Companies keep focus on enhancing the quality, efficiency, and customer satisfaction of their products and services while at the same time increasing their profits. Lean Manufacturing emerges as a potent strategy to address these imperatives via identifying and eliminating losses. Hence, it leads to optimized production processes and enhances overall performance of enterprises. This study presents an overview and analysis of lean manufacturing principles, implementation strategies, challenges, and economic benefits for Ukrainian enterprises. The main hypothesis of the paper was to investigate whether the Lean manufacturing approach is associated with different scope of businesses and whether it brings efficient outcomes for all of them. Based on conducted structured literature review the study highlights the versatility of lean methodologies across various industries and administrative processes. Employing scientific methods like comparative analysis and theoretical generalization, the research offers insights into the outcomes of lean implementations, including cost savings, productivity enhancements, and improved product quality for business organizations. The main outcomes of study underscore the critical role of strong leadership commitment and organizational culture in driving successful lean transformations. Through overviewing case studies and practical insights, the article illustrates real-world applications of lean manufacturing principles from different industries, exemplified by organizations AeroStar, Nova Poshta and Boeing. The paper is theoretical. However, the study advocates the practical importance of adoption of lean principles to achieve operational excellence for companies regardless of their scope of operating activities. Also, it offers suggestions for future research to explore emerging technologies’ impact and cross-cultural comparisons in lean manufacturing practices. 

Key words: lean manufacturing; waste reduction; 5S; efficiency; quality; sustainable improvement.
INTRODUCTION

Global market dynamics and competition are forcing companies from all over the world to look for ways to improve the quality and efficiency of their products and services, at the same time to meet customer needs and increase company’s profits. One effective way is to determine «consumer value» - what customers are willing to pay for and when it should be delivered. Maintaining consumer value is essential for ensuring long-term relationships with customers. By continuously meeting client needs, businesses can ensure high customer loyalty and increase its lifetime value. The vast majority of clients (93%) are willing to spend more in companies that offer the best way of their support, and if customers receive timely and efficient service, then (90%) of them are more likely to apply for the service again in the future [1].

Companies can focus on reducing the time during which the product or service does not bring additional value. This is called Lean Manufacturing (LM), which could be integrated into the organization’s corporate strategy and culture. The implementation of LM tools can lead to temporary changes, but the overall transformation can significantly change the company’s performance in the long run. Lean culture has been developed at Toyota enterprises, and nowadays used in various fields, including healthcare, accounting, information technology, etc. [2].

Using lean approaches, Caterpillar has been able to improve production workflow and reduce wastes. Similarly, Kimberly-Clark adopted lean manufacturing principles to enhance staff development and engagement. Additionally, LM led to a decline in absenteeism and an increase in personal productivity. John Deere made a significant investment in lean technology in 2003, resulting in reduced waste and improved production time and quality at its main facility in Iowa. Parker Hannifin, one of the world’s largest producers of motion control technology, began using electronic strategies to incorporate lean manufacturing nearly 20 years ago. These initiatives ultimately increased quality and productivity while simultaneously reducing costs [3].

Despite these significant results, the implementation of LM methodologies has not been widely studied in the context of Ukrainian companies. According to a report by the Lean Enterprise Institute, the Lean Institute Ukraine (LIU) is helping domestic companies to adopt practices on using Lean methodologies. Hoshin Kanri (policy deployment) helps companies align their strategies and operations effectively [4].

This approach is crucial in maintaining companies’ focus and direction, aiming disruptions caused by the ongoing war in Ukraine. Some Ukrainian companies have already leveraged Lean thinking to keep their employees safe, rethink business objectives and reorient operations during geopolitical crises. This has involved creating smaller, more agile teams and maintaining a strong focus on core business values and goals. Considering current challenges faced by domestic enterprises during geopolitical conflicts and other implementation issues the results of leveraging LM might be underestimated, hence identification of these problems remains relevant.

LITERATURE REVIEW

Recently, the manufacturing sector changed significantly, and there is a high demand on improving efficiency and optimizing resources in growing competitive markets. Many scholars [5-6, 7-8, 9, 10, 11] highlighted the important role of modern logistics and streamlined technologies [12, 13, 14] in achieving these goals. For example, Lomotko mentioned the importance of applying the «just in time» (JIT) approach, originally developed in response to market dynamics in Japan, which has become a cornerstone of lean manufacturing [5]. Using lean manufacturing principles, organizations strive to optimize their operations and eliminate waste, thereby increasing overall efficiency.

The implementation of lean manufacturing techniques goes beyond manufacturing in the context of lean management [7]. Understanding the importance of flexibility management in the modern business environment, lean management is becoming a competitive advantage for organizations. Vlasov [7] accentuates the effectiveness of lean manufacturing

Ключові слова: ощадливе виробництво; скорочення витрат; 5S; ефективність; якість; стійке вдосконалення.
principles and methods in improving the efficiency of companies (not only manufacturing), but also administrative and organizational processes. This highlights the multilateralism of lean manufacturing methodologies to achieve organizational excellence in a variety of fields. A key aspect of implementing lean manufacturing is the systematic implementation of its principles, methods and tools.

Scholars [5, 14] described a lean manufacturing transformation system that provides a structured approach for organizations looking to improve their efficiency and sustainability. This system is characterized by five fundamental questions, serves as a roadmap for organizations to effectively implement lean manufacturing principles and achieve operational excellence. Moreover, Vlasov [7] emphasized the importance of a deep understanding of lean manufacturing principles, concepts and tools for successful implementation in his work.

Organizations can develop a solid framework for implementing lean manufacturing in the office through a systematic analysis of the literature review and practical recommendations. This system includes training programs tailored to the needs of the organization and practical examples of lean manufacturing tools such as value flow mapping and the 5S system. One of the key aspects is the usage of digital platforms and technologies to facilitate transformation and adaptation in the industry [6]. Digital platforms enable efficient information exchange between supply chain participants and serve as a catalyst for innovative business models. Usage of digital platforms facilitate improving collaboration, optimization operations, and effective responding to crises such as the Covid-19 pandemic or war, in particular for logistics and manufacturing enterprises.

In addition, effective control and reducing cost tools are important components of production efficiency [9]. The impact of information technologies on production outsourcing and further enterprise productivity was shown in work [15]. The researchers highlighted the crucial role of IT investment, which leads to lower costs and a significant improvement in product quality at manufacturing plants.

Meanwhile, other researchers proposed a methodology aimed at augmenting manufacturing productivity by enhancing operational efficiency [16]. Their approach adjusts curtailing cycle time, streamlining changeovers, and eradicating errors in the production process and highlights the imperative of leveraging methodologies to fine-tune manufacturing efficiency.

As we can see, companies are constantly trying to optimize their costs and maintain quality and productivity. It can be achieved by using Agile methodologies for enhancing company efficiency, particularly in managing IT projects [17]. It requires transforming the organizational culture and implementing Agile scaling methodologies, such as Scrum and Agile Framework, to bring them in line with current market conditions. This can be achieved by combining efforts towards continuous cost control and continuous improvement initiatives. Moreover, the involvement of innovations in production processes is important for maintaining a competitive position in the market [18]. Innovation-oriented outsourcing strategies together with integration between design and production processes allow companies to increase their capabilities while effectively managing costs. This highlights the importance of balancing efforts to reduce costs and invest in improving internal processes and achieving long-term growth and market competitiveness.

Thus, the literature review emphasizes the importance of modern logistics technologies and lean management methods to improve the efficiency and competitiveness of an organization. Numerous studies are examining the impact of lean management or logistics technologies on a company’s sustainability results, however, there is a limited amount of research in the Ukrainian context. Although, the specific strategies and structures needed to effectively integrate lean manufacturing techniques to optimize overall operational efficiency are not well described.

There is a shortage of available studies which provide detailed overview and analysis of how to integrate these lean management approaches to reach sustainable functioning for domestic companies. Due to identified research gaps, the main focus of this study is to conduct an overview on lean management methods and their implementation by Ukrainian enterprises. Ukrainian companies can achieve operational excellence, optimize resource usage and effectively navigate the complexities of the modern business landscape by incorporating best practices of applying lean manufacturing principles.

**AIMS AND OBJECTIVES**

The main research objective is to conduct an overview and analyze the principles and key concepts of Lean Manufacturing through examining and identifying the implementation strategies and challenges associated with these processes. In addition, to evaluate economic benefits of Lean Manufacturing implications and provide practical recommendations for organizations seeking to adopt lean manufacturing methodologies. The purpose of the study is to identify and further develop theoretical and practical examples of implementing Lean methodologies to improve the quality and efficiency of business and economic processes of enterprises.

**METHODOLOGY AND RESEARCH METHODS**

The study is based on structural literature review of relevant and up-to-date material of primary and
secondary sources and applied scientific methods such as comparative analysis to evaluate the effectiveness of different approaches and theoretical generalization. The methodology ensures that stated research objectives are achieved. The detailed steps of the applied methodology are as follows:

1) Identify and compile a list of credible primary and secondary sources relevant to Lean manufacturing.

2) Categorize the collected materials based on themes such as Lean principles, implementation strategies, and industry applications.

3) Conduct literature review and identify areas where information is lacking, inconsistent, or underexplored.

4) Formulate research hypotheses that address the specific questions or issues found in the existing research.

5) Based on outcomes of the previous steps, apply comparative analysis to evaluate the effectiveness of different Lean manufacturing approaches and methodologies.

6) Draw conclusions based on the synthesized findings. Provide recommendations for future research and practical applications in the field of Lean manufacturing.

**DATA ANALYSIS AND RESULTS**

Based on conducted literature review, we can admit that the implementation of lean manufacturing methodologies has brought significant results to companies and organizations in various industries. This use contributes to improving efficiency, production quality and at the same time customer satisfaction with the final product.

Next step is the analysis of key results from LM implementation and discuss their impact on the organization’s performance.

One of the main results of implementing lean manufacturing methods is to obtain significant economic benefits. By focusing on reducing losses and optimizing overall processes, organizations can achieve cost savings and increase profits. Research shows that the implementation of lean manufacturing has led to a huge reduction in production costs, in some cases from 20% to 40% [19]. These savings are explained and achieved by various factors, including lower storage costs, shorter order completion times, and improved resource efficiency. In addition, lean manufacturing allows companies at production facilities to increase the efficiency of their operations, which leads to increased productivity and increased output. By optimizing processes and eliminating activities that don’t add value, companies can increase productivity with existing resources. For example, Toyota, a pioneer in lean manufacturing, was able to achieve an excellent level of productivity and efficiency thanks to its famous manufacturing system [11]. This system is focused on sustainable improvement and involvement of all employees in the working process, which leads to increased efficiency in all areas. Besides all mentioned above, lean manufacturing also contributes to improving product quality and customer satisfaction. By focusing on error prevention and root cause analysis, companies can reduce defects and ensure stable product quality. Research shows that companies implementing lean manufacturing methodologies have achieved significant defect reduction, resulting in increased customer satisfaction and brand loyalty [17].

Optimization of production processes, automation, reducing the cycle and improving the quality of goods and services – all this has long been a hallmark of lean management. The Lean Institute Ukraine [20, 21] stated that companies (international and domestic) have implemented this concept and have realized results (Fig. 1).

According to Figure 1, we can notice that in 2022 Ukrainian practices have shown slightly higher improvements in profitability of 8.5% and order processing time reduction of 55% compared to international practices, which have demonstrated broader enhancements across profitability, productivity, equipment throughput, and operational efficiency metrics.

Successful implementation of lean manufacturing requires a solid and targeted management strategy and a supportive organizational culture. Leadership plays a crucial role in shaping vision, guiding, and mobilizing resources to implement all lean initiatives in a comprehensive manner. Research has shown that companies where the lean manufacturing transition is supported by senior management are more likely to achieve sustainable results and overcome implementation difficulties [19]. Moreover, organizational culture plays an important role in shaping employees’ attitudes to lean manufacturing methods, their reactions and behavior. A culture of continuous sustainable improvement, empowerment, and collaboration is essential to increase employee engagement and promote lean manufacturing initiatives. The work’s outcomes show that organizations with a developed culture of engagement and transparency are likely to continue to transform lean manufacturing and have long-term success [22]. Involving all employees in the process and empowering them are fundamental principles of lean manufacturing, emphasizing the importance of involving advanced employees in process improvement activities. By enabling employees to identify and solve problems on the spot, companies can use their knowledge and experience to ensure continuous improvement and sustainability.

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Companies with high levels of employee engagement in lean initiatives show higher levels of productivity, quality, and innovation adaptation [8]. Furthermore, employee empowerment promotes a sense of ownership and self-responsibility, which leads to increased levels of personal motivation and job satisfaction. When employees are given the opportunity to share their ideas and suggestions for improvement, they are more likely to feel valued and involved in their work. This sense of belonging creates a culture of responsibility in which employees are proud of their work and strive for excellence [2].

In order to evaluate identified economic benefits of lean manufacturing [20-21, 12, 23-27] implications and provide practical recommendations for organizations seeking to adopt lean manufacturing methodologies we represent several real-world examples with analysis of lean manufacturing implications.

Lean Manufacturing is widely applicable across many industries, verified track record of success, holistic approach to improving production efficiency and quality. After conducting comparison analysis [28-29] we can identify the following: it focuses on reducing waste, which is a common issue in many manufacturing environments, and fosters a culture of continuous improvement and employee involvement. The results of the analysis are represented in (Table 1).

**Fig. 1. Advantages of Lean management based on the international experience compared with Ukrainian practice**

*Sources: compiled by the authors based on the [20, 21]*

<table>
<thead>
<tr>
<th></th>
<th>International practice</th>
<th>Ukrainian practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-15% Profitability</td>
<td>8.5% Profitability</td>
<td></td>
</tr>
<tr>
<td>15-90% Productivity</td>
<td>33% Performance</td>
<td></td>
</tr>
<tr>
<td>20-50% Equipment's throughput</td>
<td>20% Equipment capacity</td>
<td></td>
</tr>
<tr>
<td>24-40% Costs</td>
<td>55% Reduced order processing time</td>
<td></td>
</tr>
<tr>
<td>25-50% Defects</td>
<td>45% Defects</td>
<td></td>
</tr>
<tr>
<td>50-90% Inventory</td>
<td>67% Stocks</td>
<td></td>
</tr>
<tr>
<td>40-60% Cycle duration</td>
<td>27% Cycle duration</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1**

Comparison analysis of manufacturing methodologies: Lean, Six Sigma, TQM, JIT, and TOC

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Case Studies</th>
</tr>
</thead>
</table>
| Lean Manufacturing    | Reduces waste and increases efficiency, improves product quality, shortens production time, increases customer satisfaction | Implementation can be costly and time-consuming, requires cultural change and employee buy-in, not suitable for all types of production | Toyota: Reduced lead times by 70%  
                        |                                                                             |                                                                               | Nike: Improved production efficiency by 40%                                  |
| Six Sigma             | Reduces defects, improves process control, enhances customer satisfaction  | Can be expensive to implement, requires extensive training, focuses primarily on quality, not speed | General Electric: Saved $10 billion over five years  
                        |                                                                             |                                                                               | Motorola: Saved $16 billion since its implementation                         |
| Total Quality Management (TQM) | Achieving permanent success by prioritizing customer satisfaction, encourages continuous improvement, enhances organizational culture | Can be bureaucratic, requires significant training and education, slow implementation process | Xerox: Reduced manufacturing costs by 50%  
                        |                                                                             |                                                                               | Toyota: Maintained market leadership                                           |
| Just-In-Time (JIT)    | Reduces inventory costs, minimizes waste, increases efficiency and responsiveness | Highly dependent on suppliers, requires precise demand forecasting, risk of production disruptions | Toyota: Inventory turnover increased  
                        |                                                                             |                                                                               | Harley Davidson: Reduced inventory costs by 75%                              |
| Theory of Constraints (TOC) | Identifies bottlenecks, improves throughput, enhances overall system performance | Requires ongoing monitoring, limited by weakest link in the process           | Boeing: Improved production rates  
                        |                                                                             |                                                                               | Ford: Reduced cycle times                                                      |

*Sources: compiled by the authors based on the [23-27]*
According to the outcomes (Table 1) of a comparative analysis with other manufacturing approaches, lean manufacturing provides a balanced approach to efficiency, quality, and cost reduction. Although Six Sigma is superior to other approaches in terms of quality control and defect reduction. However, it has some drawbacks: it is an expensive approach in the context of Ukrainian companies and is primarily focused on quality rather than overall efficiency. Total quality management provides long-term implementation steps and reliable benefits [27, 28, 29], but can be slow to implement and bureaucratic. The Just-in-time system is great for reducing inventory costs, but it largely depends on accurate demand forecasting and a stable economic situation. Theory of constraints effectively identifies bottlenecks, but can be limited by the weakest link in the process.

**DISCUSSION**

Nova Poshta, as a leader in delivery and logistics in Ukraine, faced challenges such as the need to reduce queues, increase productivity and speed up parcel processing. By implementing lean manufacturing techniques, the company successfully coped with these tasks, which led to space savings, faster parcel search, and increased branch productivity. Despite initial resistance to change, Nova Poshta’s commitment to lean manufacturing has enabled it to make significant improvements in its operations [20, 21, 30].

Aerostar, a recognized leader in the Ukrainian ventilation equipment market, has implemented Lean manufacturing techniques to improve efficiency and optimize processes. Their implementation was aimed at solving such problems as unbalanced assembly processes and the lack of visual control systems. As a result, Aerostar has significantly reduced footprint, reduced assembly time, and increased productivity. Despite the fact that they faced similar problems, resistance to changes in existing processes, the results of implementation provided significant improvements in all workflows [20, 21, 31].

Another example is the Boeing company, which improved its manufacturing processes using lean manufacturing methodologies to build the 787 Dreamliner. By implementing Lean Manufacturing principles such as value stream mapping, cellular production, and continuous production, Boeing has been able to reduce lead times, eliminate waste, and improve overall efficiency. The implementation of lean manufacturing allowed Boeing to launch the 787 Dreamliner ahead of schedule and on budget, demonstrating the efficiency of lean manufacturing in challenging production environments [27].

The experience of domestic companies mentioned in (Table 2) shows the transformative impact of lean manufacturing methodologies on solving operational problems and improving productivity, efficiency and supply chain management [20, 21, 27, 34, 35].

**Table 2**

<table>
<thead>
<tr>
<th>Companies</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nova Poshta</td>
<td>Space savings of 20%, faster parcel searches by 43%, and increased branch productivity by 20%.</td>
<td>Initial resistance to change, high cost of implementation for all departments</td>
</tr>
<tr>
<td>Aerostar</td>
<td>Reductions in space usage (40%), assembly time (27%), and increased productivity by 33%.</td>
<td>Resistance to changes in stable processes</td>
</tr>
<tr>
<td>Boeing</td>
<td>Enhanced visibility and awareness within the Tier-1 and Tier-2 supply chain, resolved the battery issue</td>
<td>Unforeseen challenges and disruptions</td>
</tr>
</tbody>
</table>

Sources: compiled by the authors based on the [32, 33, 34, 35]

According to the above-mentioned results in (Table 2), we can notice that despite initial difficulties and no anticipated obstacles, companies’ commitment to lean manufacturing principles has contributed to significant progress, highlighting the value of continuous improvement and adaptability in today’s competitive business environment.

However, the main challenges are initial resistance to change and high implementation costs across different departments of an organization. These issues can hinder adoption and realization of benefits from new initiatives. Lean approach involves fostering a culture of continuous improvement through effective communication, involvement of employees in the change process, and demonstrating tangible benefits early on to build confidence. For managing high implementation costs, Lean principles advocate for incremental implementation focused on high-impact areas first, leveraging pilot projects to prove return on investment before full-scale deployment.

**CONCLUSIONS**

Based on conducted review and analysis, we can mention that companies have implemented various strategies to enhance efficiency and productivity. These efforts have resulted in significant reductions in space usage, assembly times, and improvements in productivity metrics.
However, there are some challenges such as resistance to change, high implementation costs and unforeseen disruptions highlight the difficulties associated with improving operational performance in various industries. The success areas highlighted in the case studies demonstrate the importance of strategic implementation and adaptation to industry-specific challenges for sustainable operational gains. We can point out the importance of Lean manufacturing as a catalyst for improving efficiency in modern enterprises. By applying lean manufacturing principles and practices, companies can optimize internal operations, eliminate losses, and improve overall productivity. Although, the successful implementation of lean manufacturing requires a common strategic approach, a strong commitment of management and a commitment to continuous improvement from all personnel. Ukrainian companies can reach their full potential to continuous improvement from all personnel. Ukrainian companies can reach their full potential and achieve a sustainable competitive advantage in a modern, dynamic and unstable business environment during ongoing war.

As the result, we can see that the Lean manufacturing shows significant advantages over traditional business management. It makes the transition from centralized vertical management to horizontal structures, involving all employees in the process. It improves teamwork and an emphasis on resource management. Lean manufacturing aims to eliminate various types of losses, including overproduction, waiting times for materials, unnecessary movements, excess inventory, defects, and underutilization of employee capacity. Implementing lean management techniques offers a viable strategy for improving business efficiency by optimizing processes, increasing employee engagement, and minimizing losses.

Suggestions for future research. Future research in this area could explore the impact of modern technologies, such as artificial intelligence and internet of things on lean manufacturing practices. Additionally, longitudinal studies could investigate and prove the long-term effects of lean transformations on organizational performance and sustainability.

Moreover, cross-cultural comparisons could provide valuable insights into the applicability of lean manufacturing methodologies across different industries and geographical regions.

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