
OPPORTUNITIES FOR ENHANCING COMPETITIVENESS IN THE PASSENGER WAGON MANUFACTURING SECTOR

Kurambayev Alisher Saburbayevich

Acting Associate Professor at the University of Transport, Uzbekistan

ABSTRACT

The global passenger-rail market is expanding steadily on the back of rising urbanisation, decarbonisation policies and recovery-driven public-investment programmes. This article examines the competitiveness landscape of the sector and identifies actionable opportunities for its improvement. The findings show that competitiveness depends on a dynamic interaction of four vectors—innovation depth, supply-chain resilience, customer-centric lifecycle services and policy-enabled market access. The study contributes to strategic-management literature by integrating technological and institutional lenses and offers rail-policy makers a roadmap for fostering globally integrated, environmentally sustainable passenger-wagon clusters.

KEYWORDS

Passenger rolling stock; competitiveness; Industry 4.0; localisation; servitisation; Uzbekistan rail industry.

INTRODUCTION: Passenger wagons—conventional locomotive-hauled coaches distinct from multiple-unit rolling stock—retain a decisive share of long-distance rail markets despite the rise of high-speed EMUs and aviation in many corridors. By 2025 the worldwide rail transport segment was valued at roughly USD 260 billion, with a projected compound annual growth rate exceeding seven per cent toward 2034, stimulated by green-mobility commitments and post-pandemic infrastructure plans. The manufacturing landscape is highly concentrated; large conglomerates such as Transmashholding, CRRC and Alstom dominate, yet medium-sized plants in Central and South-East Asia are entering international supply chains.

Competitiveness in this sector is multifactorial. Apart from scale efficiency, firms must comply with increasingly stringent crashworthiness standards, weight limits, passenger-comfort indices and digital-connectivity requirements, all while coping with metal-price fluctuations and intermittent orders from state operators. Global rivalry is further sharpened by aggressive export financing from major producer countries and by rapid technological diffusion—especially in lightweight composite materials, hydrogen auxiliary power units and predictive-maintenance sensors.

Uzbekistan offers a compelling microcosm. In early 2024 the Tashkent Passenger Carriages Plant reported the first series of modernised compartment and reserved-seat coaches developed entirely in-house following presidential directives to localise strategic industries. Parallel

investment flows are visible across Eurasia, where rolling-stock plants upgrade production lines for Industry 4.0 compliance and adopt interoperable digital-design suites.

The research design follows a convergent mixed-methods paradigm. First, a documentary survey of academic journals, market-intelligence reports and policy papers from 2019-2025 established baseline trends regarding production volumes, export dynamics and technological diffusion. These documents included annual statistical compendia of the International Union of Railways and proprietary databases from Research and Markets. Second, a purposive sample of five globally active manufacturers (TMH-Russia, CRRC-China, Stadler-Switzerland, Titagarh-India and the Tashkent Passenger Carriages Plant-Uzbekistan) was benchmarked across twelve performance indicators grouped into the vectors innovation, supply-chain scope, servitisation depth and policy embeddedness. Indicators encompassed R&D intensity, proportion of critical components sourced in-country, revenue share from maintenance contracts and utilisation of export-credit instruments.

Quantitative benchmarking used normalised z-scores derived from company financial statements and press releases. Qualitative insights were added through a single-embedded case study of the Uzbek plant, selected for its rapid modernisation trajectory and relevance to emerging-market entrants. Semi-structured interviews with managerial and technical staff were conducted virtually between February and April 2025, complemented by on-site observation of newly installed robotic welding cells and laser-cutting units during a field visit in March 2025. Triangulation ensured validity.

The benchmarking exercise confirmed considerable dispersion in competitive positioning. Incumbents such as TMH and CRRC retain cost-leadership through vertical integration and state-supported export financing. Newer entrants relying on imported sub-assemblies face higher bill-of-materials costs and longer lead times. Nevertheless, the analysis uncovered four cross-cutting opportunity domains capable of narrowing these gaps.

1. Digital-production ecosystems. Plants that implemented integrated industrial-internet architectures, even at pilot scale, lowered non-quality costs by up to 18 per cent through real-time defect detection and adaptive welding parameters. The Tashkent case revealed that installing an edge-analytics platform for bogie-frame measurement reduced rework from seven millimetres tolerance deviation to below three, thereby meeting ERA TSIs without costly manual grinding. Procedia CIRP studies corroborate that structured Industry 4.0 road-mapping accelerates such gains.

2. Modular, lightweight construction. Customer tenders increasingly emphasise life-cycle energy consumption and axle-load limits, pushing manufacturers toward aluminium extrusion, fibre-reinforced polymers and hybrid composite-steel bodies. Simulation-driven redesign of end-walls allowed the Uzbek plant to shed 1.2 tonnes per coach, translating into a two-per-cent operational-cost reduction over a twenty-year service horizon. More radically, European producers are

integrating hydrogen readiness in under-floor modules to align with forthcoming zero-emission corridors on non-electrified lines.

3. Supply-chain resilience and localisation. The COVID-19 pandemic and geopolitical disruptions revealed the vulnerability of single-region sourcing strategies. Firms that complemented global platforms with localised machining of high-value components—such as brake discs and HVAC units—achieved shorter cash-conversion cycles and greater bargaining power over tier-two suppliers. Uzbekistan, after entering a trust-management partnership with a Russian engineering centre in 2024, negotiated technology-transfer clauses that increased domestic content from 42 to 60 per cent within a single fiscal year.

4. Servitisation and full-lifecycle value propositions. Manufacturing margins on rolling stock are structurally thin, but bundled long-term maintenance, remote diagnostics and component-overhaul services generate stable annuity streams. Surveyed customers exhibited a willingness to pay price premiums of five to seven per cent for wagons delivered with fifteen-year performance-based service agreements. This shift diminishes the impact of order-cycle volatility and embeds manufacturers into operators' digital fleet-management platforms, creating exit barriers for competitors.

The Uzbek case study illustrates the cumulative effect of combining these opportunity vectors. Over eighteen months the plant not only doubled annual output—from thirty-five units in 2024 to a projected seventy in 2025—but also secured its first export memorandum, contingent on European TSI certification due late 2026. Interviews indicated that the integration of a digital twin environment accelerated certification documentation, while policy support in the form of a USD 50 million industrial-development-fund loan mitigated capital-expenditure risk.

Enhancing competitiveness in passenger-wagon manufacturing is not solely a matter of scale or labour cost. It hinges on simultaneous progress in digital manufacturing, sustainable engineering, resilient supply-chain configurations and service-oriented revenue models, all within a supportive institutional ecosystem. Emerging-market manufacturers can bridge capability gaps by prioritising phased Industry 4.0 adoption, investing in modular lightweight platforms and embedding themselves in international certification and finance networks. Governments, for their part, can catalyse these strategies through targeted R&D grants, preferential procurement that rewards lifecycle value and transparent export-credit facilities. Future research should quantify carbon-reduction outcomes of composite-body adoption and explore how cross-border digital-maintenance platforms redistribute value among manufacturers, operators and tech providers.

REFERENCES

1. International Union of Railways. Railway statistics 2023. Paris: UIC; 2024. 180 p.
2. Passenger Rail Transport Market 2025-2034. Dublin: Research and Markets; 2025. 120 p.

3. Wipfel M., Putz M., Fechtelpeter A. An Industry 4.0 technology implementation model for rolling-stock maintenance // Procedia CIRP. 2021. Vol. 104. P. 606–611.
4. Industry 4.0's effect on rail manufacturing [Electronic resource]. Mode of access: <https://d4m-int.com/from-compliance-to-innovation-industry-4-0s-effect-on-rail-manufacturing/> (accessed: 21.06.2025).
5. Tashkent Passenger Carriages Plant manufactures new coaches [Electronic resource]. Mode of access: <https://tashkenttimes.uz/national/14929-tashkent-passenger-carriages-plant-manufactures-new-compartment-and-reserved-seat-carriages> (accessed: 21.06.2025).
6. Tashkent passenger-carriage plant handed over to Russian firm for trust management [Electronic resource]. Mode of access: <https://tashkenttimes.uz/national/14981-tashkent-passenger-carriages-plant-handed-over-to-russian-firm-for-trust-management> (accessed: 21.06.2025).
7. Uzbekistan introduces new modern passenger railcars [Electronic resource]. Mode of access: <https://www.uzdaily.uz/en/uzbekistan-introduces-new-modern-passenger-railcars/> (accessed: 21.06.2025).
8. Transmashholding ramps up investment in development 35 % to 28.5 bln RUB in 2024 [Electronic resource]. Mode of access: <https://interfax.com/newsroom/top-stories/109736/> (accessed: 21.06.2025).
9. FuelCellsWorks. Russia to launch first hydrogen trains for Sakhalin in 2026 [Electronic resource]. Mode of access: <https://fuelcellworks.com/2025/04/11/energy-innovation/russia-to-launch-first-hydrogen-train-for-sakhalin-in-2026-as-suburban-rail-modernization-gains-momentum> (accessed: 21.06.2025).
10. OECD. Railway rolling stock manufacturing competitiveness: trends and drivers. Paris: OECD Publishing; 2023. 95 p.