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OPTIMIZATION OF WORK PROCESSES IN A PRODUCTION COMPANY IN ALBANIA

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ABSTRACT

The manufacturing sector faces considerable challenges in a dynamic and competitive environment, and process improvement is a crucial tool to enhance competitiveness and maintain long-term sustainability. This study analyses the importance of optimizing work processes in manufacturing companies and provides a comprehensive guide to enhance efficiency and productivity within these organizations. With a results-oriented approach and particular attention to continuous change management, this study aims to provide a practical guide for manufacturing companies seeking to enhance their operations and increase competitiveness in the market. Work process optimization involves enhancing work processes within an organization to increase productivity, reduce costs, improve quality, and decrease processing time. The study implements the Kanban system, widely adopted in manufacturing companies, to optimize efficiency and reduce waste. Results show 99% efficiency, meeting EU quality standards, optimizing resource utilization, minimal machine downtime, and improved production time. The study concludes that changes positively impact productivity and efficiency.

Keywords: Process Optimization, Production Technology, Kanban Method, Average Production Time, IMOS

1 INTRODUCTION

Work process optimization implies improving and more efficiently using work processes within an organization or manufacturing company. The primary goal of process optimization is to increase productivity, reduce cost-effectiveness, enhance quality, and decrease processing time. Optimizing work processes involves identifying and eliminating inconsistencies, disruptions, and delays during production. This process is geared towards improving efficiency and maximizing the utilization of available resources and capacities. Optimized processes create more significant opportunities for entrepreneurship and innovation, allowing companies to develop and test new ideas more seamlessly alongside established, stabilized processes. In this study, the Kanban system, a method widely adopted in manufacturing companies for production management and inventory control, has been implemented to enhance efficiency and reduce unnecessary waste.

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The use of timber and its processing will assist in a more efficient and sustainable utilization of timber resources, as well as its processing to produce more durable and versatile furniture. In this study, an experimental methodology has been utilized to examine the current work processes within the company under investigation. This encompasses the identification of weaknesses, the formulation of recommendations for enhancement, and the delineation of an action plan for executing the suggested modifications. The objectives of this study are to increase production efficiency to enhance output and reduce production costs; to decrease the time required to produce a specific product; to ensure that each product is accurate and within pre-defined quality standards and conformity; to minimize waste and material misuse; and to reduce operational costs through the implementation of technology. This study commences with an analysis of processes involving the identification of the company's machinery, specifying activities, and determining the time needed for each step using flowchart techniques.
Secondly, changes are put into action. Through the application of the Kanban method, a new automated machine is introduced to carry out all the processes. Following this implementation, the performance of this new process is continually monitored.
This study aims to provide a valuable contribution to the field of work process optimization in manufacturing companies

by combining an in-depth analysis of current processes with the utilization of the latest technology and innovative practices. It also provides a new platform for manufacturing companies and industry professionals to explore and implement innovative ways of optimizing processes based on the insights derived from practical examples and the latest technological advancements.

2 MATERIALS AND METHODS

In this study, an experimental methodology has been employed to test two hypotheses:
H_0: Changes in work processes do not have a significant impact on the productivity and efficiency of the company under study.
H_1: Changes and improvements in work processes have a positive and significant impact on the productivity and efficiency of manufacturing companies.
Based on the results we will obtain; we will see which one stands or if we can reach another conclusion based on the outcomes collected. They offer two contrasting views on the impact of optimizing work processes in a company [4],[1].
The use of the 'Kanban System' as a method was suggested by the company to aid in optimizing work processes. The Kanban System was implemented to control the inventory of materials used in production, both before and after the installation of the new machinery, for materials such as wood panels, melamine, and other supplies. A Kanban card was created for each material. This physical card contained necessary information such as the quantity of panels that entered the warehouse, the maximum amount we could store, the name of the panel, the supplier's address, and contact number. These cards were placed near each pallet storing the materials. When the quantity approached the designated minimum (which was 10 MDF panels), employees took the Kanban cards and placed a new order with their material suppliers. This order specified the new quantities of MDF panels needed. Suppliers received the Kanban orders and delivered the necessary materials to replenish the inventory at the company. This sequence continued as a cycle for several months.

3 CASE DESCRIPTION AND ANALYSIS

3.1 PRODUCTION OVERVIEW

The company had three production machines: pantograph, edge bander and SCM CYFLEX. Pantograph is an old mechanism with parallelogram linkage used for engraving purposes on materials such as wood, steel, plastic, etc., [1],[9]. This machinery operates with milling cutters of various sizes. The use of these machines varies depending on specific applications and can be adapted for use in mass production processes or individual production. The company under study utilized it for both these types of production. It is beneficial in the production of similar products as well as shaping the designed form of the wooden material.
The Edgebander machine is a device used to apply an "edge" to veneered material, wooden panels, or other types of materials. It is used to achieve a high-quality finish.
The machine contains a series of rotating blades or a device that applies an edge of material (as in an edge band) to the edge of a panel previously worked on in the Pantograph machine. The processes through which the wooden materials passed were as follows: Ensuring that the first part of the material intended for use was free from dust and impurities. The material segment entered the edge banding machine, which trimmed it to the desired size and applied it to the edge of the panel. The adhesive materials used were a specific "glue" with pellets designed for the edge bander. Following the edge application, the machinery could also perform a trimming process to remove excess material from the "edge," creating an even and smooth edge. The panel could undergo further finishing processes such as trimming, varnishing, or polishing to achieve a smooth and uniform surface. The edge banding machines were manually controlled [20],[2].
SCM CYFLEX is a CNC-programmed machine directly connected to the designers' office servers.
Table I outlines the average time it takes for three different types of machines to complete a simple task. The Pantograph Machine requires an average of 60 minutes to complete a simple task. The Edgebander Machine takes slightly less time, with an average of 50 minutes needed for a simple task. Lastly, the CNC Machine is the quickest of the three, with an average completion time of 45 minutes for a simple task.
Table I categorizes each machine by its efficiency in completing straightforward tasks, ranking them from the longest to the shortest average working time.

Table I - The average working time of the machines

Pantograph Machine	The average time for a simple task = 60 minutes.
Edgebander Machine	The average time for a simple task = 50 minutes.
CNC Machine	The average time for a simple task = 45 minutes.

The average time of the machines is calculated under the best possible working conditions, meaning errors, axis misalignments, plate size, work complexity, and material processing difficulty are minimized. This indicates that the conditions are optimal, and this time is the best possible [24],[7],[6]. Based on the responsibilities within work processes, it becomes feasible to pinpoint the areas where difficulties are encountered and where improvements and the adoption of new technologies are necessary.
Indeed, the overview of the company's operations has been instrumental in identifying both the strengths and potential weaknesses within its multifaceted structure.
A comprehensive analysis has been conducted by examining different facets, ranging from strategic planning and financial reporting to capacity planning, maintenance, and customer service. This approach has provided valuable insights into the company's core competencies and areas where improvements are needed.

Table II categorizes various work activities and processes across various aspects of business operations. Grouping activities and processes into pairs indicates a broad spectrum of functions essential for efficient and innovative business operations. These include:

- Planning and Production Analysis, which pairs with Sales and Financial Reporting, suggests a strategic approach to aligning production capacity with market demands and financial health.
- Capacity Planning and Maintenance and Customer Service emphasize the importance of operational readiness and customer satisfaction.
- Materials Procurement and Innovation and Development highlight the relationship between efficiently sourcing materials and developing new products or services.
- Production and Assembly and Employee Training indicate the importance of skilled labor in manufacturing processes.
- Quality Control, Supplier Networking, and Collaboration are necessary to maintain high standards through effective supply chain relationships.
- Process Management, Product Development, and Adequate Distribution focus on continuously improving operational processes and delivering products to the market.
- Process Improvement and Information Technology suggest enhancing operational efficiencies through technology.
- Inventory Management and Risk Management underline the need to balance stock levels while mitigating business risks.
- Packaging and Transportation, paired with Automation and Robotics, point out the logistics of product delivery and the increasing role of technology in automation.
- Shipping, distribution, and Return and Recycling focus on the end-to-end logistics of product distribution and the sustainability aspect of business operations.
- Recordkeeping and Reporting, integrated with Workplace Safety, emphasize the administrative aspects of business operations and the importance of a safe working environment.

Process improvement, Information Technology, Risk Management, Automation and Robotics, and Workplace Safety are integral to maintaining and enhancing operational, technological, and safety standards within a business.

Table II offers a holistic view of the diverse activities and processes involved in running a business, illustrating the interconnectedness of functions from production to distribution, innovation, safety, and sustainability.

3.2 AUTOMATED MACHINERY REVOLUTION

3.2.1 Technical Specifications

The machinery was entirely automated and performed all three functions of the existing machines in the company, aiming to save time and enhance quality. The machinery is 5 meters long and is divided into three zones: First Zone: Cutting the piece placed into the machinery in a given shape automatically provided by the company's external server. Second Zone: This area consists of 2 milling heads, each with three directional axes, enabling the creation of holes and the opening of cavities for joining the pieces together.

Third Zone: The area deals with edging the cut piece's edges, then finishing the piece and ejecting it at the end.

The average time required for the machinery under perfect working conditions was 45 minutes. Implementing new technology in work processes aimed at ensuring the necessary personnel training for the effective use of this technology. To ensure a comprehensive evaluation, the company utilized a one-month monitoring period through advanced monitoring systems, leaving no stone unturned in assessing the functionality of the new processes.

Table II - Work activities and processes

Planning and production analysis	Sales and financial reporting
Capacity planning	Maintenance and customer service
Materials procurement	Innovation and development
Production and assembly	Employee training
Quality control	Supplier networking and collaboration
Process management	Product development and adequate distribution
Process improvement	Information technology
Inventory management	Risk management
Packaging and transportation	Automation and robotics
Shipping and distribution	Return and recycling
Record keeping and reporting	Workplace safety

3.2.2 Technological Integration

After installing the new machinery, a new technology was implemented involving the design phase right from the initial stages of the product, based on client requirements. This technology then seamlessly transferred to the new machinery without requiring excessive manual labor. The new program was IMOS. IMOS is a program that handles furniture design. Besides its designing capabilities, this program can generate the cost for the final product, indicating the quantity of materials used and the amount of waste produced. After these internal phases in the design office, the file is transferred to the machinery service, initiating the production process [32],[30],[29]. For this study, the "Production Efficiency Index" is a method that includes information such as the number of products manufactured about the planned capacity, the number of failed products in the process, and the production time for a single product. This method aided in understanding the importance and validity of the new machinery. The machinery was tested for producing 80 pieces of furniture within a month.

The goal was to determine how well the machinery meets production targets, maintains product quality, and minimizes downtime. Based on these key performance indicators, the study provides a comprehensive understanding of the machinery's importance and validity. Table III provides an overview of the metrics used for evaluating the performance of machinery throughout each week of the month. The IMOS system played a crucial role in this assessment, offering consistent management and optimization of resources across the weeks. This system facilitated various operational tasks, including but not limited to monitoring production capacities, tracking inventory levels, scheduling production runs, and overseeing other resource management-related aspects. [11,17,19]. Table III is structured to reflect three key performance indicators: Production Efficiency, Product Quality, and Downtime. Table III succinctly captures the machinery's operational performance, demonstrating a generally high level of efficiency and quality, with the IMOS system aiding in maintaining consistent standards and minimizing downtime.

Table III - Metrics for assessing performance

Time	**Production efficiency**	**Product quality**	**Downtime**
1st week	0.99	Within the standards	2 min
2nd week	0.99	Within the standards	2 min
3rd week	0.97	2 defective items	2 min
4th week	0.99	Within the standards	2 min
5th week	0.99	Within the standards	2 min

4 RESULTS AND DISCUSSION

Implementing the advanced automated machinery has yielded notable results, fundamentally transforming the company's production landscape. The integration of cutting-edge technology has been assessed through various key performance indicators, shedding light on its impact on efficiency, quality, and downtime. Productivity Efficiency: 99% efficiency was achieved due to the speed of furniture production compared to the planned output. With a set limit of 80 pieces of furniture per month, the month under study was August, with five weeks, averaging 16 per week. However, there was one defect in the cabinet delivery due to a programming issue caused by the company's still-new technology. Out of the planned 16, only 15 furniture items were produced. Incorporating the IMOS program has been a game-changer in the design-to-production workflow [18],[23]. This innovative software facilitates intricate furniture design and provides accurate cost estimates, material quantities, and waste projections. The technology has enabled a smooth transition from design conceptualization to the actual manufacturing process, reducing manual labor and enhancing overall operational efficiency. Regarding quality assurance, all furniture meets EU standards, which are implemented through our collaborators to whom we export furniture. Machine Downtime: Machine downtime, when the machinery stops working, was minimal, mainly occurring during material plate changes, depending on the material specified by the client. Production Time: We have significantly improved production time, speeding up all processes and meeting deadlines outlined in our client contracts. Upon completion of one furniture item, we noted a production time of 45 minutes, which shows an improvement compared to the previous three existing machines in our company, demonstrating our success in achieving the initial goal through the investment in this machinery, thus optimizing production processes. A one-month monitoring period was dedicated to training personnel for effective machinery utilization. This proactive approach ensured a seamless adaptation to the new technology, minimizing potential challenges and streamlining the learning curve.

5 CONCLUSION AND RECOMMENDATION

This study has shown that the changes and improvements in our work processes significantly and positively impact our productivity and efficiency. Our successful integration of advanced automated machinery has positioned us at the forefront of manufacturing excellence. By consistently adhering to the recommended strategies, we can maintain our competitive edge and pave the way for continuous innovation and growth in this dynamic industrial landscape. A crucial part of this journey involves predicting the timeframe required for the new machinery to offset its initial acquisition cost. This projection is vital for our financial planning and helps us assess the long-term return on investment. Given the relatively short monitoring period of less than three months for the new machinery, it is essential that we closely monitor its performance over an extended duration. This extended observation will give us more comprehensive insights into its cost-effectiveness, reliability, and contribution to our bottom line. As we progress, continual evaluation, data-driven decision-making, and a proactive stance toward evolving technologies will be vital to unlocking sustained success and maintaining our leading position in this competitive manufacturing landscape.

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