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CONCEPTUAL MODEL FOR THE IMPLEMENTATION OF LEAN MANUFACTURING IN LOGISTICS ORGANIZATIONS

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Abstract. Digitalization plays a key role in the development of lean manufacturing, especially at large enterprises involved in logistics. The integration of digital technologies significantly enhances the transparency, controllability, and efficiency of production and logistics processes, contributing to the minimization of losses and costs. This study evaluates prospects for implementing lean technologies based on the example of the Russian Post—one of the largest logistics enterprises in the country. The research involved an analysis of key bottlenecks and problems at the company, as well as a detailed breakdown of each current loss. In accordance with obtained results, the authors suggest a conceptual model for process improvement to ensure continuous enhancement of processes and growth in operational efficiency.

Keywords: lean manufacturing, logistics, operational efficiency, conceptual model, the Russian Post

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КОНЦЕПТУАЛЬНАЯ МОДЕЛЬ ВНЕДРЕНИЯ БЕРЕЖЛИВОГО ПРОИЗВОДСТВА В ДЕЯТЕЛЬНОСТЬ ЛОГИСТИЧЕСКОЙ ОРГАНИЗАЦИИ

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Аннотация. Цифровизация играет ключевую роль в развитии бережливого производства, особенно на крупных предприятиях, связанных с логистикой. Интеграция цифровых технологий позволяет значительно повысить прозрачность, управляемость и эффективность производственных и логистических процессов, способствуя минимизации потерь и издержек. В данном исследовании оценивается потенциал реализации lean-технологий на примере Почты России – одного из наиболее крупных предприятий логистической отрасли в стране. В ходе исследования был проведен анализ ключевых узких мест и проблем на предприятии, а также проведена детализация каждого типа текущих потерь. На основании полученных результатов авторами была разработана концептуальная модель совершенствования процессов, необходимая для обеспечения непрерывного улучшения работы предприятия и роста операционной эффективности.

Ключевые слова: бережливое производство, логистика, операционная эффективность, концептуальная модель, Почта России

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Introduction

In the modern conditions of global competition and increasing market dynamics, enterprises face the necessity to improve production efficiency and optimize business processes. One of the most effective tools to achieve these goals is lean manufacturing. It is a management philosophy focused on identifying and eliminating all types of loss, reducing costs, and enhancing the quality and flexibility of production operations.

However, despite its widespread adoption, many organizations experience difficulties in properly understanding and implementing lean approaches. This necessitates the development of conceptual models and methods for adapting lean manufacturing to the specifics of particular enterprises (Jones, 2003; Kahramanova, 2024).

Lean manufacturing represents a philosophy and management concept aimed at the most efficient use of enterprise resources while simultaneously improving product quality and value for the end customer. The value creation flow is a sequential set of actions, operations, and processes required to transform initial resources (such as raw materials, data, or components) into a final product or service that meets customer requirements and expectations. The key task is to ensure the most efficient and continuous movement of this flow, minimizing delays, downtime, and unnecessary operations. For this reason, the constant search for and elimination of loss (Muda) that does not add value and increases costs is the core of lean manufacturing. Such losses may include overproduction, downtime, waiting, defects, unnecessary transportation, etc.

The implementation of lean technologies allows for the formation of a culture of continuous improvement, engaging every employee in this process. This system not only increases the economic efficiency and competitiveness of enterprises but also contributes to sustainable development by reducing time, material, and labour costs, increasing productivity, and improving product quality. Understanding and managing flows creates the foundation for eliminating bottlenecks, reducing order lead times, lowering inventory levels, and enhancing quality (Sharafullina, 2020; Sirotkin, 2022).

Lean manufacturing tools are practical methods and techniques used to identify, eliminate, and prevent loss, as well as to improve the efficiency and quality of processes. Their application allows for systematic optimization of production and business processes, reducing costs and increasing value for the customer.

Effective use of these tools requires a systematic approach, the involvement of all employees, and continuous analysis of results. Ultimately, this path leads to sustainable improvements in efficiency and competitiveness. The implementation of lean manufacturing tools at the "Russian Post" has significant potential to enhance efficiency, reduce costs, and improve the quality of services provided. Given the specifics of the activity—mass customer service, logistics, processing, and delivery of postal items—the adoption of lean methods necessitates adaptation to the industry's features and business processes.

The current market dynamics, quality requirements, cost reduction, and the need for increased flexibility in production processes make the adoption of lean manufacturing essential for enterprises. Applying lean technologies helps identify and eliminate bottlenecks in production, reduce order fulfillment times, increase customer satisfaction, and boost economic efficiency. This is especially relevant for large enterprises with complex manufacturing and logistics systems, where traditional optimization methods are no longer sufficient.

Digital systems automate accounting for raw materials, supplies, defects, and waste; enable precise planning; and ensure timely replenishment of resources, forming a fundamental basis for the implementation of lean principles (Belova, 2024; Chelombitko, 2020).

At large logistics enterprises, digitalization promotes the optimization of material flows through automated transport systems, reduces downtime, and increases order processing speed. Business analytics platforms and artificial intelligence tools allow real-time analysis of key performance indicators (KPIs), supply chain control, and more informed decision-making. Overall, these advancements contribute to increased production flexibility and the competitiveness of companies (Lyamin, 2025; Petrova, 2019; Pulin, 2020; Savina, 2022).

In logistics companies, where key resources are time, accuracy, and the speed of moving goods and documents, the application of lean manufacturing tools significantly contributes to reducing costs and improving customer service levels. The main lean tools most frequently used in logistics include:

1. 5S—a method for organizing the workspace to enhance order, ergonomics, and safety;
2. Value Stream Mapping (VSM)—visualizing the entire process chain to identify bottlenecks and sources of waste;
3. Kanban—a visual inventory and process management system to maintain optimal resource levels with minimal delays;
4. Kaizen—a method of continuous improvement involving employee engagement and ongoing analysis;
5. The analysis of eight types of loss (Muda) present in logistics operations, such as excess movement, waiting, defects, and unnecessary transportation.

Effective implementation of these tools requires adaptation to the specifics of the logistics sector—high variability in orders and the need to synchronize multiple participants and technological stages, as well as requirements for speed and accuracy of information processing.

Modern research, such as that by Liker (2020), notes that implementing 5S and VSM leads to significant reductions in order fulfillment times and inventory levels without sacrificing service quality. The use of Kanban in logistics systems allows for the optimization of material and information flows, enabling flexible responses to demand changes and efficient inventory management (Liker, 2020).

Materials and Methods

Within the framework of this research, a thorough analysis of contemporary literature on the examined topic was conducted. Modern studies consider the impact of digitalization and information systems in supporting lean tools at logistics enterprises, which enhances transparency, controllability, and adaptability of operations. Researchers today pay significant attention to the application of lean manufacturing tools to improve the efficiency of logistics processes and optimize the functioning of logistics-focused companies. K.P. Ilyina and V.F. Gorshenin explore modifications of the lean management model considering the digitalization of logistics processes. Their work emphasizes the importance of adapting traditional Lean methods to modern digital technologies to increase transparency and manageability of operations (Golubenko, 2020; Ikramov, Emelyanov, 2022; Ilicheva, 2022; Ilyina, 2022).

V.A. Khamanova, as well as M.I. Danilenko and O.V. Korkacheva, investigate the application of lean manufacturing concepts in warehouse logistics, highlighting ways to improve processes based on specific enterprise examples. The authors note that an essential aspect is the use of flow mapping tools and the analysis of eight types of loss to identify bottlenecks. Furthermore, the researchers analyze the optimization of logistics business processes based on lean principles, identifying the main losses characteristic of logistics and methods for their elimination. They highlight that applying lean tools significantly reduces delivery times and costs (Khamanova, 2020; Danilenko, 2019).

In her work, T.V. Glavatskaya focuses particularly on the features of the concept of lean logistics, analyzing a set of methods and tools aimed at creating pull-based supply chains and increasing efficiency. The author substantiates the need for a systematic approach to implementing lean principles across all stages of logistics operations (Glavatskaya, 2019).

Another researcher, S.A. Korelov, explores the possibility of using lean manufacturing tools in transportation companies, emphasizing the importance of Kaizen sessions and the 5S system for improving the quality and speed of service delivery (Korelov, 2019).

M.A. Alexandrova et. al. emphasizes lean manufacturing as a key tool for increasing labour productivity and operational efficiency across various types of enterprises, including logistics organizations (Alexandrova M. 2022.).

Thus, scientific studies confirm that a comprehensive application of lean manufacturing tools in logistics promotes the systematic identification and elimination of losses, improves customer service quality, and supports sustainable enterprise development.

Modern logistics companies, especially state communication operators, face a number of systemic problems related to inefficient process organization, a high share of manual labour, and insufficient digitalization. Lean manufacturing, adapted to the specifics of logistics, serves as an effective tool for identifying and resolving these issues. The implementation of lean methods not only reduces costs and operation times but also enhances customer service quality. A systematic approach—involving the creation of specialized teams, the use of digital technologies, and the integration of continuous improvement methodologies—is critically important.

Results and Discussion

In this research, the “Russian Post” is taken as a case study due to its key role in the national postal and logistics system. This organization provides a wide range of services, including the delivery of correspondence and parcels, as well as offering financial and transport-forwarding services. The scale of its operational activities and its geographical coverage create unique conditions accompanied by significant complexity in organizational and technological processes. Furthermore, the company faces the need to improve efficiency, optimize costs, and adapt to modern challenges such as digitalization and increased competition in the logistics market. Therefore, the analysis and implementation of lean manufacturing tools specifically within the “Russian Post” possess high practical and scientific significance, allowing for the identification of systemic problems and the development of comprehensive recommendations for sustainable enterprise development and improvement of service quality.

To enhance the operational efficiency of the “Russian Post,” a systemic approach to identifying problem areas and bottlenecks in business processes is critically important and an immediate priority. This approach enables a fundamental understanding of the causes of delays and inefficiencies at various stages of postal item processing and delivery. In particular, based on a detailed process analysis, implementing lean manufacturing tools becomes a mechanism not only for identifying losses but also for developing comprehensive solutions to minimize them, which significantly contributes to improving the company’s key operational indicators (Table 1).

Table 1. Main Bottlenecks in Processes (designed by the authors).

Problem	Description	Impact
Long processing and sorting time of shipments	Multiple manual sorting steps, insufficient automation	Delays, increased delivery time
Insufficient automation of logistics operations	High level of manual labor, data entry errors	Errors, repeated operations, delays
Long delivery times in remote regions	Limited logistics infrastructure, inadequate routing	Low service quality, customer dissatisfaction
High error rates in shipment acceptance and delivery	Inefficient procedures, lack of standardization	Increased costs, customer dissatisfaction
Excessive operations and movements within branches	Inefficient arrangement of equipment and staff	Wasted time and resources

The table presents an analysis of the key problem areas identified in the activities of the postal operator, detailing their causes and impacts. The conducted analysis reveals consistent cause-and-effect relationships. In particular, the prolonged cycle of processing and sorting shipments is directly correlated with the predominance of manual labour and the low level of automation in these processes. As a result, excessive delays occur, extensively increasing the overall delivery time and predictably lowering the level of customer service.

Similarly, the insufficient level of automation in the logistics chain leads to a high proportion of manual operations. This, in turn, results in an increased number of errors caused by human factors, the need to perform repeated (corrective) actions, and the cumulative growth of time losses at all stages.

Additionally, a significant bottleneck is the long delivery times in remote regions, caused by limited logistics infrastructure and inefficient routing. This negatively affects service quality and customer satisfaction. Furthermore, the high frequency of errors during shipment acceptance and delivery, caused by the lack of regulated and standardized procedures, leads to increased costs and decreases trust in the company.

Excessive operations and unnecessary movements within branches, arising from irrational placement of equipment and staff, result in unjustified expenditures of time and resources.

To systematically identify and subsequently optimize these issues, the following key methods are applied:

1. Value Stream Mapping (VSM)—a method for visualizing the entire process of handling postal shipments, from acceptance to delivery to the final consumer. The use of VSM allows for detailed identification of non-value-added operations, redundant actions, downtime, and function duplications, which facilitates targeted implementation of measures to eliminate waste (Table 2).

2. Loss analysis based on the eight types of Muda, which involves a comprehensive examination of the following aspects:

— Overproduction—manifested in the excessive creation of documents or services that are not demanded by end consumers.

— Waiting—idle intervals between stages of postal shipment processing.

— Transportation—suboptimal and prolonged logistics routes.

— Overprocessing—duplication of operations and checks that do not affect quality.

— Excess inventory—accumulation of unsold or unused resources.

— Unnecessary motions—non-ergonomic placement of work zones and employee movements.

— Defects—sorting errors, loss, or damage to shipments.

— Underutilized employee potential—lack of involvement in improvement processes and absence of a suggestion incentive system.

3. The “5 Whys” method—a root cause analysis tool consisting of repeatedly asking "why?" to identify the primary cause of problems, such as delivery delays.

4. Pareto charts and ABC analysis—used to determine priority problems that have the greatest impact on process efficiency.

5. Gemba Walk—the practice of direct observation of processes at workplaces, which helps uncover hidden and unforeseen inefficiencies.

For a deeper understanding, Table 2 displays a detailed breakdown of each loss type.

Table 2. Loss types (designed by the authors).

Type	Example in the “Russian Post”	How to Identify?
Overproduction	Printing excess receipts that remain unused	Material consumption analysis
Waiting	Truck downtime due to uncoordinated scheduling	Time tracking of logistics operations
Transportation	Non-optimal delivery routes (excess kilometers)	GPS data analysis of transport
Overprocessing	Data duplication across different systems	Comparison of IT processes
Inventory	Accumulation of unused goods	Inventory audits
Movement	Non-ergonomic layout of sorters’ workstations	Motion Study
Defects	Address errors, lost shipments	Analysis of complaints
Unexploited potential	Lack of employee suggestion systems	Staff surveys

Table 2 presents a detailed classification of types of operational losses, where each type is not only identified but also illustrated with specific examples from the activities of "Russian Post" and accompanied by practical tools for its identification. This creates a clear diagnostic mechanism: for example, overproduction is diagnosed through material consumption analysis, waiting losses are identified using time tracking of work processes, and inefficient transportation is detected by monitoring routes using GPS data.

— Overprocessing is revealed during audits and comparisons of IT processes.

— Inefficient employee movements are recorded using video work analysis (motion study).

— Defects and their causes are uncovered through systematic analysis of complaints.

— Underutilized employee potential is assessed via specialized surveys.

Thus, the application of lean manufacturing tools forms a systematic methodology for reorganizing the business processes of Russian Post. This scientifically grounded approach allows for the targeted elimination of "bottlenecks," leading to a comprehensive positive effect: increased operational efficiency, cost reduction, and significant improvement in customer service quality. In the long term, this transformation ensures the company builds a flexible and resilient operating model, which is a key factor in strengthening its competitiveness in the market.

The “Russian Post” is a enterprise performing critically important communication and correspondence handling functions throughout the country. According to the results of the Accounts Chamber audit, the enterprise faces issues in many areas of its operations. Among the main problems are irrational resource allocation, poor cost optimization, imprudent investments, and others. The introduction of lean manufacturing in many areas of the enterprise's activity will help solve most of these problems. Lean tools are aimed at identifying issues at various process levels, their resolution, and continuous process monitoring. This approach optimizes processes and standardizes necessary reports, procedures, and other assets depending on the specifics of each department, sector, or activity area. It helps reduce costs, increase enterprise transparency, simplify decision-making, and enhance employee engagement.

To ensure the competent and effective implementation of lean manufacturing tools, it is necessary to develop a conceptual model for improving organizational processes. However, an important preliminary step before using the model is to form a Lean team consisting of company employees. Below, an algorithm for creating such a group will be presented with practical examples to provide a fuller understanding of the specifics and tasks of the Lean team, which will specialize in implementing lean manufacturing at different levels and stages of company activities. For applying lean tools in strategic and financial planning areas, the creation of a similar group from senior management employees is envisaged.

Formation of a Lean Team:

At enterprises implementing lean manufacturing, establishing an internal lean team is a key stage of transformation. Typically, its composition includes production specialists (masters, technologists, and engineers) (60-70%), representatives of adjacent departments (logistics, quality control, and procurement) (20-25%), an HR specialist, and an internal trainer (10-15%).

At “KAMAZ,” such teams are formed based on the “5+2” principle: 5 core members from production units and 2 mentors (a Lean methodology expert and an HR business partner).

Functions and Areas of Responsibility:

Practical experience of leading industrial enterprises shows the following typical directions of lean teamwork:

A. Operational Activities: Conducting Kaizen sessions (at “Severstal”—12-15 sessions monthly); analyzing losses using Value Stream Mapping (mapping 3-5 key processes quarterly); implementing 5S tools (weekly audits at 20-30 workstations).

B. Educational Function: Monthly training for 5-7% of personnel (as in “ROSATOM”);

developing standards and visual instructions; conducting problem-solving workshops (at "Gazprom Oil"—40-50 events annually).

Recommendations for Development:

— Gradual Scaling: start with 1-2 pilot shops/lines.

— Motivational System: At "UralVagonZavod," bonuses are used for implemented improvements (up to 15% of savings).

— Integration with Digital Systems: use of mobile applications for recording losses (experience of "SIBUR").

— Knowledge Succession: mentoring systems and a "School of Lean Leaders."

Properly organized, Lean teams formed from enterprise employees become drivers of continuous improvement, achieving on average 15-25% growth in operational efficiency within the first two years. Key success factors are involvement of frontline personnel, alignment with business goals, and a systematic approach to measuring results.

After forming the team, it is necessary to refer to the model (Figure 1).

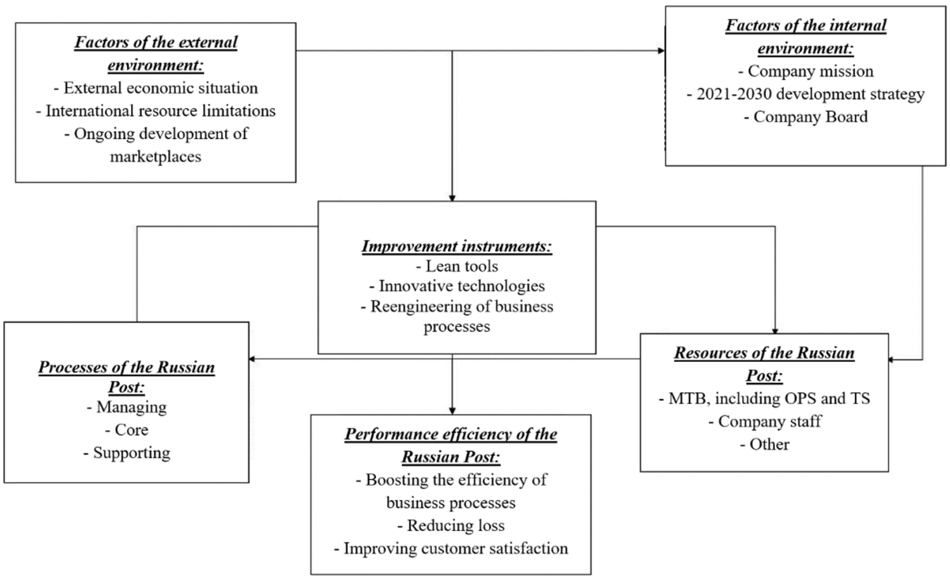

Fig. 1. Conceptual Model for Process Improvement (designed by the authors).

The model represents a dynamic system where external and internal factors form the context for applying improvement tools that transform the company's processes through the lens of available resources, directing efforts toward achieving strategic goals of efficiency enhancement.

The developed conceptual model (Fig. 1) is a dynamic process management system that transforms identified problem areas (Table 1) through the application of targeted Lean tools (Table 2). The model functions as a continuous improvement cycle, where each element is interconnected with the others.

External factors (sanctions, resource constraints, marketplace pressures) create direct challenges for the processes of Russian Post. For example, the disruption of international logistics chains forces a revision of core delivery processes, requiring resource adaptation—redistribution of transport or switching to alternative routes. Simultaneously, the development of marketplaces stimulates innovative technologies (API integration with Ozon), which impacts supporting IT infrastructure processes.

Internal factors act as a filter for responding to external impacts. The company's mission, emphasizing its social role, limits the optimization of loss-making rural postal offices, linking resources (finances, equipment) and budgeting management processes. The 2021-2030 strategy sets priorities; for instance, the focus on digitalization directs reengineering tools toward redesigning data processing workflows, which requires resource investments (software updates, staff training).

The research results demonstrate significant potential for applying lean manufacturing in the logistics activities of the "Russian Post". Based on the identified data and conducted analysis, key conclusions can be drawn, reflecting perspectives and directions for the company's further development to improve efficiency and the quality of services provided.

The conducted analysis of the significance and application of lean manufacturing tools in the "Russian Post" operations confirmed the high effectiveness of this approach to enhancing operational efficiency and client service quality. Using methods such as VSM, 5S, Kanban, and Kaizen made it possible to identify key problem areas in the company's business processes, including long processing and sorting cycles, insufficient automation levels, and frequent errors during parcel handling.

Conclusion

The implementation of the conceptual model for introducing lean manufacturing, with the formation of specialized lean teams, promotes a systematic approach to continuous process improvement and staff engagement in efficiency enhancement. Particular importance is attached to the integration of digital technologies, which increases transparency and manageability of production and logistics operations, reducing losses and costs.

Thus, comprehensive application of lean principles and tools contributes to reducing order fulfillment times, lowering defect rates, and improving customer satisfaction. Incorporating these methods into postal and logistics activities ensures the formation of a sustainable, competitive operational model that meets modern market demands and supports the enterprise's sustainable development.

The analysis confirmed systemic problems in the operational activities of the "Russian Post", including a high share of manual labour, suboptimal routing, and insufficient process standardization. The application of lean manufacturing tools (VSM, Muda analysis, 5S) enables effective identification and classification of these issues. A conceptual model for implementing lean manufacturing was developed, taking into account the industry specifics of a logistics company and integrating external (sanctions, marketplace development) and internal (mission, strategy) influencing factors. The model ensures a systematic approach to process transformation through targeted use of Lean tools.

Further research should focus on developing a KPI system to evaluate the implementation effectiveness of the model.

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