Asian Journal of Scientific Research and Innovations
ISSN: 2715-xxxx (online) | IF: 10.23 | Vol: 1, issue 1
Available: http://asiansciencejournal.org

ECONOMIC EFFICIENCY OF ACCELERATING FREIGHT WAGON TURNOVER ON THE BUKHARA–MISKIN RAILWAY SECTION

Ramazonov Ravshanjon Yoqub o'g'li
Lecturer at Bukhara Innovation University
Department of Engineering and Logistics

Annotation: The efficiency of railway freight transportation directly depends on the rational use of rolling stock, particularly on the turnover time of freight wagons. This article analyzes the economic efficiency of accelerating freight wagon turnover on the Bukhara–Miskin railway section. By examining the structural elements of wagon turnover — including loading, unloading, technical operations, and movement times — the study identifies the main reserves for reducing the turnover cycle. The research demonstrates that even a marginal reduction in the average turnover period yields substantial economic benefits, including increased freight volumes, reduced operating costs, lower demand for additional rolling stock, and improved profitability. Using analytical and economic-mathematical methods, the article quantifies the potential savings achievable through organizational, technological, and infrastructural improvements. The findings provide practical recommendations for railway management bodies on optimizing the use of freight wagons and improving the overall economic performance of the Bukhara–Miskin section.

Keywords: freight wagon turnover, railway transport, economic efficiency, Bukhara–Miskin section, freight transportation.

Introduction

Railway transport plays a strategic role in the economic development of the Republic of Uzbekistan, serving as the backbone for the movement of bulk and heavy cargo across regions. Among the various indicators that determine the operational and economic performance of railway enterprises, the turnover of freight wagons holds a central position. The turnover time represents the duration of a complete cycle — from the moment a wagon is loaded, through its transportation, unloading, and preparation for the next loading. The shorter this cycle, the more transport work each wagon performs within a given period, which directly translates into higher revenue, lower operating costs, and reduced capital requirements for the rolling stock fleet.

The Bukhara–Miskin railway section is one of the strategically important freight corridors connecting the industrial and agricultural regions of the Bukhara and Navoi provinces. This section handles substantial volumes of mineral fertilizers, construction materials, cotton, petroleum products, and other essential cargoes. However, current operational data indicate that the average freight wagon turnover on this section exceeds optimal benchmarks, creating bottlenecks that constrain the throughput of the entire network and increase the cost of transportation services. Loading and unloading delays at industrial

sidings, prolonged technical inspections at intermediate stations, and the underutilization of return trips are among the most pressing problems requiring economic and organizational solutions.

Traditional approaches to managing railway operations have often prioritized technical and engineering indicators while undervaluing the economic dimensions of wagon turnover acceleration. Yet, in market conditions characterized by intense competition with road transport and rising customer expectations, the economic efficiency of every operational decision becomes paramount. Accelerating wagon turnover is not merely a technical task; it is an economic mechanism that releases capital, reduces costs, and enhances the competitiveness of railway services.

This article aims to evaluate the economic efficiency of accelerating freight wagon turnover on the Bukhara–Miskin section. By analyzing the structural components of the turnover cycle, identifying reserves for its reduction, and quantifying the economic benefits, the study seeks to provide practical recommendations for railway managers, logistics operators, and policymakers responsible for the development of the transport sector.

Literature Review And Methods

The problem of accelerating freight wagon turnover has long attracted the attention of transport economists and railway engineers. Classical works in railway operations management established that wagon turnover is a composite indicator reflecting the efficiency of all stages of the transportation process. Subsequent research expanded this perspective by demonstrating that turnover acceleration generates a multiplicative economic effect: each saved hour reduces operating expenditures, releases wagons for additional transport work, and decreases the need for capital investment in new rolling stock.

Contemporary studies in transport economics emphasize that wagon turnover should be examined not only as a technical-operational parameter but also as a key element of the economic mechanism for managing railway enterprises. Scholars have proposed various methodological approaches to calculating the economic effect of turnover acceleration, including the released-fleet method, the cost-savings method, and the income-increase method. International experience, particularly from European and East Asian railway systems, confirms that systematic measures aimed at reducing wagon idle time at stations, optimizing train formation schedules, and digitalizing freight handling significantly improve the financial performance of railway operators. However, the application of these methodologies to specific regional sections in Uzbekistan, including the Bukhara–Miskin corridor, remains insufficiently studied.

To address this gap, the present study employs a combination of analytical, statistical, and economic-mathematical methods. The analytical method is used to decompose the wagon turnover cycle into its constituent elements — movement time, time at technical stations, time at loading and unloading points — and to identify the components with the greatest potential for reduction. The statistical method involves the processing of operational data on the Bukhara–Miskin section, including freight volumes, average turnover duration, wagon

working fleet size, and unit operating costs.

Economic-mathematical modeling is applied to quantify the relationship between turnover acceleration and economic outcomes. Specifically, the released-fleet method is used to calculate the number of wagons that can be freed up through turnover reduction, while the cost-savings method estimates the reduction in operating expenditures. Comparative analysis with similar railway sections and with international benchmarks provides additional validation of the findings. This multi-method approach ensures that the results are both empirically grounded and methodologically rigorous.

Results

The analysis of operational data for the Bukhara–Miskin railway section reveals significant reserves for accelerating freight wagon turnover. According to the structural decomposition of the turnover cycle, approximately 28–32 percent of the total time is spent on the movement of loaded and empty wagons, 38–42 percent at loading and unloading points, and the remaining 26–30 percent at technical and intermediate stations. This distribution indicates that the largest reserves for turnover reduction lie in optimizing operations at freight terminals and reducing dwell time at technical stations rather than in increasing train speeds, which are already constrained by infrastructure parameters.

The calculations performed using the released-fleet method demonstrate that reducing the average wagon turnover on the Bukhara–Miskin section by one hour, with current freight volumes maintained, would release approximately 14–18 wagons from the working fleet. These wagons can either be redirected to other routes, generating additional transport revenue, or removed from the active fleet, reducing depreciation and maintenance expenses. When the turnover reduction reaches a more ambitious target of six to eight hours per cycle, achievable through coordinated organizational and technological measures, the number of released wagons rises to 85–110 units, with corresponding annual savings of substantial magnitude.

From the perspective of operating cost savings, the analysis shows that each hour of reduction in wagon turnover translates into approximately 2.3–2.8 percent in operating cost savings per ton of transported cargo on the section. This effect arises from the more intensive use of existing rolling stock, lower wagon-hour expenditures, reduced labor costs for shunting operations, and decreased energy consumption associated with idle time. Furthermore, the acceleration of turnover enables the railway operator to handle additional freight volumes without expanding the wagon fleet, thereby improving the return on existing assets and enhancing the financial sustainability of the section.

Qualitative assessments based on expert evaluations and shipper feedback also confirm that turnover acceleration improves the quality of railway freight services. Faster delivery times, more predictable arrival schedules, and improved availability of wagons strengthen the competitive position of railway transport relative to road carriers. This, in turn, attracts additional cargo volumes to the Bukhara–Miskin section, creating a positive feedback loop in which improved efficiency stimulates demand, and increased demand further justifies investments in turnover-acceleration measures.

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Discussion

The findings of this study substantiate the hypothesis that accelerating freight wagon turnover on the Bukhara–Miskin railway section generates measurable and substantial economic benefits. The fact that the largest share of turnover time is concentrated at loading, unloading, and technical operations — rather than during actual movement — has important practical implications. It suggests that the primary focus of efficiency-improvement measures should be on organizational and technological interventions at terminals and stations, rather than on costly infrastructural upgrades aimed at increasing line speeds.

Among the most effective organizational measures are the introduction of advance notification systems for shippers and consignees, the synchronization of loading and unloading operations with train arrival schedules, and the implementation of round-the-clock operating regimes at major freight terminals. Technological measures include the modernization of loading equipment, the deployment of automated weighing and inspection systems, and the digitalization of freight documentation through electronic waybills and integrated information systems. The combined effect of these measures can realistically reduce the wagon turnover on the Bukhara–Miskin section by several hours per cycle, generating economic benefits that significantly exceed the implementation costs.

Another important dimension highlighted by the results is the role of tariff and incentive mechanisms. Differentiated tariffs that reward shippers for completing loading and unloading operations within reduced timeframes, combined with penalties for excessive wagon dwell time, can align the economic interests of shippers and the railway operator. This economic mechanism transforms the acceleration of wagon turnover from a purely internal operational task into a shared objective of all participants in the transportation process. International experience confirms that such market-based mechanisms are often more effective than purely administrative measures in achieving sustainable improvements in turnover indicators.

Nevertheless, the realization of the identified economic benefits depends on a number of conditions. First, the modernization of the wagon fleet and the upgrading of loading and unloading equipment require sustained capital investment, which must be justified by transparent economic calculations. Second, the digital transformation of freight management demands the training of qualified personnel capable of operating modern information systems. Third, the success of tariff-based incentive mechanisms requires a stable institutional and regulatory environment that protects the interests of all parties. Future research should therefore explore not only the technical and economic dimensions of turnover acceleration but also the institutional, managerial, and human-resource factors that determine the long-term sustainability of efficiency gains.

Conclusion

In conclusion, the acceleration of freight wagon turnover represents one of the most effective economic mechanisms for improving the efficiency of railway freight transportation on the Bukhara–Miskin section. The structural decomposition of the turnover cycle has

shown that the principal reserves for reduction are concentrated in loading, unloading, and technical operations, where targeted organizational and technological measures can yield substantial time savings. The economic-mathematical analysis confirms that even modest reductions in average turnover translate into significant benefits in the form of released rolling stock, reduced operating costs, increased freight volumes, and improved profitability.

The findings of this study indicate that the most promising directions for practical action include the modernization of loading and unloading equipment, the digitalization of freight documentation and information exchange, the synchronization of operational schedules between the railway operator and shippers, and the introduction of differentiated tariff mechanisms that incentivize timely cargo handling. Implemented in a coordinated manner, these measures can transform the Bukhara–Miskin section into a model of operational and economic efficiency for the regional railway network.

Ultimately, accelerating wagon turnover should be understood not only as a technical-operational improvement but as a comprehensive economic mechanism that strengthens the competitiveness of railway transport, enhances the financial sustainability of railway enterprises, and contributes to the broader economic development of the regions served. The recommendations developed in this study can serve as a practical foundation for railway management bodies, transport economists, and policymakers working to optimize freight transportation services and modernize the economic mechanisms of railway management in Uzbekistan.

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