FUNCTIONAL CONSTRAINTS IN RAILWAY MANUFACTURING: CHALLENGES AND SOLUTIONS

Khudayarova Mekhrangiz Muadovna
Assistant of "Economics and management"
Department of Tashkent State University of Economics
E-mail: m.khudoyorova@tsue.uz

Abstract. *This article examines functional barriers within the railway transport production system and their impact on efficiency, modernization, and competitiveness. Barriers were classified into seven categories as technological, resource allocation, managerial, human capital, financial-economic, logistical, and informational. Their interrelation with economic processes was analyzed through a clustering approach, revealing that these obstacles collectively reduce production capacity, increase costs, and slow down modernization. To address these challenges, a monitoring and diagnostic framework linking barriers, capacity parameters, and economic outcomes is proposed. The research emphasizes that overcoming such constraints through strategic management and innovative platform-based solutions is essential for sustainable growth, economic stability, and international competitiveness of the railway sector.*

Key words: *Railway transport, production capacity, functional barriers, efficiency, modernization, resource allocation, competitiveness, innovation.*

Introduction

The railway transport sector is a strategic component of national infrastructure, playing a crucial role in industrial productivity, economic competitiveness, and international connectivity. However, the efficiency of railway production enterprises is often constrained by functional barriers that go beyond technical limitations, encompassing managerial, financial, and human resource challenges. These barriers, which frequently manifest in latent forms, disrupt production processes, reduce resource efficiency, and slow down modernization. The importance of studying such constraints lies in the need to ensure sustainable growth and competitiveness of the railway industry in Uzbekistan and globally. Identifying, classifying, and assessing the economic impact of functional barriers provides a foundation for developing practical solutions to enhance production capacity, optimize resource allocation, and strengthen the resilience of the sector in the face of technological and economic transformations.A scientific approach to identifying functional barriers in the railway transport production system requires, first of all, examining these barriers in correlation with economic processes. Declining production in certain enterprises of the railway sector, the slow

pace of technological modernization, and the low efficiency of resource utilization indicate the presence of internal functional obstacles within the system. To determine their economic essence, it is advisable to analyze such barriers through a clustering approach.

The first category comprises technological barriers. The obsolescence of production equipment, disruptions in planned maintenance activities, and delays in the introduction of modern modules negatively affect the modernization process. According to the analysis, in enterprises such as the "Foundry mechanical factory," JSC ("Quyuv-mexanika zavodi" AJ) and "O'ztemiryo'lmashta'mir" JSC, obsolete equipment accounts for 55-65% of assets, serving as a major source of disruptions in technological processes. Consequently, production capacities are underutilized, leading to a decline in overall efficiency.

The second group includes disproportions in production flows. These are associated with inefficient allocation of raw materials, spare parts, energy resources, and labor reserves, as well as imbalances in workload distribution between workshops and sections. For instance, at the Tashkent Mechanical Plant, while the main units operated at full capacity, auxiliary workshops utilized only 30-35% of their potential. Such internal disproportions significantly undermine overall efficiency in the production system.

Managerial barriers constitute another critical challenge, resulting in systemic economic losses. Centralized information flows, excessive bureaucracy in decision-making, and the insufficient application of digital platforms hinder operational efficiency. In practice, such constraints restrict productivity and planning in production processes.

Human capital barriers are associated with the shortage of engineering and technical specialists, skill gaps among existing personnel, and insufficient adaptability to new technologies. For example, at "O'ztemiryo'lmashta'mir" JSC, the shortage of highly qualified technologists and mechanics has limited the enterprise's ability to fully exploit its production potential. Regional disparities in workforce competencies also represent a notable manifestation of such barriers.

Economic and financial barriers remain the most critical constraints to modernization. Insufficient depreciation allocations, limited capital investments, and difficulties in attracting external financing slow down technological renewal. At the "Foundry mechanical factory," JSC ("Quyuv-mexanika zavodi" AJ) for instance, capital investments over the last five years have amounted to only 8-10% of the total value of fixed assets.

The efficiency of the railway transport production system is shaped by numerous factors, among which functional barriers stand out as major destabilizing elements undermining internal stability. Such barriers, which disrupt production continuity and

represent bottlenecks within the value chain, span across economic-supply, technological, resource allocation, human capital, and information flows. Functioning in an interconnected manner, they collectively reduce system-wide efficiency. Importantly, these barriers often manifest in latent forms, becoming identifiable only through targeted analysis. Therefore, their identification, typology, and assessment of economic impact constitute essential steps in developing scientifically grounded solutions to enhance the efficiency of the system.

The following table presents the functional barriers identified within the railway transport production system, clustered into specialized categories. Each type of barrier has been classified based on its essence, practical manifestations, and economic consequences, drawing on scientific and practical analysis. These barriers are closely interconnected with such factors as the actual state of the sector's internal environment, imbalances in planning, and technological deficiencies.

Table 1. Functional barriers in the railway transport production system

№	Type of barrier	Essence and content	Manifestation form	Economic impact
1.	Technological barriers	Physical and moral obsolescence of production equipment	Prolonged maintenance cycles, low equipment frequency	Production disruptions, increased service time
2.	Resource allocation barriers	Unequal and inefficient distribution of available resources	Overcapacity in one workshop, shortages in another	Underutilization of capacity, decline in production efficiency
3.	Managerial barriers	Centralized and slow coordination of production processes	Bureaucratic decision-making, interruptions in information flows	Misallocation of material resources, loss of operational efficiency
4.	Human resource barriers	Insufficient qualification, experience, and motivation	Shortage of engineering and technical staff, lengthy inspection cycles	Decline in work quality, reduced production safety

5.	Financial-economic barriers	Limited investment sources and lack of funding	Insufficient depreciation funds, lack of external investments	Stagnation of development, delays in technological modernization
6.	Logistical barriers	Imbalances between internal and external logistics systems	Excessive additional operations, losses, increased unit freight costs	Longer delivery times, higher transport costs
7.	Informational barriers	Lack of automation or unified digital system	Errors in data recording, delays in reporting	Decline in the quality of analytical processes

To systematically overcome the challenges identified in the railway transport production system, it is essential to manage the sector's production capacity through comprehensive strategic platforms. Establishing a monitoring and diagnostic framework based on the interrelation of "functional barrier – capacity parameter – economic outcome" will enable continuous evaluation of barriers' impact on integral indices, assessment of resource transformation efficiency, and the development of long-term forecasts.

Conclusion

In conclusion, ensuring the stable and balanced growth of production capacity in the railway transport sector necessitates a comprehensive and scientifically grounded approach. This requires, first and foremost, the identification of functional barriers within the production system, followed by their systematic elimination through well-structured strategic mechanisms. At the same time, it is crucial to integrate innovative, platform-based transformations that enable the modernization of technological processes, the optimization of resource allocation, and the improvement of management efficiency. Implementing such measures will not only enhance operational effectiveness and reduce overall production costs, but also contribute to strengthening the sector's resilience, ensuring its long-term economic sustainability, and increasing its competitiveness in both national and international markets.

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