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BENCHMARKING OF RAILWAY SUPPLY CHAIN PERFORMANCE: THE ROLE OF ORGANIZATIONAL CULTURE

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Abstract: This paper addresses the research gap concerning business performance analysis of multinational railway supply chain organizations through a combined quantitative approach. Data were collected from 46 organizations across 24 countries, grouped into seven geographical regions within the supply chain of a Canadian multinational railway transport manufacturer, enabling a structured benchmarking comparison of regional business performance. The Analytic Hierarchy Process (AHP) method was applied across six business performance categories (market and financial, operations, employees, investment and development, quality, and customer satisfaction), to rank regional performance. Results consistently identified North America as the highest-ranked region and Latin America as the lowest, across both specific and equal weight AHP cases. To investigate the source of underperformance, the Mann-Whitney U test was applied to business performance and organizational culture datasets. Statistically significant differences were confirmed between North America and Latin America in both domains, suggesting that organizational culture may be a contributing factor to the observed business performance gap. The findings provide a cross-regional benchmarking baseline and a starting point for targeted improvement strategies in underperforming regions, while calling for larger datasets in future research.

Keywords: Railway supply chain; business performance; AHP; organizational culture; Mann-Whitney U test; benchmarking.

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1. INTRODUCTION

Contemporary organizations operate in an environment shaped by accelerating technological change, intensifying global competition, and increasing geopolitical uncertainty (Terchila, 2025). Constant increase of competitiveness between organizations and the development of technology compel organizations towards different strategies in order to improve their business performances and operations (Habib et al, 2019; Fu et al., 2022). Under these circumstances, in order to establish and to have control over its business performances,

it is important for organizations to create comprehensive strategies, systems and processes for the organization, aligned with their available resources (Anwar et al., 2025). Namely, benchmarking of supply chain performance measures has been recognized as a key instrument for identifying gaps and guiding strategic improvement, with increasing attention toward holistic, multi-dimensional approaches that go beyond individual operational metrics (Peng Wong & Wong, 2008).

The key requirement for organizations in the field of manufacturing is the management of the processes that involve the movement of material throughout the whole path, starting from the supplier, continuing through value enhancement processes, towards distribution lines to the end consumers. The supply chain can be defined as a "backbone of modern economies" and it represents an integrated system of tasks involving planning, managing and controlling materials, segments and finished products throughout all stages from supplier to consumers (Stevens, 1989; Pennekamp et al., 2023).

In terms of logistics aspects, many forms of transportation have been used, though, over a considerable period, the rail transportation system has been seen as the most frequently utilized way to handle supply chain transportation between partnering organizations, due to its efficiency and economical aspect (Hajiaghaei-Keshteli et al., 2014).

With the expansion of the supply chains over the world, the railway transportation has become a relevant topic owing to the fact it contains several benefits over the road transportation in terms of safety, reliability, affordable prices and more environmental-friendly solution (Gholamizadeh et al., 2024). Cross-regional benchmarking extends this concept to multinational settings, where performance differences across geographies can reveal the influence of contextual factors such as organizational culture, market maturity, and institutional environment (Dattakumar & Jagadeesh, 2003). Given these advantages, it is important to explore potential methods for improving the business performance of the railway supply chains organizations, as they manage processes related to the design, manufacturing, and maintenance of the railway transportations systems (Pyrgidis, 2021). One such method is cross-regional benchmarking, which enables organizations to systematically compare their performance against peers operating in different geographical contexts, thereby identifying best practices and areas requiring targeted improvement.

Based on the previously stated, the aim of the paper is to identify strongest and weakest link in organizations grouped by regions regarding business performance in the observed multinational railway industry supply chain, furthermore investigating the possible cause of the underperformance in the weakest ranked, exploring the authors' presumption that the possible cause may be associated with the organizational culture of the observed organizations. The previous research topic gives a review of relevant available researches regarding the topic. Data and methodology section provide a detailed review of the suggested model for multinational railway supply chain examination in terms of business performance, following results and discussion in which the results of the AHP and statistical analysis are provided. Lastly, the authors conclude their findings and propose further steps towards a more detailed analysis.

2. PREVIOUS RESEARCH

Business performance measurement in supply chains till now are approached through various frameworks and methodological combinations. Spasojević Brkić et al. (2012, 2013) developed and empirically validated a multi-category business performance framework covering market and financial, operations, employee, investment and development, quality, and customer satisfaction dimensions, providing the conceptual foundation for the present study. Tomic et al. (2017) extended this work by demonstrating that organizational culture and quality improvement tools significantly predict business performance outcomes across supply chain organizations, establishing the theoretical link between cultural factors and operational results that motivates the second stage of the present analysis. More broadly, Fu et al. (2022) confirmed that organizational structure and strategic alignment are among the strongest determinants of sustainable supply chain performance across industries, while Anwar et al. (2025) demonstrated that supply chain integration, when embedded in strategic management practice, produces measurable improvements in business performance across diverse organizational contexts.

The role of organizational culture in supply chain performance has received increasing theoretical and empirical attention. Organizational culture shapes the informal norms, communication patterns, and risk tolerance that determine how supply chain partners collaborate, share information, and respond to disruption (Tomic et al., 2017). Cameron and Quinn's competing values framework, widely applied in cross-national organizational research, suggests that cultural orientations systematically differ across geographical regions, with implications for how organizations prioritize efficiency, flexibility, and external relationships, all of which are directly reflected in business performance categories such as operations, customer satisfaction, and employee performance (Cameron & Quinn, 2011). In supply chain contexts specifically, Gimenez and Ventura (2005) showed that internal integration between supply chain functions is a necessary precondition for effective external integration with partners, and that this internal coherence is itself culturally mediated. These findings collectively suggest that observed regional differences in supply chain business performance may reflect deeper differences in organizational culture rather than purely operational or technical factors.

Railway supply chains present a distinctive research context. Liberalization and globalization processes have significantly transformed supply chain organization in the railway industry, altering the roles and relationships among firms operating at different levels of the production hierarchy (Esposito & Passaro, 2009). Gholamizadeh et al. (2024) positioned railway transport as a strategically important supply chain mode due to its advantages in safety, reliability, cost efficiency, and environmental impact relative to road transport, while also identifying structural vulnerabilities including infrastructure dependency and limited flexibility. Kumar et al. (2025) identified key barriers to effective supply chain management in rail transport, including coordination failures, information asymmetry, and institutional rigidity. Despite the sector's strategic importance, the literature on railway supply chain performance measurement remains underdeveloped relative to road and air freight research (Kumar & Agarwal, 2024), and cross-regional comparative studies are particularly scarce.

Cross-regional comparisons in supply chain research have employed both parametric and non-parametric statistical approaches. Spasojević Brkić et al. (2023) applied the Mann-Whitney U test to examine differences in Kaizen implementation across countries and industries in a multinational supply chain, providing direct methodological precedent for the present study's comparative design. Lee and Roh (2012) compared accounting-based and market-based performance indicators across countries using ANOVA, identifying persistent regional variation in supply chain performance that underscores the need for geographically stratified

analysis. Vachon and Mao (2008) conducted a country-level analysis linking supply chain strength to sustainability performance, finding that regional economic and institutional context moderates the relationship between supply chain practices and outcomes — a finding directly relevant to the present study's regional grouping design.

The AHP method has been widely applied in supply chain performance evaluation. Gaudenzi and Borghesi (2006) used AHP for supply chain risk management, while Kumar and Agarwal (2024) combined AHP with TOPSIS to evaluate Indian railway supply chain parameters — the closest precedent to the present study in terms of both sector and method. Wang (2024) applied AHP in combination with machine learning to optimize green supply chain efficiency, demonstrating the method's adaptability to complex multi-criteria contexts. Despite this breadth of application, the literature reveals a significant gap: no study to date has applied AHP in combination with non-parametric statistical analysis to evaluate and explain regional business performance differences within a multinational railway supply chain, particularly through the lens of organizational culture.

Moreover, while cross-regional benchmarking has been recognized as a valuable tool for identifying performance gaps and guiding improvement strategies in supply chain contexts, its application to the railway sector remains limited. This paper addresses that gap.

3. DATA AND METHODOLOGY

3.1. Business Performance Categories

Several authors emphasise the following business performances categories as key components for achieving a comprehensive and thorough analysis (Spasojevic Brkic et al., 2012; Spasojevic Brkic et al., 2013; Tomic et al., 2017; Yusuf et al., 2013; Sadikoglu et al., 2010; Nogueira et al., 2025; Zhu et al., 2013):

1. The Market and Financial Performances category gives insight involving the dynamic of changes in the total number of customers over time, whether the profit of the company shows increases, the existence of pressure from competitors and the growth of return of assets over time;

2. The Operations Performances category secures data regarding the company’s productivity changes over time, the level of delivery time accuracy, the stability of costs over time, the success in the field of waste reduction programs, and the decrease of total time cycle over time;

3. The Employees Performances category examines the levels of employee’s non-validated or notified absences in the observed company, employee satisfaction and commitment, the changes of salaries and benefits, and the decrease of employee turnover rate over time;

4. The Investment and Development Performances category is provided in order to access the company’s frequency of research and development investments, capacities expansions and investments in innovation and technical improvements;

5. The Quality Performance category tracks the overall improvements of processes and products in the observed company, the improvements of consistency of products and processes, the declining of expenses associated with poor quality and the level of effective coverage of processes by their documented Quality Management System;

6. The Customer Satisfaction Performances category analyses the increase of satisfaction of customers over time, the changes in numbers of complaints and warranty claims, loyalty of customers and the importance and impact of customer's voice in the company.

That being said, in order to create the AHP model, the data obtained from questionnaires is classified into previously defined six categories, where each represents the criteria of the analysis, as listed:

1. Market and Financial Performances
2. Operations Performances
3. Employees Performances
4. Investment and Development Performances
5. Quality Performance
6. Customer Satisfaction Performances

In the methodological section of the paper, the proposed AHP model is applied to evaluate the optimal and worst business performance of railway supply chain organizations, categorized into multiple regions.

3.2. Data Grouping for Analysis

The analysis of the business performances is conducted based on a sample of data collected in the supply chain of transport manufacturer, in the field of transport industry regarding railway solutions. The questionnaires were administered through the supply chain management network of the Canadian multinational railway manufacturer and collected over the course of the operational assessment cycle. All participating organizations responded voluntarily as part of an established performance evaluation process.

For the purpose of this paper, the total of 46 questionnaires from different companies have been obtained, that originate from 24 countries. The data is grouped based on the geographical areas, as listed:

- North America – Canada, United States of America;
- Nordic European Countries – Denmark, Norway, Sweden, Finland;
- Central and Eastern European Countries – Czech Republic, Poland, Hungary, Romania
- Southern European Countries – Italy, Spain
- Western European Countries – France, Germany, Switzerland, Great Britain, Austria, Belgium;
- Latin American Countries – Mexico, Brazil;
- Asia and Pacific Countries – China, Australia, Thailand, India.

The number of questionnaires obtained from each country of every region and the total number of participated organizations are presented in Table 1.

Table 1 Data display of participated companies

Region Name	Country Name	Number of Organizations by Country	Total Number by Region
North America	Canada	4	6
	USA	2	
Nordic Europe	Denmark	2	8
	Finland	1	
	Norway	1	
	Sweden	4	
Central and Eastern Europe	Czech Republic	1	8
	Hungary	2	
	Poland	3	
	Romania	1	
Southern Europe	Italy	1	3
	Spain	2	
Western Europe	Austria	1	13
	Belgium	1	
	France	1	
	Germany	3	
	Great Britain	5	
	Switzerland	2	
Latin America	Brazil	1	2
	Mexico	1	
Asia and Pacific	Australia	2	7
	China	3	
	India	1	
	Thailand	1	
TOTAL NUMBER OF PARTICIPATED ORGANIZATIONS			46

3.3. The AHP Method

In order to determine which alternative (region) achieves the optimal level of business performance based on questionnaire answers, the Analytic Hierarchy Process (AHP) method (in a specialized software) is applied**.** The main objective of the paper is to identify the regions with the strongest and weakest business performance obtained through AHP results, in order to enable comparative analysis and to determine possible causes of poor performance among organizations which are based in the lowest ranked region.

Pairwise comparisons between the six business performance categories were derived directly from the questionnaire data, using the mean scores of each category per region as the basis for comparison. The consistency of the resulting comparison matrices was verified through the Consistency Ratio (CR), which remained below the threshold of 0.1 in both AHP cases, confirming the internal coherence of the priority weights assigned to each criterion.

Furthermore, the results may further serve to statistical analysis that will aim to recognise a certain cause that influences the business performance of the analysed system, the supply chain of a multinational railway industry company. Based on the ratings obtained from the questionnaire through the five-point Likert scale, the data used for further AHP analysis is presented in Table 2.

Table 2 Obtained data from questionnaires from regions

BUSINESS PERFORMANCES	North America	Nordic Europe	Central and Eastern Europe	Southern Europe	Western Europe	Latin America	Asia and Pacific
Market and Financial Performances	3.200	2.950	2.771	2.800	3.200	2.400	2.571
Operations Performances	3.567	2.950	3.000	2.867	2.969	2.800	3.086
Employees Performances	3.267	2.950	2.543	2.867	3.046	2.600	2.829
Investment and Development Performances	3.667	2.850	3.257	2.600	3.369	2.600	3.029
Quality Performance	3.733	3.100	2.714	2.733	3.554	2.600	2.629
Customer Satisfaction Performances	3.200	2.950	2.800	3.067	3.262	2.500	2.743

The AHP method is conducted in two separate cases:

- Case 1: The weight of criteria is determined based on the authors assessment of importance for the analysis, in that case the biggest (critical) impact in the final ranking of the alternatives is by the following criteria: Operations Performances, Employees Performances and Quality Performance; while the following criteria is regarded as slightly less important for the analysis, but still significant: Market and Financial Performances, Investment and Development Performances and Customer Satisfaction Performances.
- Case 2: As a model sensitivity check, a second case is evaluated in which all criteria are assigned equal weights. This approach is used to examine potential changes in the ranking of alternatives under conditions of equal importance and to assess the sensitivity of the results to variations in criterion weighting.

4. RESULTS AND DISCUSSION

4.1. The AHP Results

The results of both cases of the AHP analysis are showcased in Table 3. Both conducted AHP cases suggest that the highest ranking among the selected regions is the Northern American region, with the overall score of 0.179 in the first case, and 0.178 in the second case of the AHP Method analysis. There have not been any changes in the ranking of the other regions, which confirms the model is stable. In the case of Nordic Europe, there have not been any changes in the final score of this region. The following three regions: Central and Eastern Europe, Southern Europe and Asia and Pacific hold the middle placed rankings in both cases, with minimal variations in their results. The consistently superior performance of North America may reflect the region's geographic and organizational proximity to the multinational manufacturer's headquarters, as well as more mature supply chain integration practices and established communication channels with the parent organization. The middle-ranked regions (Western Europe, Nordic Europe, Central and Eastern Europe, and Asia and Pacific) display relatively similar AHP scores, suggesting a broadly comparable level of supply chain performance maturity, with differences likely attributable to variation in market conditions, regulatory environments, and integration levels with the parent organization. Lastly, the Latin

American region is ranked as lowest regarding their business performance based on the questionnaire answers, with the overall score of 0.117 in first case, and 0.116 in second case of the analysis.

Table 3: The AHP Results

AHP Results	North America	Nordic Europe	Central and Eastern Europe	Southern Europe	Western Europe	Latin America	Asia and Pacific
Case 1: Specific Weights	0.179	0.143	0.134	0.132	0.162	0.117	0.133
Case 2: Equal Weights	0.178	0.143	0.135	0.133	0.163	0.116	0.132

4.2. Statistical Comparison between Regions

For the purpose of determining the optimal statistical test for the obtained data analysis, a descriptive statistical analysis is conducted. The scale model that the questionnaire employed is a Likert scale that consists of five points in total, with number 1 representing the lowest rating, while 5 represents the highest rating in the questionnaire.

General descriptive data regarding the characteristics of questionnaire results for best (North America) and worst ranked (Latin America) regions in the field of business performances is showcased in table 4, following information regarding number of the non-missing values, mean, median, minimum and maximum values, range, standard deviation, and coefficient of variation. The results of descriptive statistical analysis confirm the larger dataset regarding the North America region (Valid N - 180) than Latin American region (Valid N - 60). The results of the descriptive statistical analysis (Table 4) indicate differences in variability between the two datasets. The coefficient of variation (CV) for variable North America is estimated at the value of 27.52%. Variable regarding the Latin American region shows a coefficient of variation of 30.48%, slightly exceeding the 30%, which suggests a higher level of variability among respondents. In analysis that consist Likert scale datasets, the coefficient of variation values is used to determine which type of tests are suitable to perform: when the coefficient of variation exceeds 30% for even one variable in the analysis, the application of nonparametric tests is considered adequate. For the further course of statistical analysis, the Mann-Whitney U test will be used in order to examine possible differences between the chosen groups.

Table 4 The results of descriptive statistical analysis – business performance

Variable	Descriptive statistical analysis							
	Valid N	Mean	Median	Minimum	Maximum	Range	SD	CV (%)
North America	180	3.439	4.000	1.000	5.000	4.000	0.946	27.520716
Latin America	60	2.583	3.000	1.000	5.000	4.000	0.787	30.481419

The results of the Mann-Whitney U test (Table 5) indicate a statistically significant difference between North America and Latin America datasets regarding business performances in these regions, concluded on the fact that the p-value obtained the value 0, which suggests the rejection of the null hypothesis ($p<0.05$). This result shows that the values

of Latin America are lower than North America, which has previously been assessed by the AHP method in the previous segment of the paper.

Table 5 Mann-Whitney U test results – business performances

Rank Sum (North America)	**Rank Sum (Latin America)**	**U**	**Z***	**p-value**
24588.50	4331.500	2501.500	6.222553	0.000000

With the goal of identifying the possible source of the significant differences observed between the North America and Latin America, another statistical analysis is conducted, related to the datasets involving organizational culture that are obtained from the questionnaire. The new hypothesis states that the identified differences may be linked to variations in organizational cultures in the two observed regions.

The results conducted by the descriptive statistical analysis (Table 6) are regarding the organizational culture of the two analysed regions. Both datasets show lower levels of homogeneity, which are indicated by the values of the coefficient of variation, 35.74% (North America) and 39.07% (Latin America).

Both variables exhibit CV values above 30%, indicating high variability and suggests non-normal data distribution. This is further supported by the large sample size and the use of a Likert scale in the questionnaire. Therefore, non-parametric methods are appropriate, and the Mann-Whitney U test is be applied.

Table 6 The results descriptive statistical analysis - organizational culture

Variable	Descriptive statistical analysis							
	Valid N	Mean	Median	Minimum	Maximum	Range	SD	CV (%)
North America	360	3.200000	3.000000	1.000000	5.000000	4.000000	1.143712	35.74101
Latin America	120	2.691667	3.000000	1.000000	5.000000	4.000000	1.051576	39.06784

The results of the Mann-Whitney U test in terms of analysing the organizational culture datasets (Table 7) indicate a statistically significant difference between North America and Latin America regions ($0.000020<0.05$).

This concludes there is a definite difference between the two groups in terms of their organizational cultures. The results indicate that the overall score of Northern American region is higher that the Latin American region ($92199.00>23241.00$).

Within the competing values framework proposed by Cameron and Quinn (2011), these differences may reflect a stronger orientation toward hierarchy and internal control in North American organizations, compared to a more clan - or adhocracy- oriented culture in Latin America, with direct implications for supply chain coordination and performance consistency.

Table 7 The results of the Mann-Whitney U test - organizational culture

Rank Sum (North America)	Rank Sum (Latin America)	U	Z*	p-value
92199.00	23241.00	15981.00	4.269692	0.000020

5. CONCLUSION

This study contributes to the benchmarking literature by providing a systematic, AHP and non-parametric statistical analysis based regional comparison of business performance across 46 railway supply chain organizations spanning 24 countries and 7 geographical regions.

The first objective was to identify which region achieves the strongest and which the weakest business performance based on questionnaire data. The AHP analysis, consistently ranked North America as the highest-performing region, with scores of 0.179 and 0.178 respectively, while Latin America ranked lowest in both cases, with scores of 0.117 and 0.116. The stability of rankings across both AHP cases confirms the robustness of the model and the reliability of the observed regional differentiation.

The second objective was to investigate the possible source of Latin America's underperformance relative to the highest-ranked region. The Mann-Whitney U test confirmed a statistically significant difference between North America and Latin America in business performance, corroborating the AHP findings through an independent statistical method. A subsequent analysis of organizational culture data revealed a statistically significant difference between the two regions in this domain as well, with North America consistently scoring higher. These findings suggest that organizational culture may be a contributing factor to the observed business performance gap, consistent with the theoretical framework established by Tomic et al. (2017), who demonstrated that organizational culture significantly predicts supply chain business performance outcomes. However, it is important to note that the present study establishes association rather than causation, namely, the relationship between organizational culture and business performance identified here warrants further investigation through longitudinal or interventional research designs.

The findings of this paper provide a methodological template and empirical starting point for future research aimed at improving underperforming business practices in railway supply chain organizations. Practical implications point toward the need for targeted organizational culture development initiatives in Latino American operations, particularly in areas of internal integration, communication norms, and alignment with supply chain partner expectations.

Nevertheless, this research is subject to several limitations. The relatively small sample size, with some regions represented by as few as two organizations, limits the generalizability of the findings. The cross-sectional design precludes causal inference, and the derivation of AHP pairwise comparisons from questionnaire data rather than expert judgment introduces a degree of subjectivity that future studies could address through structured expert elicitation. Additionally, since all data originate from organizations operating within the supply chain of a single multinational manufacturer, the findings may reflect that company's specific organizational culture and partner selection criteria rather than broader regional patterns, which limits external validity. The authors recommend replication with a larger and more balanced regional dataset, as well as the inclusion of additional explanatory variables, such as institutional environment, regulatory framework, and supply chain integration levels, to more fully account for observed regional performance differences.

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REFERENCES

Anwar, U. A. A., Rahayu, A., Wibowo, L. A., Sultan, M. A., Aspiranti, T., Furqon, C., & Rani, A. M. (2025). Supply chain integration as the implementation of strategic management in improving business performance. *Discover Sustainability*, *6*(1), 101. https://doi.org/10.1007/s43621-025-00867-w

Cameron, K. S., & Quinn, R. E. (2011). Diagnosing and changing organizational culture: Based on the competing values framework (3rd ed.). John Wiley & Sons.

Dattakumar, R., & Jagadeesh, R. (2003). A review of literature on benchmarking. *Benchmarking: An International Journal*, *10*(3), 176-209. https://doi.org/10.1108/14635770310477744

Esposito, E., & Passaro, R. (2009). Evolution of the supply chain in the Italian railway industry. *Supply Chain Management: An International Journal*, *14*(4), 303-313. https://doi.org/10.1108/13598540910970135

Fu, Q., Abdul Rahman, A. A., Jiang, H., Abbas, J., & Comite, U. (2022). Sustainable supply chain and business performance: The impact of strategy, network design, information systems, and organizational structure. *Sustainability*, *14*(3), 1080. https://doi.org/10.3390/su14031080

Gaudenzi, B., & Borghesi, A. (2006). Managing risks in the supply chain using the AHP method. *The International Journal of Logistics Management*, *17*(1), 114–136. https://doi.org/10.1108/09574090610663464

Gholamizadeh, K., Zarei, E., & Yazdi, M. (2024). Railway transport and its role in the supply chains: Overview, concerns, and future direction. In *The Palgrave Handbook of Supply Chain Management* (pp. 769–796). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-19884-7_95

Gimenez, C., & Ventura, E. (2005). Logistics-production, logistics-marketing and external integration: their impact on performance. *International journal of operations & Production Management*, *25*(1), 20-38. https://doi.org/10.1108/01443570510572222

Habib, M., Abbas, J., & Noman, R. (2019). Are human capital, intellectual property rights, and research and development expenditures really important for total factor productivity? An empirical analysis. *International Journal of Social Economics*, *46*(6), 756–774. https://doi.org/10.1108/IJSE-09-2018-0472

Hajiaghaei-Keshteli, M., Aminnayeri, M., & Fatemi Ghomi, S. M. T. (2014). Integrated scheduling of production and rail transportation. *Computers & Industrial Engineering*, *74*, 240–256. https://doi.org/10.1016/j.cie.2014.05.026

Kumar, M., & Agarwal, A. (2024). Application of AHP and TOPSIS for the evaluation of Indian railway supply chain parameters. (2024). *Indian Journal of Engineering and Materials Sciences*, *31*(02). https://doi.org/10.56042/ijems.v31i2.2109

Kumar, M., Vipin, Agarwal, A., Goyal, A., & Gupta, S. (2025). Unlocking the barriers to supply chain management in rail transport: A modified-total interpretive structural modelling (M-tism) approach. *Journal of Infrastructure Preservation and Resilience*, *6*(1), 29. https://doi.org/10.1186/s43065-025-00146-y

Lee, J., & Roh, J. J. (2012). Assessing global supply chains: Perspectives on performance measures across leading countries. *International Journal of Business Excellence*, *5*(5), 554. https://doi.org/10.1504/IJBEX.2012.048803

Nogueira, E., Gomes, S., & Lopes, J. M. (2025). Unveiling triple bottom line's influence on business performance. *Discover Sustainability*, *6*(1), 43. https://doi.org/10.1007/s43621-025-00804-x

Pennekamp, J., Matzutt, R., Klinkmüller, C., Bader, L., Serror, M., Wagner, E., Malik, S., Spiß, M., Rahn, J., Gürpinar, T., Vlad, E., Leemans, S. J. J., Kanhere, S. S., Stich, V., & Wehrle, K. (2023). *An interdisciplinary survey on information flows in supply chains* (arXiv:2401.01022). arXiv. https://doi.org/10.48550/arXiv.2401.01022

Peng Wong, W., & Yew Wong, K. (2008). A review on benchmarking of supply chain performance measures. *Benchmarking: An international journal*, *15*(1), 25-51. https://doi.org/10.1108/14635770810854335

Pyrgidis, C. N. (2021). *Railway transportation systems: design, construction and operation*. CRC press.

Sadikoglu, E., & Zehir, C. (2010). Investigating the effects of innovation and employee performance on the relationship between total quality management practices and firm performance: An empirical study of Turkish firms. *International Journal of Production Economics*, *127*(1), 13–26. https://doi.org/10.1016/j.ijpe.2010.02.013

Spasojević-Brkić, V., Đurđević, T., Omić, S., Klarin, M., & Dondur, N. (2012). An empirical examination of quality tools impact on financial performances: Evidence from Serbia. *Serbian Journal of Management*, *7*(1), 77–87. https://doi.org/10.5937/sjm1201077S

Spasojević Brkić, V. K., Djurdjević, T., Dondur, N., Klarin, M. M., & Tomić, B. (2013). An empirical examination of the impact of quality tools application on business performance: Evidence from Serbia. *Total Quality Management & Business Excellence*, *24*(5–6), 607–618. https://doi.org/10.1080/14783363.2012.677306

Spasojević Brkić, V., Tomić, B., Perišić, M., & Janev, N. (2023). Differences in Kaizen implementation between countries and industry types in multinational supply chain. *FME Transactions*, *51*(2), 183-191. http://dx.doi.org/10.5937/fme2302183S

Stevens, G. C. (1989). Integrating the supply chain. *International Journal of Physical Distribution & Materials Management*, *19*(8), 3–8. https://doi.org/10.1108/EUM0000000000329

Terchila, S. (2025). The future of entrepreneurship: strategic approaches for business adaptation in a changing global environment. From risks to opportunities. *Studies in Business and Economics*, *20*(1), 263-280. https://doi.org/10.2478/sbe-2025-0015

Tomic, B., Spasojević Brkić, V., Karapetrovic, S., Pokrajac, S., Milanović, D. D., Babić, B., & Djurdjevic, T. (2017). Organizational culture, quality improvement tools and methodologies, and business performance of a supply chain. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, *231*(13), 2430–2442. https://doi.org/10.1177/0954405416629100

Vachon, S., & Mao, Z. (2008). Linking supply chain strength to sustainable development: A country-level analysis. *Journal of Cleaner Production*, *16*(15), 1552–1560. https://doi.org/10.1016/j.jclepro.2008.04.012

Wang, L. (2024). Efficient green supply chain management for transit manufacturing enterprises integrating AHP, K-NN, and MILP in the context of sustainable development. *IEEE Access*, *12*, 36680–36701. https://doi.org/10.1109/ACCESS.2024.3372012

Yusuf, Y. Y., Gunasekaran, A., Musa, A., Dauda, M., El-Berishy, N. M., & Cang, S. (2014). A relational study of supply chain agility, competitiveness and business performance in the oil and gas industry. *International Journal of Production Economics*, *147*, 531–543. https://doi.org/10.1016/j.ijpe.2012.10.009

Zhu, Q., Sarkis, J., & Lai, K. (2013). Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of*

Purchasing and Supply Management, *19*(2), 106–117. https://doi.org/10.1016/j.pursup.2012.12.001