JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS
VOLUME 04, ISSUE 11
MOPNTHLY JOURNALS
ISSN NUMBER: 2751-4390
IMPACT FACTOR: 9,08

IMPROVING THE EFFICIENCY OF MATERIAL AND TECHNICAL RESOURCE UTILIZATION IN ENTERPRISES

Sattarova Umida Abdivayitovna
2 nd-year Master's Student,
Asia International University, Bukhara City
nafisaabdullayeva588@gmail.com
Scientific Supervisor**:** prof. **B. F. Azimov**

Annotation: This article examines modern strategies for improving the efficiency of material and technical resource use in enterprises. The analysis focuses on circular economy principles, lean manufacturing, advanced technological solutions such as artificial intelligence and Industry 4.0, and performance-based management approaches. Integrating these methods enables enterprises to reduce production costs, minimize environmental impact, strengthen competitiveness, and support sustainable development goals. A comprehensive overview reinforces the need for systemic transformation in resource management to meet contemporary economic and environmental challenges.

Keywords: Material efficiency; circular economy; lean manufacturing; Industry 4.0; artificial intelligence; resource management; sustainability; production optimization; waste reduction.

Efficient use of material and technical resources is fundamental for reducing production costs, enhancing competitiveness, and achieving sustainability across enterprises. As global markets become increasingly resource-constrained, enterprises are compelled to adopt modern strategies that minimize waste, optimize resource flows, and improve operational productivity. A holistic approach integrating circular economy principles, lean methodologies, advanced digital technologies, and data-driven management practices has emerged as a central requirement for sustainable industrial development.

The circular economy provides a transformative alternative to the traditional linear production model. By promoting durability, reuse, recycling, and remanufacturing, circular strategies maximize material utility and minimize waste. Emerging concepts such as Enhanced Landfill Mining demonstrate the potential of recovering valuable materials and energy from waste streams previously deemed unusable.

Resource valorization within agricultural and industrial processes further strengthens circularity. Turning agricultural residues into high-value products, such as bioethanol or industrial enzymes, highlights the economic and environmental benefits of circular production loops. Improvements in material efficiency contribute to reduced resource extraction, lower energy consumption, and decreased emissions. Global experiences show that implementing circular measures significantly enhances national resource productivity and dramatically reduces final disposal volumes.

Lean manufacturing plays a crucial role in optimizing material and technical resource utilization. By identifying and eliminating non-value-adding activities, lean principles streamline processes and enhance production efficiency.

The integration of lean practices with circular economy principles—often described as green-lean approaches—helps enterprises achieve both operational excellence and environmental improvements. Using methods such as the 6R principles enables industries like furniture manufacturing to reduce wood waste and improve reclaiming practices.

Monitoring tools, such as Green Performance Maps, support real-time measurement and evaluation of resource consumption and waste generation. These tools strengthen environmental management and promote continuous improvement at the shop-floor level.

Modern technological innovations, particularly artificial intelligence and Industry 4.0 systems, offer transformative potential for improving resource efficiency. AI-driven optimization systems facilitate predictive maintenance, dynamic resource allocation, and improved waste management. Intelligent allocation in digital infrastructures can optimize performance and reduce unnecessary resource use.

Industry 4.0 technologies—including cyber-physical systems, IoT, big data analytics, and digital twins—enable smarter production environments capable of self-monitoring and adaptive control. Data science techniques applied to material degradation analysis and resource flow modeling help identify inefficiencies and extend the lifespan of critical materials.

AI-enhanced recycling, product lifecycle management, and waste-to-energy processes further strengthen the integration of technology with circular economy objectives.

Several industry-specific technological advancements significantly improve material and technical resource efficiency. In textile and leather production, supercritical carbon dioxide processes reduce pollution by serving as clean, versatile solvents. Industrial by-products, such as tall oil from cellulose pulping, can be converted into higher-value materials through innovative chemo-enzymatic pathways.

In manufacturing, vacuum-assisted resin infusion technologies allow large-scale composite production while minimizing chemical exposure. The use of industrial by-products such as phosphogypsum and fly ash in construction materials helps address disposal challenges and reduce environmental impacts. Advanced additive manufacturing methods like Directed Energy Deposition minimize waste and machining requirements while enabling sustainable production of high-value materials.

Effective resource efficiency requires strong management frameworks supported by measurable indicators. Establishing performance indicators enables enterprises to assess production efficiency, environmental impact, and economic outcomes. Transforming operational data into financial metrics helps guide strategic decision-making.

Integrated assessment models support the analysis of trade-offs between resource use, emission reduction, and economic development. National and international organizations emphasize the need for continuous monitoring and evaluation, recognizing that resource efficiency policies require long-term commitment and adaptive governance. Research on small and medium-sized enterprises highlights key drivers such as energy and water savings, renewable energy use, waste minimization, and recycling as essential components for improving resource efficiency.

Enhancing the efficiency of material and technical resource utilization in enterprises demands a comprehensive strategy that incorporates principles of the circular economy, lean manufacturing, advanced technologies, and robust managerial oversight. These integrated approaches enable enterprises to reduce costs, improve environmental performance, strengthen competitiveness, and support sustainable development. As industries face increasing ecological and economic pressures, implementing such multifaceted strategies is essential for achieving long-term resilience and resource security.

References:

1. Flys, V. (2024). Planning and analysis of the efficiency of material resource utilization at the enterprise. Economic Analysis, 34(4), 548–556. https://doi.org/10.35774/econa2024.04.548

2. Braun, A., Kleine-Moellhoff, P., Reichenberger, V., & Seiter, S. (2018). Case Study Analysing Potentials to Improve Material Efficiency in Manufacturing Supply Chains,

Considering Circular Economy Aspects. Sustainability, 10(3), 880. https://doi.org/10.3390/su10030880

3. Jones, P. T., Geysen, D., Tielemans, Y., Van Passel, S., Pontikes, Y., Blanpain, B., Quaghebeur, M., & Hoekstra, N. (2013). Enhanced Landfill Mining in view of multiple resource recovery: a critical review. Journal of Cleaner Production, 55, 45–55. https://doi.org/10.1016/j.jclepro.2012.05.021

4. Seguí Gil, L., & Fito Maupoey, P. (2018). An integrated approach for pineapple waste valorisation. Bioethanol production and bromelain extraction from pineapple residues. Journal of Cleaner Production, 172, 1224–1231. https://doi.org/10.1016/j.jclepro.2017.10.284

5. Xudoyberganovich, S. M., & Fattohovich, A. B. (2025). TASHKILOTDA KADRLAR SIYOSATINI SHAKLLANTIRISH VA UNI AMALGA OSHIRISH STRATEGIYASI. ИКРО журнал, 14(01), 3-6.

6. Шамуратов, М., & Азимов, Б. (2025). TASHKILOTDA KADRLAR SIYOSATINI SHAKLLANTIRISH VA UNI AMALGA OSHIRISH STRATEGIYASI. ИКРО журнал, 1(3).

7. Azimov, B. F., & Amonov, Z. M. (2025). Prospective directions for enhancing regional competitiveness through increased innovation activity. Multidisciplinary Journal of Science and Technology, 5(6), 1263-1266.

8. Tolibova, S., & Azimov, B. (2025). COMPETITIVE STRATEGIES AND EFFECTIVE WAYS TO UTILIZE THEM. Journal of Applied Science and Social Science, 1(4), 355-358.

9. Azimov, B. F. (2025). METHODOLOGICAL APPROACHES TO EVALUATING THE EFFICIENCY OF THE NATIONAL INNOVATION SYSTEM. Multidisciplinary Journal of Science and Technology, 5(6), 1960-1963.

10. Азимов, Б. Ф., & Гафарова, Д. Т. (2013). ПРИОРИТЕТНЫЕ НАПРАВЛЕНИЯ СОВЕРШЕНСТВОВАНИЯ МЕХАНИЗМА РЕСУРСНЫХ НАЛОГОВ. In ЕКОНОМІКА І УПРАВЛІННЯ: ПРОБЛЕМИ НАУКИ ТА ПРАКТИКИ (pp. 278-279).

11. Ma'mura, E., & Azimov, B. F. (2025). INNOVATION EFFICIENCY EVALUATION METHODS. SHOKH LIBRARY.

12. Azimov, B. (2025). INNOVATION AND ITS IMPLEMENTATION AS A FACTOR OF ECONOMIC GROWTH. International Journal of Artificial Intelligence, 1(3), 581-584.