

MUHANDISLIK

& IQTISODIYOT

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*Ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

2026
sentyabr-oktabr

Belarus–O'zbekiston

ilmiy-texnik hamkorligi: zamonaviy muhandislik
ta'limi, amaliy kvalifikatsiyalar va innovatsion
sanoat rivoji



ISSN: 3060-463X

Xalqaro ilmiy-amaliy konferensiya

РЭУ.РФ
ИМЕНИ Г.В. ПЛЕХАНОВА
ФИЛИАЛ В Г. ТАШКЕНТЕ



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Elektron nashr, 2026-yil, sentyabr/oktabr.

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- 05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
- 05.01.03 – Informatikaning nazariy asoslari
- 05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
- 05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
- 05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
- 05.01.07 – Matematik modellash
- 05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
- 05.02.00 – Mashinasozlik va mashinashunoslik
- 05.02.08 – Yer usti majmualari va uchish apparatlari
- 05.03.02 – Metrologiya va metrologiya ta'minoti
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- 05.05.05 – Issiqlik texnikasining nazariy asoslari
- 05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
- 05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
- 05.08.03 – Temir yo'l transportini ishlatish
- 05.08.06 – "G'ildirakli va gusenisali mashinalar va ularni ishlatish" (texnika fanlari)
- 05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
- 05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
- 10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
- 10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
- 08.00.01 – Iqtisodiyot nazariyasi
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- 08.00.06 – Ekonometrika va statistika
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Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

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UDC: 656.2:338.5

BEYOND FINANCIAL METRICS: RAILWAY TRANSPORT EFFICIENCY

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Abstract. This thesis examines why the formal presence of financial stability or institutional mechanisms in railway passenger transport does not, in itself, constitute evidence of economic efficiency. The purpose of the study is to establish—both across national models and within a single operator—that efficiency is a property of functional configuration rather than instrument existence. Three international institutional models were compared analytically, and three integral indices—asset condition, financial stability, and business activity—were computed for a national passenger operator over 2020–2025 using the geometric-mean method. The results show that no international model is universally superior, as each is conditional on its specific institutional environment. Furthermore, while asset condition and financial stability rose steadily, business activity remained persistently low, confirming that resource and financial adequacy do not automatically translate into genuine efficiency.

Keywords: economic efficiency, railway passenger transport, institutional configuration, financial-functional decoupling, integral index.

Annotatsiya. Ushbu dissertatsiya ishida temir yo'l yo'lovchi transportida moliyaviy barqarorlik yoki institutsional mexanizmlarning rasman mavjudligi nimaga o'z-o'zidan iqtisodiy samaradorlik ko'rsatkich bo'la olmasligi tadqiq etiladi. Tadqiqotning maqsadi — ham milliy modellar darajasida, ham yagona operator doirasida samaradorlik vositalarning shunchaki mavjudligidan emas, balki funksional konfiguratsiyaning holatidan iborat ekanligini asoslashdan iborat. Ishda uchta xalqaro institutsional model tahliliy jihatdan solishtirildi va geometrik o'rtacha qiymat usuli yordamida 2020–2025-yillar davomida milliy yo'lovchi tashish operatori uchun uchta integral indeks — aktivlar holati, moliyaviy barqarorlik va ishbilarmonlik faolligi hisoblab chiqildi. Natijalar shuni ko'rsatadiki, xalqaro modellarning hech biri mutloq ustunlikka ega emas, chunki ularning har biri muayyan institutsional muhitga bog'liq. Shuningdek, aktivlar holati va moliyaviy barqarorlik barqaror o'sgan bo'lsa-da, ishbilarmonlik faolligi past darajada qolgan, bu esa resurs va moliyaviy yetarlilik **avtomatik ravishda** haqiqiy samaradorlikka aylanmasligini tasdiqlaydi.

Kalit so'zlar: iqtisodiy samaradorlik, temir yo'l yo'lovchi transporti, institutsional konfiguratsiya, moliyaviy-funksional uzilish, integral indeks.

Аннотация. В данной диссертации исследуется, почему формальное наличие финансовой устойчивости или институциональных механизмов на железнодорожном пассажирском транспорте само по себе не является свидетельством экономической эффективности. Цель исследования — обосновать как на уровне национальных моделей, так и в рамках отдельного оператора, что эффективность является свойством функциональной конфигурации, а не фактом существования инструментов. В ходе работы было проведено аналитическое сравнение трех международных институциональных моделей, а также методом средневзвешенного геометрического рассчитаны три интегральных индекса за 2020–2025 годы для национального пассажирского оператора: состояние активов, финансовая устойчивость и деловая активность. Результаты показывают, что ни одна из международных моделей не обладает абсолютным превосходством, поскольку каждая обусловлена своей институциональной средой. Кроме того, при устойчивом росте состояния активов и финансовой устойчивости деловая активность оставалась стабильно низкой, что подтверждает: ресурсная и финансовая обеспеченность не конвертируются автоматически в реальную эффективность.

Ключевые слова: экономическая эффективность, железнодорожный пассажирский транспорт, институциональная конфигурация, финансово-функциональный разрыв, интегральный индекс.

INTRODUCTION

A recurring analytical limitation in assessing railway passenger transport is equating the formal presence of an institutional mechanism, or a satisfactory financial ratio, with genuine operational efficiency. In practice, mature transport systems demonstrate that a segment can maintain long-term institutional stability alongside financial support, while a single operator may show improving asset and liquidity indicators without a corresponding gain in real economic conversion. The purpose of this thesis is to establish, at both international-comparative and firm-specific levels, that efficiency depends on how mechanisms are functionally configured



rather than their mere formal existence. Artificial intelligence tools were also utilized during the editing process of this text.

LITERATURE REVIEW

J. Preston provides the general methodological foundation for rail transport economics [1], while Y. Crozet analyzes the relationship between state-operator governance and public-service obligations in Europe [2]; both studies focus primarily on single institutional contexts. F. Mizutani examines corporate vertical integration in Japan [3], highlighting its density dependence, and A. Kahn's regulatory-economics framework explains how prices and costs follow distinct mechanisms under tariff regulation [4], though these frameworks do not provide firm-level metrics for resulting inefficiencies.

R. Kaplan and D. Norton demonstrate the predictive limits of relying solely on financial performance measures [5], while K. Talluri and G. van Ryzin formalize the economic cost of demand-capacity mismatches within revenue-management theory [6]. However, these insights remain to be integrated with the comparative institutional literature on regulated network industries. Artificial intelligence tools were also utilized during the editing process of this text.

Consequently, comparative international research illustrates why institutional models vary in application, and performance-measurement literature highlights why financial indicators alone are incomplete. Integrating these two perspectives shows that both share a common theoretical foundation: efficiency is a configurational property rather than a purely instrumental one. This thesis addresses that research gap.

RESEARCH METHODOLOGY

At the international level, three primary institutional models from developed countries—state-regulated (European), corporate-integrated (Japanese), and competitive-contractual (British)—were evaluated based on their central mechanisms, operating conditions, and institutional limits using a comparative-institutional method that distinguishes external form from internal functional logic.

At the firm level, three integral indices were computed for a national passenger operator over 2020–2025 using the geometric mean of their component ratios. This method ensures that a lower value in any single component is reflected in the outcome rather than masked by an average. Artificial intelligence tools were also utilized during the editing process of this text. The business-activity index was calculated using the following formula:

$$K_{ba} = \sqrt[5]{K_1 \cdot K_2 \cdot K_3 \cdot K_4 \cdot K_5}$$

where K_1 through K_5 represent accounts payable turnover, sustainable growth, service profitability, return on equity, and equity turnover ratios, respectively. The trajectories of the three indices were then evaluated to determine the alignment between resource and financial adequacy and real efficiency.

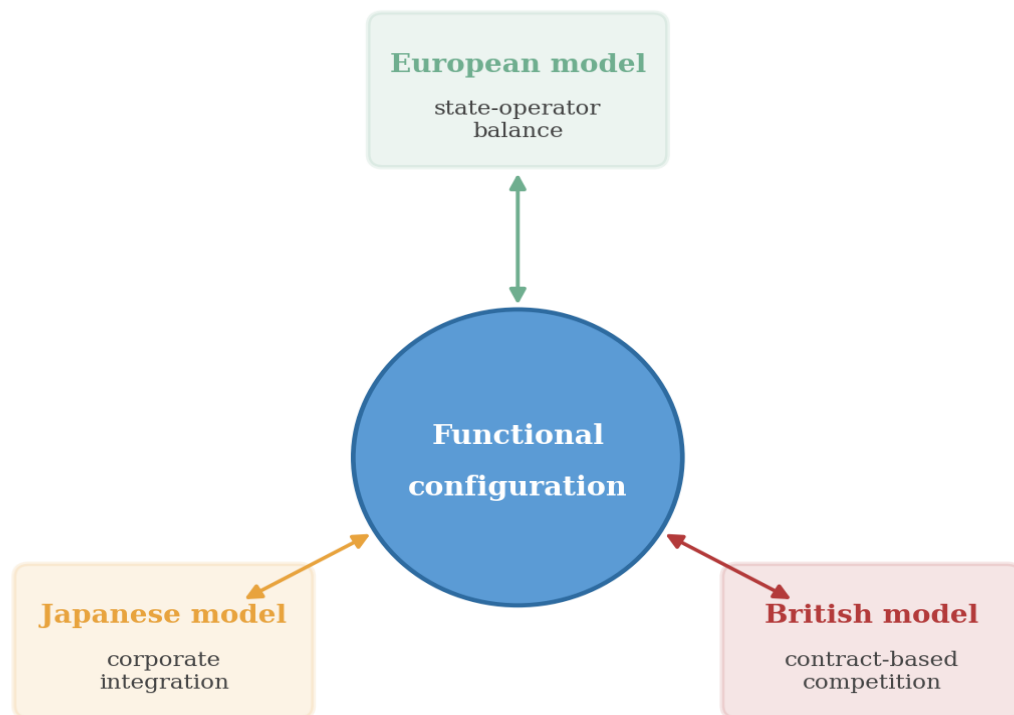
ANALYSIS AND RESULTS

Table 1 summarizes the three international models, while Table 2 and Figure 1 present the firm-level indices. Artificial intelligence tools were also utilized during the editing process of this text (Table 1).

Table 1
Institutional structure of the three priority models¹

Model	Central mechanism	Operating condition	Institutional limit
European model	Institutional separation of infrastructure and operations	Stable budget, long-term state commitment	High subsidy dependence; weak cost-discipline incentive
Japanese model	Corporate integration of infrastructure, transport, and commerce	High population density and demand concentration	Unsuitable for low-density areas; cross-subsidy opacity
British model	Contract- and tender-based competition among operators	Mature legal-institutional environment	Natural-monopoly fragmentation; rising coordination costs

¹ Source: Author's synthesis. Artificial intelligence tools were also utilized during the editing process of this text.



Efficiency = functional configuration, not the formal presence of instruments

Figure 1. Convergence of the three institutional models on functional configuration²

Table 2
Theoretical content of the three integral indices³

Index	Economic content	2020→2025	Theoretical reading
K_{as} — asset condition	State of the resource base and technical potential	0.583 → 0.651	Reflects resource availability rather than its economic return
K_{fs} — financial stability	Liquidity, solvency, and capital structure	0.646 → 0.679	Largely sustained through external compensatory financing
$\\$K_{ba}\\$ — business activity	Degree to which resources convert into real economic return	0.292 → 0.347	Serves as the primary indicator reflecting genuine efficiency

² Source: Author's elaboration.

³ Source: Author's calculations. Artificial intelligence tools were also utilized during the editing process of this text.

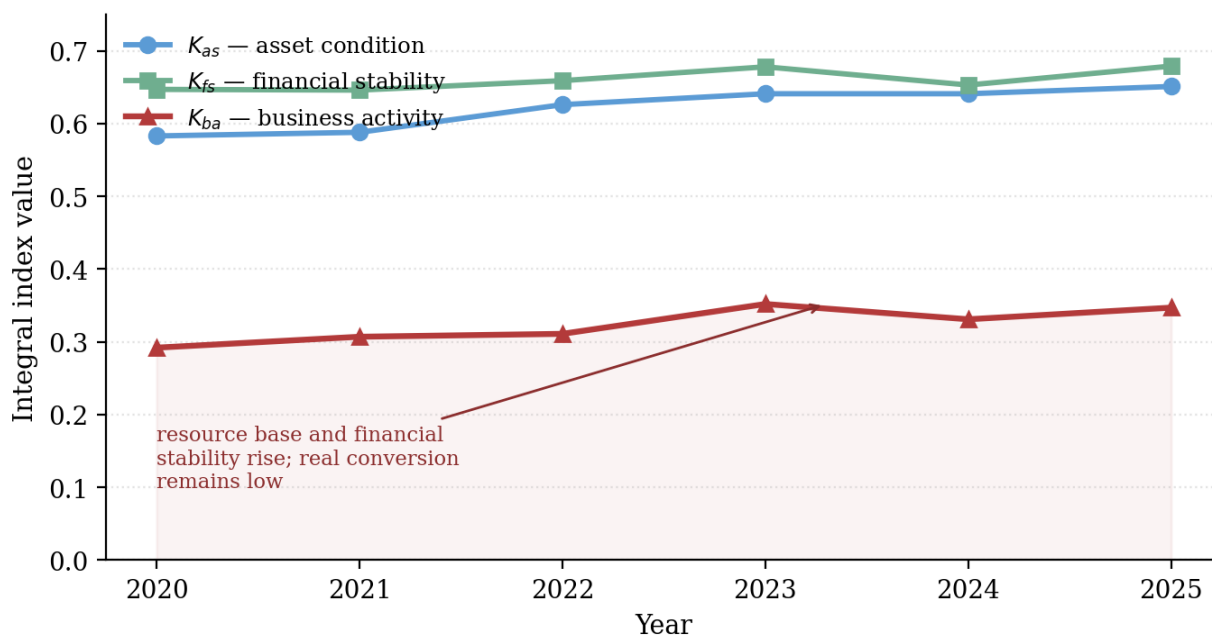


Figure 2. Trajectory of the three integral indices, 2020–2025⁴

The comparison illustrates that each institutional model operates effectively within its specific environmental conditions, supporting the conclusion that no single universal model exists. At the firm level, the asset condition index increased from 0.583 to 0.651, and financial stability rose from 0.646 to 0.679. In contrast, business activity remained within the range of 0.292 to 0.352 throughout the period, staying at less than half the level of the other two indices in every observed year. Artificial intelligence tools were also utilized during the editing process of this text.

The persistent gap between K_{fs} and K_{ba} empirically supports A. Kahn's proposition [4] that, under tariff regulation, price-driven financial indicators and resource-driven cost indicators operate through distinct mechanisms and do not necessarily move together. This finding extends R. Kaplan and D. Norton's analysis [5] regarding financial-only assessments to regulated network settings where structural alignment is critical. In parallel, comparing the three models demonstrates that both Japan's corporate integration model and Britain's competitive model address efficiency requirements when specific prerequisites (such as demand density or institutional maturity) are met—reflecting the same configurational logic that separates K_{fs} from K_{ba} within a single firm. Artificial intelligence tools were also utilized during the editing process of this text.

The practical implication is that neither adopting a foreign institutional model nor achieving a specific financial ratio serves as sufficient evidence of efficiency. Both require ensuring that the functional configuration of the mechanism—rather than its mere formal existence—aligns with the relevant demand, density, and regulatory conditions.

CONCLUSION AND RECOMMENDATIONS

This thesis demonstrates, at both international-comparative and firm-specific levels, that efficiency in railway passenger transport is a configurational property rather than a purely instrumental one. Consequently, no single institutional model is universally superior, and improved financial stability does not automatically imply gains in operational efficiency. Artificial intelligence tools were also utilized during the editing process of this text. Future research could model the relationships among the three integral indices econometrically and expand the institutional comparison using quantitative compatibility indices.

4 Source: Author's calculations.



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2026

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