and efficient destruction that ensures maximum environmental safety, then enhancing product quality involves using safe, eco-friendly, and reusable resources that add value to the product without negatively impacting the environment.

Waste management and lean management signify the minimization of associated costs, the enhancement of operational efficiency, and the development of responsible and sustainable approaches to resource management and environmental protection. (Ciocoiu et al., 2024)

In conclusion, the correlation between quality management and waste management leads us to lean management. The objectives of lean management focus on reducing the use of materials, space, time, human effort, and capital in the production process of goods and services to be provided to consumers.

To conclude, the focus in lean production is on efficiency to maximize value for the customer, but without affecting quality. Lean seeks to eliminate all activities that do not add value to the production process, including holding inventory (stock), repairing faults, and unnecessary movement of people and products around a manufacturing plant.

Optimizing the flow of products and services through value streams sequences of activity that flow horizontally across technologies, assets, and functions to customers - allows the business to respond to consumer demand faster. Efficiency also makes it simpler and more accurate to manage information. (Elsharydah et al.,2020)

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3. COMPARATIVE STUDY BEFORE AND AFTER THE IMPLEMENTATION OF LEAN MANAGEMENT IN A CAR MANUFACTURING PLANT IN ROMANIA

In the current European context, as well as in Romania, the issue of waste management occupies an important place in the concerns of all entrepreneurs, regardless of the field of activity. The benefits offered by the implementation of efficient production have been a decisive factor in the rapid decision to adopt lean production in European companies. To highlight the advantages of waste management correlated with lean production, it was necessary to conduct a comparative study of the parameters of a manufacturing process before and after the implementation of these two tools. This study is essential because the results obtained lead to an objective evaluation of the impact and effectiveness of the strategy mentioned. (Martínez-Jurado & Moyano-Fuentes, 2014)

The evaluation focuses on the improvements brought by the implemented strategy and involves a comparative analysis of parameters such as: production volume, quality, costs, labor efficiency, and, finally, employee satisfaction. This comparative study also supports the identification of new areas where lean production can enhance continuous optimization, leading to the sustainability of the entity in the business environment and strengthening its competitiveness in this highly dynamic marketplace. (Abatan et al., 2024)

TABLE 1 - PARAMETERS OF A CAR MANUFACTURING PLANT FROM ROMANIA IN 2021

AUTOMOBILEFACTORY YEAR 2021 BEFORE THE IMPLEMENTATION OF EFFICIENT MANAGEMENT														
	January	February	March	April	May	June	July	August	September	October	November	December	Annual	
1 PRODUCTION VOLUME(pieces)	10000	9800	10200	9500	10500	10300	10000	9700	10100	9900	10200	10000	120200	total
2 PRODUCTION COSTS(million euros)	12.5	12.3	12.7	12.1	13	12.8	12.5	12.2	12.6	12.4	12.7	12.5	150.3	total
3 PERCENTAGE OF DEFECTIVE/ REFUSED PRODUCTS	2.5	2.3	2.8	2	3	2.7	2.5	2.2	2.6	2.4	2.7	2.5	2.52	media
4 PRODUCTION TIME(hours)	32	31	33	30	34	33	32	31	33	32	33	32	32.17	media
5 WORKFORCE YIELD(piece/employee)	8	7.5	8.2	7.3	8.5	8.1	8	7.7	8.3	8	8.2	8	7.98	media
6 EMPLOYEE SATISFACTION [1-5]	3.8	3.7	3.9	3.6	4	3.8	3.7	3.6	3.9	3.8	3.9	3.8	3.79	media

The previous table consolidates data collected from a car manufacturing plant in Romania in 2021, which characterizes the production process before the implementation of efficient management. (Affyadah, Rose, Ab Rashid, & Mohamed, 2021)

TABLE 2 - PARAMETERS OF A CAR MANUFACTURING PLANT FROM ROMANIA IN 2023

AUTOMOBILEFACTORY YEAR 2023 AFTER THE IMPLEMENTATION OF EFFICIENT MANAGEMENT														
	January	February	March	April	May	June	July	August	September	October	November	December	Annual	
1 PRODUCTION VOLUME(pieces)	10500	10200	10800	10000	11200	10900	10500	10100	10700	10300	10800	10500	126500	total
2 PRODUCTION COSTS(million euros)	11.8	11.5	11.9	11.3	12.2	12	11.7	11.4	11.8	11.6	11.9	11.7	140.8	total
3 PERCENTAGE OF DEFECTIVE/ REFUSED PRODUCTS	1.8	1.5	1.9	1.3	2	1.8	1.6	1.3	1.7	1.5	1.8	1.6	1.65	media
4 PRODUCTION TIME(hours)	29	28	30	27	31	30	29	28	30	29	30	29	29.17	media
5 WORKFORCE YIELD(piece/employee)	9.5	9	9.8	8.8	10	9.7	9.5	9	9.3	9	9.8	9.5	9.41	media
6 EMPLOYEE SATISFACTION [1-5]	4.2	4	4.3	3.9	4.4	4.1	4	3.9	4.1	4	4.2	4.1	4.10	media

In Table No. 2, data characterizing the production process after the implementation of efficient management is consolidated. In both cases, data has been collected over a total period of one calendar year, with monthly monitoring to highlight any seasonal variations. The values of parameters such as production volume, production costs, percentage of scrap or defects, production time, production efficiency, and employee satisfaction have been tracked and consolidated. (Martur F., 2023)

A brief analysis of all monitored parameters reveals the following details: the production volume is expressed in the number of cars produced monthly, and production costs are expressed in millions of euros, including raw material costs, labor costs, and general production costs. The annual consolidation is calculated as the sum of monthly values for both production volume and production costs. (Isac, Dobrin, & Badshah, 2020)

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Furthermore, we monitored the percentage of rejected or defective products; this parameter is expressed as a percentage of the total products manufactured. Production time is expressed in hours, representing the average duration required to complete the manufacture of a product.

Labor productivity is monitored as the monthly average value of the number of products made by an employee in a month. Employee satisfaction is expressed as an average monthly satisfaction score, quantified using an internal survey with a scale from 1 to 5, where 1 represents dissatisfaction and 5 represents very satisfied. (Queiroz et al., 2024)

An analysis of production efficiency was performed using Figure No. 2 by comparing the production levels before and after the implementation of efficient management.

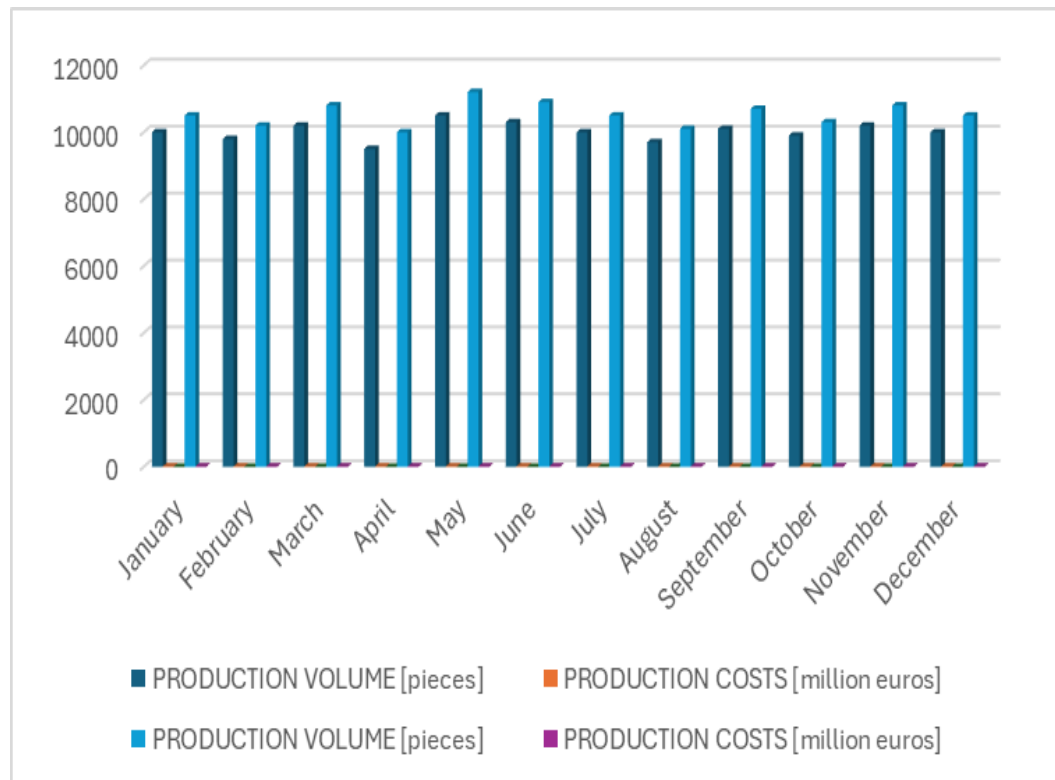


FIGURE 2 - MONTHLY COMPARATIVE ANALYSIS OF PRODUCTION VOLUME AND PRODUCTION COST

Before the implementation of efficient production, the monthly production volume varied between 9,500 and 10,500 automobiles. After implementation, it increased, ranging from 10,000 to 11,200 automobiles per month.

Before implementation, production costs were generally higher, ranging from 12.1 to 13.0 million euros monthly. After implementation, costs decreased, ranging from 11.3 to 12.2 million euros monthly.

In conclusion, based on the analysis of the chart in Figure 2, we observe that production volume increased, and production costs decreased after the implementation of efficient management, compared to the period before the strategy was implemented.

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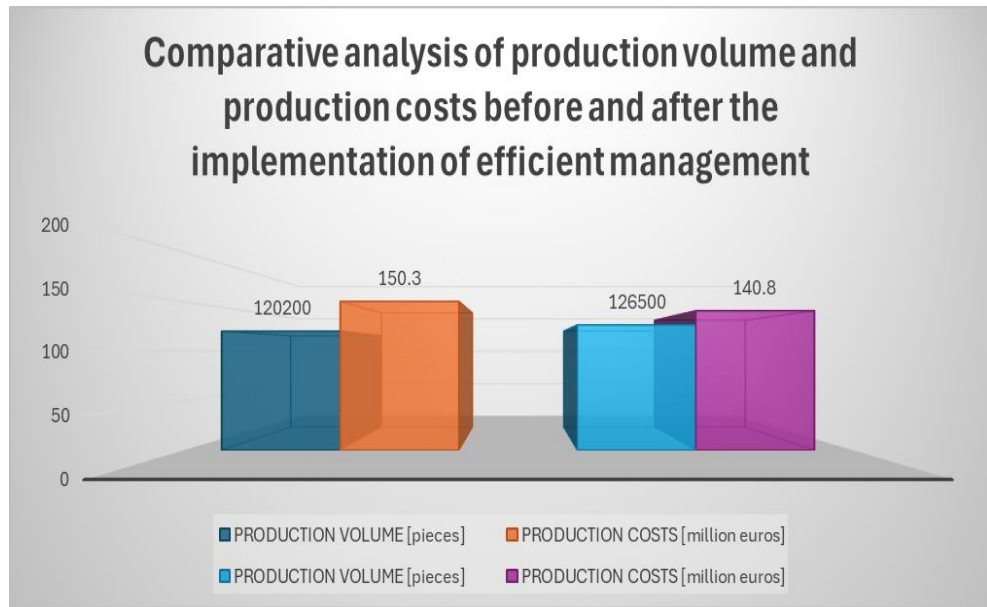


FIGURE 3 - COMPARATIVE ANNUAL ANALYSIS OF PRODUCTION VOLUME AND PRODUCTION COSTS [PERSONAL CONTRIBUTION]

Figures 3 and 4 summarize the results regarding production volume and production costs. Figure 3 compares the total annual values of these two parameters, while Figure 4 provides a trend analysis of monthly production volume values before and after the implementation of Lean management.

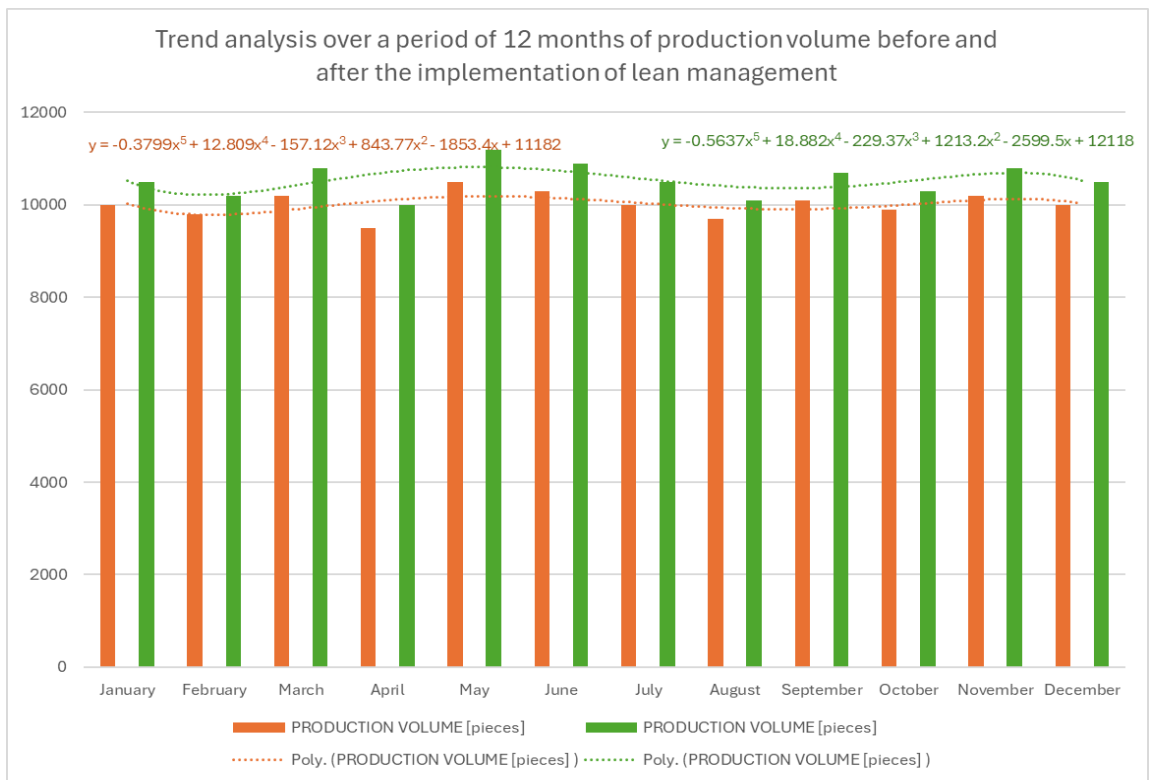


FIGURE 4 - COMPARATIVE ANALYSIS OF PRODUCTION VOLUME [PERSONAL CONTRIBUTION]

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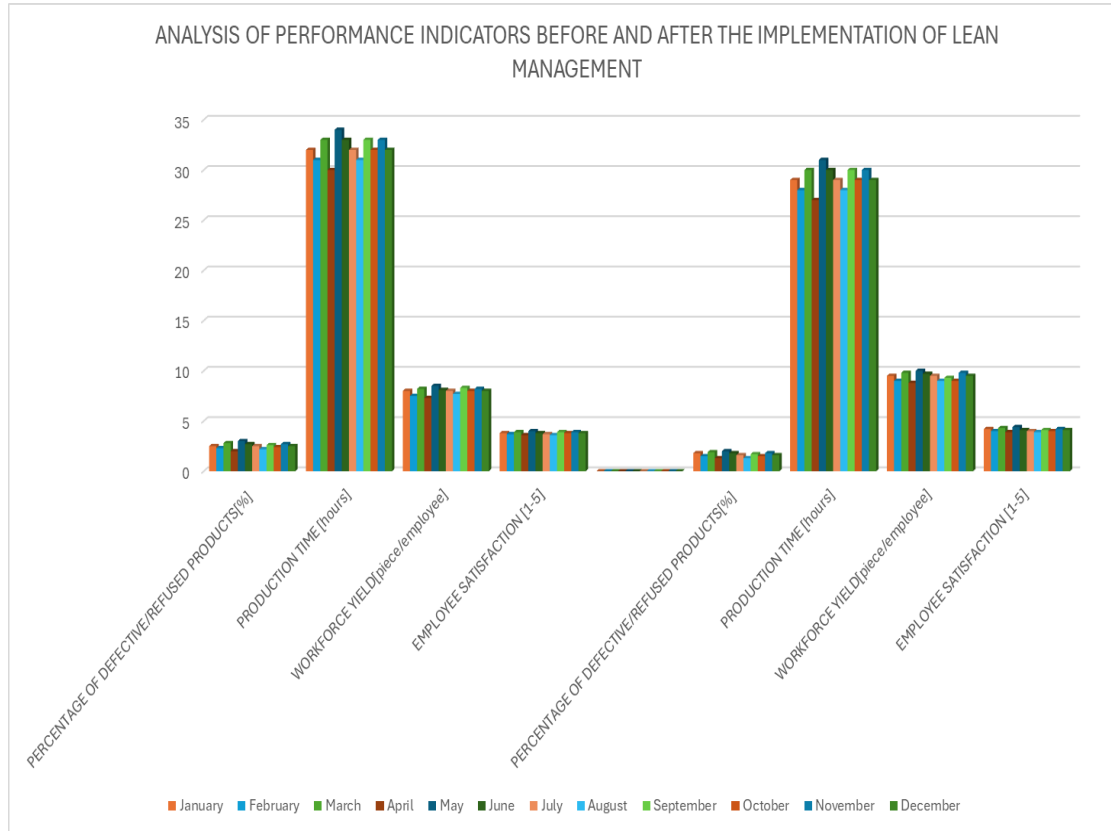


FIGURE 5 - COMPARATIVE MONTHLY ANALYSIS OF ALL ANALYZED PARAMETERS [PERSONAL CONTRIBUTION]

In Figure 5, the values of all monthly analyzed parameters are compared before and after the implementation of lean management, as follows:

- **Production Time:** The graph indicates a reduction in production time in 2023 compared to 2021. Before the implementation of efficient production, the average time ranged between 30 and 34 hours to manufacture an automobile. After implementation, this decreased to a range of 27 to 31 hours.
- **Labor Productivity:** The efficiency of the workforce was analyzed in 2021 and 2023 through a comparative study of individual productivity. A significant increase is observed for 2023 after implementing lean management.

Before implementation, productivity generally ranged from 7.3 to 8.5 automobiles produced per employee per month. After implementation, it increased, ranging from 8.8 to 10 automobiles produced per employee per month.

- **Product Quality:** This is highlighted by the reduction in the percentage of rejected and defective products in 2023. The trends for these parameters show a clear improvement in quality and a significant reduction in waste generated from rejects. Before the implementation of efficient production, the rejection rate ranged from 2.0% to 3.0% monthly. After implementation, it decreased to a range of 1.3% to 2.0% monthly. (Marin, 2022)
- **Monthly Labor Productivity:** An increase in individual production output is noted for the period following the implementation of lean management. Before implementation, productivity was generally between 7.3 and 8.5 automobiles produced per employee per month. After implementation, it increased, ranging from 8.8 to 10 automobiles per employee per month

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- **Employee Feedback:** There is an observed increase in employee satisfaction scores for 2023 compared to 2021, prior to the implementation of lean management. Before implementing efficient production, satisfaction scores ranged from 3.6 to 4.0 monthly. After implementation, they increased, ranging from 3.9 to 4.4 monthly. (Holmemo & Korsen, 2023)

In conclusion, the implementation of efficient management led to an overall increase in production volume and a decrease in production costs. The adoption of efficient production also resulted in a reduction in monthly production costs.

The implementation of efficient production led to:

- A decrease in the percentage of defective or rejected products monthly,
- A reduction in the time required to manufacture a product,
- Improved monthly workforce productivity,
- Increase employee satisfaction each month. (Pardi, 2021)

In the end, the implementation of lean management at the automobile factory had a significant positive impact on all analyzed aspects, including production volume, costs, quality, production time, workforce productivity, and employee satisfaction.

4. CONCLUSIONS

Based on the analysis conducted, it is evident that the implementation of Lean Production and Lean Management in companies in Romania can bring numerous benefits and contribute to improving operational performance and market competitiveness.

What can be easily observed is that the implementation of Lean Production principles and Lean Management leads to much more efficient use of all resources, resulting in reduced waste and rejections. Overall, there is significant improvement in all production processes, which leads to increased operational efficiency.

Efficient Management achieves cost reduction in the production process by eliminating waste, minimizing the volume of generated waste, removing unnecessary activities, and enhancing the quality of operations. The decrease in costs and the improvement in product quality demonstrate an increase in the company's profitability, as it will benefit from higher earnings through reduced costs and the elimination of rejections and defective products.

Considering the current dynamic context regarding environmental changes, waste management, and customer requirements, efficient management will help reduce the manufacturing and delivery time of products to clients while also increasing flexibility in response to the a forementioned dynamic environment.

Lean production and lean management place employees and their satisfaction at the forefront, as a satisfied employee is likely to be more engaged and collaborate better with colleagues. This leads to a pleasant working environment, where teams function effectively, ultimately contributing to the company's success.

This paper presents a study on lean production and waste management, as well as the correlation between the two. Such a study is necessary at the European Union level, but especially in Romania, where there is a need for a comprehensive overview of the business environment and all the challenges and opportunities that arise from implementing lean production and lean management.

The current work aims to identify the best practices for the correct and efficient implementation of lean management. By observing and analyzing the steps taken by companies in the process of implementing lean management, we contribute to establishing new directions and strategies regarding these implementations, yielding truly remarkable results in many companies. Lean management is beginning to be better understood

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in Romania, with the goal of this paper being to contribute to the adaptation of all fundamental principles of lean production to the Romanian business environment and the requirements of the Romanian market.

In conclusion, the implementation of Lean Production and Lean Management is a necessity in the current business environment in Romania. Research on this topic provides valuable new guidelines and perspectives for companies seeking to adopt this strategy for continuous improvement in their performance.

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