

## **COMPREHENSIVE APPROACH TO PRODUCT DESIGN: HARMONY BETWEEN TECHNICAL CAPABILITIES AND ECONOMIC FEASIBILITY**

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Ensuring the economic efficiency of a project is crucial for achieving success and competitiveness in the market. Considering economic aspects at all stages of development helps create a more balanced, cost-effective, and consumer-attractive product. Moreover, avoiding design errors can be achieved by employing a full life cycle methodology, where cost estimation is formed at all stages – from production to disposal – by collaborating with economists for cost forecasting and pricing and involving consumers in testing to receive feedback for product optimization.

Ignoring economic characteristics at the early stages of development can lead to financial losses and market failure. In agricultural machinery manufacturing, a

harmonious balance between technical capabilities and economic feasibility is a prerequisite for success. Only then will the product be competitive and in demand.

Technical and economic characteristics of a product are closely interconnected, and optimizing one can lead to changes in the other. Let us examine the interrelationship between key technical characteristics and economic indicators.

Productivity affects production costs – higher productivity means more units of product are manufactured per unit of time, reducing the cost per unit. Manufacturing costs – higher productivity enables economies of scale, reducing overall unit costs. Economic efficiency – higher productivity allows manufacturers to shorten order fulfillment times and reduce expenses, thereby enhancing economic efficiency.

The ability of technical systems or equipment to efficiently use energy resources (electricity, heat, fuel, etc.) to perform production processes or functions with minimal energy consumption is one of the key technical characteristics of a product, directly impacting the economic performance of an enterprise.

The impact of energy efficiency on economic indicators can be examined in several ways: energy costs – high-efficiency machines and equipment consume fewer energy resources for the same workload, significantly reducing energy costs. This directly lowers operational expenses for enterprises. Maintenance and servicing costs – high energy efficiency is often associated with optimized design and reduced friction or wear of components, decreasing the need for repairs and maintenance. This helps reduce expenses for keeping equipment in working condition. Disposal and environmental penalties – energy-efficient systems and products typically produce lower emissions of harmful gases and waste, enabling enterprises to reduce disposal costs and avoid fines or sanctions for violating environmental standards. Product competitiveness – highly energy-efficient products can become a market advantage as they help consumers reduce energy expenses when using these products or equipment, which can increase product demand.

Depreciation and payback period – high energy efficiency can shorten the payback period for investments in new equipment, as businesses save on energy expenses, leading to a quicker return on investment.

Thus, energy efficiency is a crucial technical characteristic that directly impacts the economic indicators of a product. It not only reduces energy costs but also lowers operational expenses, decreases maintenance time, reduces environmental costs, and enhances product competitiveness. As a result, energy-efficient solutions provide significant savings and can substantially improve the economic efficiency of an enterprise.

Reliability affects operational and maintenance costs – high product reliability reduces the need for repairs and servicing, leading to lower maintenance and spare parts replacement costs. Restoration costs – a lower number of failures and breakdowns reduces costs associated with restoring or replacing equipment and minimizes time losses. Service life – higher reliability extends the product's lifespan, lowering overall maintenance costs and improving long-term economic efficiency. The service life determines depreciation periods, maintenance costs, repairs, and

product replacement expenses, ultimately defining overall costs and efficiency for consumers or enterprises.

Durability influences replacement costs – high-durability products incur lower replacement or renewal costs as they last longer. Material costs – extended product use reduces the need for additional materials for repairs or updates, decreasing overall expenses. Functionality – high durability means that equipment or products require fewer upgrades or modifications, reducing capital expenses.

Technical versatility of a product or equipment refers to the ability of technical systems or products to effectively function in various conditions or perform diverse functions without significant design changes or adaptation costs. In mechanical engineering, technical versatility implies the capability of using a single type of equipment or machine for different technological processes, various types of work, or across multiple industries.

Technical versatility is an important product characteristic that directly impacts an enterprise's economic indicators. It helps reduce costs associated with development, production, maintenance, and adaptation of technical systems, enhances enterprise flexibility, and promotes market expansion. As a result, versatile products or machinery have greater economic efficiency and enable businesses to gain a competitive advantage by optimizing costs and resources.

The impact of technical versatility on economic indicators can be analyzed in several ways: reducing maintenance and repair costs; increasing flexibility in use and lowering adaptation expenses by allowing businesses to quickly adjust to market and technical requirement changes; expanding market reach; reducing overall production costs.

Thus, technical characteristics such as reliability, durability, productivity, and energy efficiency directly affect economic indicators, including maintenance costs, product lifespan, production costs, and energy consumption. These characteristics can be optimized through competent design, ensuring high economic efficiency and product competitiveness in the market.

The relationship between technical and economic characteristics is crucial for developing effective engineering solutions in mechanical engineering. Evaluating and optimizing technical product characteristics such as reliability, durability, and productivity can significantly impact an enterprise's economic efficiency by reducing costs, extending product lifespan, and providing benefits for consumers.

Therefore, to achieve high economic efficiency in industrial mechanical engineering, it is essential to ensure the optimal combination of technical and economic product characteristics at all stages of its life cycle, from design to operation.

**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ БІОРЕСУРСІВ І  
ПРИРОДОКОРИСТУВАННЯ УКРАЇНИ  
ІНСТИТУТ МЕХАНІКИ ТА АВТОМАТИКИ АПВ НААН  
ДЕРЖАВНИЙ БІОТЕХНОЛОГІЧНИЙ УНІВЕРСИТЕТ**



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## ***PROCEEDINGS***

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