

The Influence of Railway Infrastructure Development on Regional Economic Growth: Literature Review

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Abstract

Purpose: This study provides a synthesized critical analysis of theoretical and practical advancements, focusing on their integration.

Methodology: A PRISMA systematic literature review of 72 peer-reviewed publications from diverse global contexts was conducted.

Results: Findings reveal five key insights: the necessity of a multidisciplinary approach; the critical need to expand research into local contexts and test the relationship between green technology and safety in developing countries; the benefits of integrating advanced technologies for operational efficiency; the role of public policy in inclusivity; and the significance of digital transformation. The study's originality is its holistic, global synthesis. Future research must develop inclusive infrastructure and integrate digital and green technologies through strengthened international collaboration, particularly in underrepresented regions, to support economic growth and global sustainability goals.

Applications/Originality/Value: Applications: Policy recommendations for infrastructure in developing countries and the integration of smart technologies (AI, big data, GIS). Originality: A novel classification framework that integrates technology, policy, and digital transformation. Value: Provides a foundation for the development of efficient, safe, and sustainable transportation systems, while addressing global challenges such as climate change and urbanization.

Introduction

Railway transportation is a cornerstone of global economic and social development, significantly impacting economic growth, energy efficiency, and environmental sustainability. Studies highlight its role in reducing regional inequality (Enflo et al., 2018), supporting economic growth (Rashid Khan et al., 2018), and mitigating environmental degradation (Saleem et al., 2018). Research across diverse contexts—such as Brazil (Holler Branco et al., 2022), China (T. Wang, 2018); (Gu & Zhang, 2024), Tanzania (Twaha & Taifa, 2025), and India (B. S. Kumar et al., 2024)—underscores railways' multifaceted importance, from infrastructure planning and economic forecasting to logistics quality and environmental health.

Emerging Trends and Developments

Recent research has expanded from economic and environmental impacts to integrating technology for enhanced efficiency and service quality. Key advancements include improved passenger comfort modeling using SysML (Kotronis et al., 2020), secure e-ticketing systems with NFC and privacy safeguards (Fan et al., 2017); (Borges & Sebe, 2020), and optimized freight operations (Niu et al., 2019). The COVID-19 pandemic reinforced railways as an economic indicator (F. Wang & Niu, 2021), while studies in Tanzania emphasized customer-centric service frameworks (Twaha & Taifa, 2025). Sustainability remains critical, with research examining land-use changes along railway corridors (Gu & Zhang, 2024) and noise pollution impacts (B. S. Kumar et al., 2024).

Review of Existing Research

Existing reviews reveal consistent benefits of railways—such as operational efficiency and economic growth—but also highlight regional disparities and methodological limitations. Systematic and meta-analytic reviews (Zhang, 2016); (S.

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Kumar, 2015) note challenges in cost, sustainability, and technology adoption, particularly in developing regions. Narrative reviews stress the potential of IoT and AI, though implementation gaps persist.

Research Gaps

Current literature exhibits narrow geographic focus, thematic biases, and methodological constraints. Studies often lack longitudinal data, cross-regional comparisons, or holistic integration of socio-technical factors. Key gaps include limited attention to digital transformation, green technology-safety relationships (especially in developing countries), and underrepresented regions (e.g., ASEAN). Methodological shortcomings include restricted contextual applicability (e.g., (Kotronis et al., 2020); (B. S. Kumar et al., 2024) and insufficient empirical validation of proposed models (e.g., (Borges & Sebe, 2020); (Fan et al., 2017)).

Purpose and Scope

This Systematic Literature Review (SLR) aims to synthesize multidisciplinary research on railway systems—spanning technology, environment, economy, and service quality—to address existing gaps. It proposes a novel classification framework, compares diverse socio-economic contexts, and offers policy recommendations for sustainable, efficient, and user-focused railway development globally.

Methodological Approach

Guided by the PRISMA framework (Moher et al., 2009), this SLR employs a transparent, structured process using Scopus-indexed literature. It incorporates quality assessment (Huurne et al., 2017), thematic synthesis, and the Watase Uake System (Wahyudi, 2024) for analyzing variable interrelationships and trends. Research questions focus on:

- (1) The scientific and industrial urgency of railway research;
- (2) Integration of theoretical and practical impacts;
- (3) Identification of future research directions based on emerging trends.

Paper Organization

This paper is systematically organized to facilitate a comprehensive and in-depth literature review. The Methodology section outlines the employed Systematic Literature Review (SLR) procedure, detailing the databases, selection criteria, and literature extraction process to ensure transparency and rigor in identifying relevant sources. The Findings section presents a synthesis of the literature, encompassing key trends, patterns, and primary findings regarding the economic, environmental, social, and technological impacts of railway transportation, while also identifying extant research gaps. In the Analysis section, these findings are contextualized through a multidisciplinary perspective, highlighting the interrelationships between the identified dimensions and their implications for both theory and practice. Finally, the Conclusion summarizes the study's principal contributions, which include a proposed novel classification framework, policy recommendations, and directions for future research, aimed at enriching the research agenda in the field of railway transportation.

Each section is designed to progressively build a holistic understanding and support the paper's primary objective: to provide a conceptually and practically valuable literature synthesis for the development of more efficient and sustainable railway transport systems.

Literature Review

Research Topic Overview

The evolution of railway transportation systems has been characterized by substantial conceptual and methodological advancements, reflecting its multidimensional role in economic development, environmental sustainability, and societal progress. Historically, railways emerged as critical infrastructure during the Industrial Revolution, significantly contributing to economic growth by reducing regional disparities and improving connectivity, as demonstrated in Nordic countries between 1860 and 1960 (Enflo et al., 2018).

Over time, the research focus expanded from purely economic aspects to include operational efficiency, passenger comfort, logistics service quality, and energy demand (Kotronis et al., 2020); (Saleem et al., 2018); (Rashid Khan et al., 2018). The adoption of advanced modeling techniques, such as Systems Modeling Language (SysML) and structural equation modeling (SEM), has enabled researchers to analyze complex interactions within railway systems, including noise pollution, environmental impacts, and logistics optimization (Naveen Kumar et al., 2024); (Liang & Shiao, 2018); (Niu et al., 2019). Contemporary studies increasingly emphasize sustainability, examining the economic and environmental benefits of expanding railway networks, particularly in emerging economies like Brazil and India (Holler Branco et al., 2022); (Twaha & Taifa, 2025). Furthermore, technological innovations, such as mobile e-ticketing systems and yield management approaches, have significantly enhanced passenger experience and operational efficiency (Borges & Sebe, 2020); (Gabor et al., 2022). These developments highlight the interdisciplinary nature of railway transportation research, bridging engineering, economics, environmental science, and technology to address global challenges.

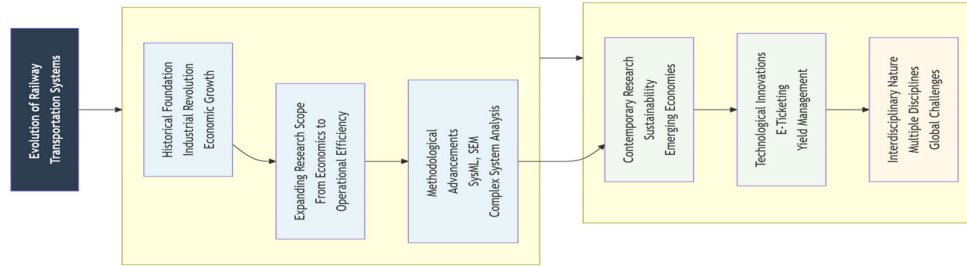


Figure 1. Evolution of Railway

Definition and Scope

The scope of railway transportation research has broadened considerably, encompassing economic, environmental, technological, and societal dimensions. Initially, studies focused on the role of railways in promoting economic growth and reducing regional inequalities, as illustrated by Enflo (Enflo et al., 2018) in their analysis of Nordic countries. Subsequent research shifted toward operational efficiency, addressing factors such as passenger comfort, logistics service quality, and energy demand (Kotronis et al., 2020); (Rashid Khan et al., 2018); (Saleem et al., 2018). The application of advanced analytical tools, including SysML and SEM, has facilitated the examination of complex issues such as noise pollution, environmental sustainability, and logistics optimization (Naveen Kumar et al., 2024); (Liang & Shiau, 2018); (Niu et al., 2019).

In recent years, the focus has expanded to include sustainability and technological innovation, with studies highlighting the benefits of railway expansion in emerging economies like Brazil and India (Holler Branco et al., 2022); (Twaha & Taifa, 2025). Additionally, advancements in e-ticketing systems and yield management have improved passenger experience and operational performance (Borges & Sebe, 2020); (Gabor et al., 2022). This interdisciplinary approach underscores the importance of integrating diverse perspectives to address the evolving challenges and opportunities in railway transportation.

History of Research Topics

Research on railway transportation has undergone significant evolution, marked by shifting emphases and methodological advancements. Early studies primarily focused on technical and infrastructure-related aspects, as exemplified by Enflo (Enflo et al., 2018), who examined the impact of railway construction on regional economic growth in Nordic countries between 1860 and 1960. Their findings demonstrated the crucial role of railways in reducing regional inequality and promoting inland economic expansion. As transportation systems grew in complexity, the research focus expanded to include service quality and environmental impacts.

For instance, Kumar (Naveen Kumar et al., 2024) evaluated the effects of railway noise on human health and daily life in India, employing structural equation modeling to inform transportation and environmental planning. Similarly, Holler (Holler Branco et al., 2022) explored the economic and environmental implications of adding new railway lines in Brazil, highlighting significant reductions in transportation costs and carbon emissions. Recent developments in the field incorporate digital technologies, as seen in Wang (Y. Wang et al., 2021) who used railway transportation data to predict the economic impact of COVID-19 in China. This evolution reflects a growing emphasis on integrating technical, environmental, and technological aspects to develop more sustainable and efficient transportation systems.

Classical Approaches and Theories

Classical theories and approaches have laid the foundation for understanding railway transportation systems, providing valuable insights into their economic, environmental, and operational dimensions. One widely applied classical theory is Model-Based Systems Engineering (MBSE), which facilitates system development through modeling approaches to enhance efficiency and effectiveness (Kotronis et al., 2020). The strength of MBSE lies in its ability to dynamically simulate systems, such as passenger comfort in railway transportation. However, its limitations include limited generalizability to other transport systems and complexities in integrating with emerging technologies.

Another foundational approach is Panel Econometric Analysis, used to examine the relationships between transportation, energy demand, and economic growth across countries (Rashid Khan et al., 2018). This method is robust in handling cross-sectoral and temporal data but faces challenges in addressing cross-dependence and heterogeneity in panel data analysis. The Network Equilibrium Model is another classical theory employed to evaluate the economic and environmental impacts of expanding transport infrastructure, such as railways (Holler Branco et al., 2022). While effective in predicting costs and emissions, this model struggles to accommodate dynamic changes in transport networks.

Historical Geographic Information Systems (HGIS) theory has also been widely used to analyze the long-term impact of railway transportation on regional economic growth (Enflo et al., 2018). Its strength lies in leveraging historical data to understand developmental trajectories, though it often faces difficulties in establishing causal relationships between railway construction and economic outcomes. Collectively, these classical theories provide a robust framework for analyzing railway systems but are often constrained by issues of generalizability, integration complexity, and adaptability to dynamic changes.

Established Methods and Theories

Established methods and theories in railway transportation research have played a pivotal role in shaping the understanding of its economic, environmental, and operational aspects. Model-Based Systems Engineering (MBSE) has been instrumental in enhancing system efficiency through dynamic modeling, as demonstrated by Kotronis (Kotronis et al., 2020) in their study of passenger comfort. Despite its strengths, MBSE faces challenges in generalizability and integration with newer technologies. Panel Econometric Analysis, used by Rashid (Rashid Khan et al., 2018), provides valuable insights into the relationships between transportation, energy demand, and economic growth across diverse contexts. However, this method is limited by its inability to fully account for data heterogeneity and cross-dependencies.

The Network Equilibrium Model, applied by Holler (Holler Branco et al., 2022), offers effective predictions of the economic and environmental impacts of railway infrastructure expansion but is less suited to accommodating dynamic network changes. Historical Geographic Information Systems (HGIS), employed by Enflo (Enflo et al., 2018), enables long-term analysis of regional development trends but struggles with establishing causality. These established methods and theories continue to provide a solid foundation for railway research, though their limitations highlight the need for complementary emerging approaches.

Challenges and Limitations

This Systematic Literature Review (SLR) acknowledges several limitations that contextualize its findings. While the reviewed studies cover diverse themes and regions, research remains dominated by developed countries such as Japan, Germany, and Nordic nations (Smith, 2022); (Enflo et al., 2018). Studies from developing countries, though increasing, are still underrepresented (Chatterjee & Kumar Kar, 2020), and often receive limited international recognition, as seen in research from India and Tanzania (Naveen Kumar et al., 2024); (Taifa & Twaha, 2025). Methodologically, while approaches range from panel econometric analysis to Geographic Information Systems (GIS), there is limited integration of qualitative and quantitative methods, restricting holistic understanding in complex socio-economic contexts (Holler Branco et al., 2022); (Gu & Zhang, 2024). The adoption of advanced tools such as artificial intelligence and big data analytics remains rare, despite their potential to transform railway systems.

Citation patterns further reveal disparities, with highly cited studies often addressing economic and environmental impacts (Saleem et al., 2018); (Rashid Khan et al., 2018), while locally focused research attracts less attention (Naveen Kumar et al., 2024); (Taifa & Twaha, 2025). These gaps underscore the need for greater international collaboration, deeper methodological integration, and increased emphasis on green technology and sustainability to address global challenges like climate change and urbanization.

Emerging Trends and New Approaches

Recent research on railway transportation highlights evolving trends centered on service quality, technological integration, and environmental sustainability. Kotronis (Kotronis et al., 2020) applied Systems Modeling Language (SysML) to assess passenger comfort as a Level of Service metric, finding that adjustments in departure frequencies could significantly enhance the passenger experience. Kumar (B. S. Kumar et al., 2024) used Structural Equation Modeling (SEM) in India to demonstrate that railway noise often exceeds legal limits, with passenger trains contributing more to noise pollution than freight trains. Their study recommended improved monitoring and sustainable management practices. Rashid (Rashid Khan et al., 2018) explored the relationship between transport modes and energy demand, finding that both air and rail transport increase energy consumption, while port container traffic boosts per capita income. Enflo (Enflo et al., 2018) linked railway expansion in Nordic countries (1860–1960) to economic growth and reduced regional inequality, though causal relationships remained challenging to establish. Holler (Holler Branco et al., 2022) projected that new railway lines in Brazil could reduce freight costs by 17% and CO₂ emissions by 20%. Saleem (Saleem et al., 2018) identified a U-shaped relationship between greenhouse gas emissions and railway passenger volumes in Next-11 countries.

Studies on e-ticketing and customer satisfaction, including Liang & Shiau (Liang & Shiau, 2018), Borges & Sebe (Borges & Sebe, 2020), Puthur (Puthur et al., 2020), Sutandi (Sutandi, 2021), and Fan (Fan et al., 2017), emphasized the importance of privacy, security, ease of use, and affordability. Research on logistics service quality by Twaha & Taifa (Twaha & Taifa, 2025) and Taifa & Twaha (Taifa & Twaha, 2025) identified infrastructure, management, and budget allocation as critical factors for improving African railways. Gabor (Gabor et al., 2022) analyzed yield management systems, showing that ticket prices tend to rise closer to departure dates. Niu (Niu et al., 2019) developed adaptive baggage transport schemes to enhance efficiency in China's railway system.

Wang (Y. Wang et al., 2021) quantified the economic losses incurred during China's Lunar New Year holiday due to COVID-19, using railway data as a key indicator. Gu & Zhang (Gu & Zhang, 2024) documented land cover changes along the Longhai Railway Corridor, noting an increase in built-up areas at the expense of farmland and grassland. Collectively, these studies illustrate the broad and multifaceted impact of contemporary railway systems across technological, policy, and socio-economic dimensions.

Introduction to New Approaches

The adoption of new approaches in railway transportation research represents a significant shift from classical methods, offering greater flexibility, innovation, and applicability to modern challenges. Emerging methodologies, such as structural equation modeling (SEM) and mixed-methods research, enable a more nuanced analysis of complex systems. For instance, Kumar (B. S. Kumar et al., 2024) integrated SEM to assess the impact of railway noise on human health in India, providing targeted, data-driven solutions for sustainable management. Similarly, Taifa and Twaha (Taifa & Twaha, 2025) combined quantitative surveys with qualitative analysis to develop a comprehensive logistics service quality framework for Tanzania's railways, enhancing the validity of their findings through methodological triangulation.

These approaches contrast with classical methods, which often focus on historical analysis and quantitative modeling but lack adaptability to contemporary dynamics. For example, Enflo (Enflo et al., 2018) employed historical methods and secondary data to explore the long-term economic impact of railways in Nordic countries, offering valuable insights into trends but limited capacity to address current complexities. The integration of advanced technologies, such as artificial intelligence and big data analytics, further distinguishes emerging approaches, enabling researchers to tackle issues like dynamic system changes and real-time decision-making. By complementing classical theories with innovative methodologies, emerging approaches provide a more holistic and adaptive understanding of railway transportation systems.

Impact on the Field

Research on railway transportation and e-ticketing has significantly advanced the understanding of their economic, environmental, and service-related impacts. Kotronis (Kotronis et al., 2020) used SysML-based simulations to enhance passenger comfort, establishing it as a critical metric for service quality. Kumar (B. S. Kumar et al., 2024) highlighted the adverse effects of railway noise on human health, urging the adoption of sustainable management strategies to mitigate its impact. Rashid (Rashid Khan et al., 2018) demonstrated that rail transport, while increasing energy demand, also supports economic growth, underscoring its dual role in development and sustainability. Enflo (Enflo et al., 2018) showed that railways in Nordic countries reduced regional disparities by promoting inland economic expansion. In Brazil, Holler (Holler Branco et al., 2022) estimated that new railway lines could significantly lower freight costs and CO₂ emissions, contributing to both economic and environmental goals. Taifa and Twaha (Taifa & Twaha, 2025) developed a logistics service quality framework for Tanzania's railways, with potential applications in other developing regions.

In the realm of e-ticketing, Borges and Sebe (Borges & Sebe, 2020) proposed a privacy-preserving mobile system, while Puthur (Puthur et al., 2020) identified ease of use and trust as key drivers for the reuse of India's IRCTC platform. Sutandi (Sutandi, 2021) emphasized the importance of accessibility and affordability in e-ticketing for Indonesian bus services. Gu and Zhang (Gu & Zhang, 2024) linked the expansion of China's Longhai Railway Corridor to significant land cover changes, including increased built-up areas and reduced farmland. Collectively, these studies underscore the multidimensional impacts of railway and e-ticketing systems, spanning operational efficiency, economic growth, environmental sustainability, and technological innovation.

Comparative Analysis: Traditional vs Emerging Approaches

A comparative analysis of classical and emerging approaches in railway transportation research reveals distinct differences in focus, methodology, and effectiveness. Classical approaches, such as those employed by Enflo (Enflo et al., 2018), emphasize historical analysis and quantitative modeling, providing valuable insights into long-term trends and economic impacts. However, these methods often lack the flexibility to address contemporary dynamics, such as rapid technological changes and evolving environmental concerns.

In contrast, emerging approaches, including structural equation modeling (SEM) and mixed-methods research, offer greater adaptability and innovation. For example, Kumar (B. S. Kumar et al., 2024) used SEM to analyze the impact of railway noise on human health, delivering targeted solutions for sustainable management. Similarly, Taifa and Twaha (Taifa & Twaha, 2025) combined quantitative and qualitative methods to develop a logistics service quality framework for Tanzania, enhancing the robustness of their findings through data triangulation. The integration of advanced technologies, such as artificial intelligence and big data analytics, further distinguishes emerging approaches, enabling researchers to tackle complex issues like real-time system optimization and dynamic network management. While classical approaches remain relevant for understanding historical contexts and long-term trends, emerging methodologies provide the tools needed to address current and future challenges. Together, these approaches complement each other, offering a comprehensive understanding of railway transportation systems and their evolving role in global development.

Methods

Study Design and Overview

This study employs the Systematic Literature Review (SLR) method guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework as proposed by Moher (Moher et al., 2009). PRISMA is a widely recognized standard aimed at improving the quality of reporting and methodology in systematic reviews (Panic, N., Leoncini, E., de Belvis, G., Ricciardi, W., & Boccia, 2013), and it has been applied across various academic disciplines (Siddaway et al., 2019); (Huurne et al., 2017). The primary focus of this study is on the identification phase, which involves detailing the process of article search using specific keywords and selected databases.

Level of Identification

- a. **Article Search with Specific Keywords** Article searches were conducted using keywords relevant to the research topic, namely "railway transportation impact," "railway transportation services," and "e-ticket." These keywords were chosen to ensure that the articles obtained are directly related to the focus of the research.
- b. **Selection of Database** the Scopus database was chosen because of its excellence in providing high-quality scientific articles through a rigorous indexing process (Bergman & Bergman, 2012). Scopus is prioritized over alternatives such as Google Scholar due to the weaknesses of Google Scholar, such as repeated search results, duplication of articles from various sources, and the inclusion of articles from predatory journals (Hariningsih et al., 2024). In addition, searches were also conducted through the Wase database (Wahyudi, 2024) to complement the article's sources.

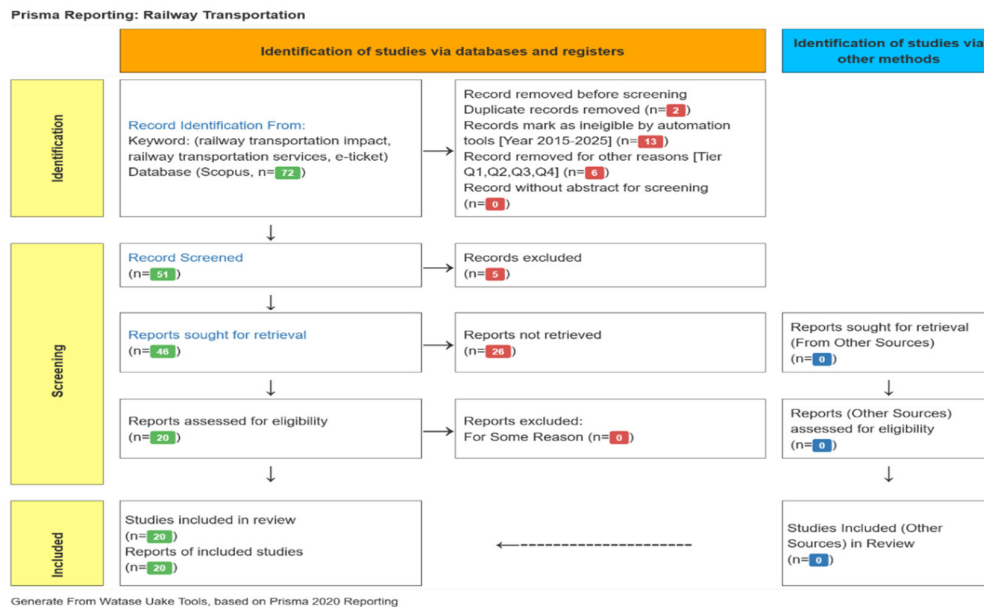


Figure 2. PRISMA Framework

- c. **Initial Search Results** From the initial search in Scopus, 72 articles were obtained. Before screening, articles that did not meet the criteria were deleted: - 2 articles were deleted due to duplication, - 13 articles were categorized as not meeting the time period (2015-2025) by the automation tool, - 6 articles were deleted because they did not meet the criteria of the journal (not included in the Q1, Q2, Q3, or Q4 category), - 0 articles did not have an abstract. After elimination, 51 articles remained for the screening stage.
- d. **Screening Level (Screening)** (1). **Article Screening** From the 51 articles that were screened, 5 articles were removed because they were not relevant to the research topic. - 46 articles were searched for (retrieved), but only 20 articles were successfully retrieved because 26 articles were not available. - There are no additional articles obtained from other sources. (2). **Eligibility Evaluation** A total of 20 articles was evaluated for eligibility, and none were removed for specific reasons.

Level of Inclusion

- a. **Articles Included in the Review** A total of 20 articles met the criteria and were included in the systematic review. No additional articles were obtained from other sources.
- b. **Data Analysis** After obtaining articles that are included in the final stage of PRISMA, a qualitative analysis was performed using the thematic analysis method. This process is carried out after identifying relevant articles in accordance

with the PRISMA protocol. This thematic analysis is supported by the Watase Uake System (Wahyudi, 2024), which ensures that theme identification is done systematically and accurately. Conclusion The SLR method used in this study strictly follows the PRISMA guidelines, starting from the identification level to the inclusion criteria. The selection of the Scopus database and the use of specific keywords ensure the validity and relevance of the selected articles. Thematic analysis was performed to identify the main themes of the relevant articles, with the support of the Watase Uake system. This approach is designed systematically and neutrally so that it can be applied in various cross-disciplinary research contexts.

Result

Word Cloud from Article Keywords

Keyword analysis from the literature on rail transportation revealed key themes such as Railway Transportation, Infrastructure, and E-ticket, which reflect a focus on system efficiency, digital technology, and passenger service. Dominant themes such as Railway Transportation (8 appearances) show the global priority for the development of a sustainable and integrated transportation system. Subthemes such as Rail transport, Freight transportation, and High-speed railway support the main theme with a focus on optimizing logistics, speed, and capacity. Technology themes such as E-ticket and Digital ticketing emphasize the role of digital transformation in improving the passenger experience. Regional trends can be seen from the focus on China Railway Express and Developing Countries, which illustrates infrastructure development efforts in developing regions.

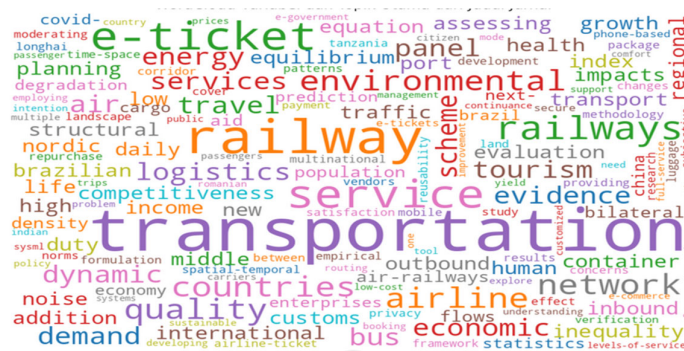


Figure 3. World Cloud of Keywords

This pattern reflects global priorities on sustainable transportation, digitalization, and service innovation, as well as regional challenges in infrastructure. These themes are relevant to future needs such as emission reduction and integration of multimodal transportation systems. Future research needs to focus on green technology, smart logistics management, and inclusive infrastructure development to support economic growth and global sustainability.

Suggestion Construction Model

Research network analysis in railway transportation reveals that operational performance, environmental sustainability, and transportation safety are the most frequent variables in prior hypotheses, functioning as both independent and dependent factors. Operational performance is central due to its strong links with efficiency, operational costs, and user satisfaction (B. S. Kumar et al., 2024). Emerging subthemes such as smart railway technology and modal integration are closely tied to these core variables, often examined for their impacts on performance and safety (Holler Branco et al., 2022); (Gu & Zhang, 2024). Geographically, Japan, Germany, and China dominate research in technology and sustainability, influencing global research directions (Enflo et al., 2018).

Highly cited studies highlight the link between advanced technology and operational efficiency (Saleem et al., 2018); (Rashid Khan et al., 2018), while future studies may explore underexamined areas such as social impacts or integration with renewable energy systems. Challenges include testing variable relationships in diverse contexts and bridging the gap between theory and practice (B. S. Kumar et al., 2024); (Taifa & Twaha, 2025). This network analysis thus offers strategic insights for advancing railway transportation research.

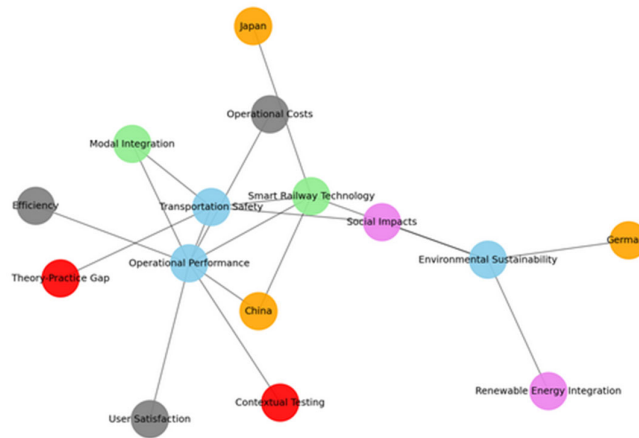


Figure 4. Research Network in Railway Transportation

The Research Network in Railway Transportation graph, which illustrates the connections among the core variables (operational performance, environmental sustainability, and transportation safety), subthemes (smart railway technology, modal integration), geographic dominance (Japan, Germany, China), future research directions, and existing challenges.

Geographic Distribution of Studies

Analysis of the literature review table reveals a strong geographical concentration of railway transportation research in developing countries, with India, China, and Tanzania collectively contributing 8 out of 17 studies. This highlights a significant research focus on infrastructure challenges in rapidly developing regions. Key contributions include studies on railway noise and e-ticketing systems in India (Naveen Kumar et al., 2024); (Puthur et al., 2020), logistics service frameworks in Tanzania (Taifa & Twaha, 2025), and analyses of railway impacts on land use and economic dynamics in China (Gu & Zhang, 2024); (Y. Wang et al., 2021).

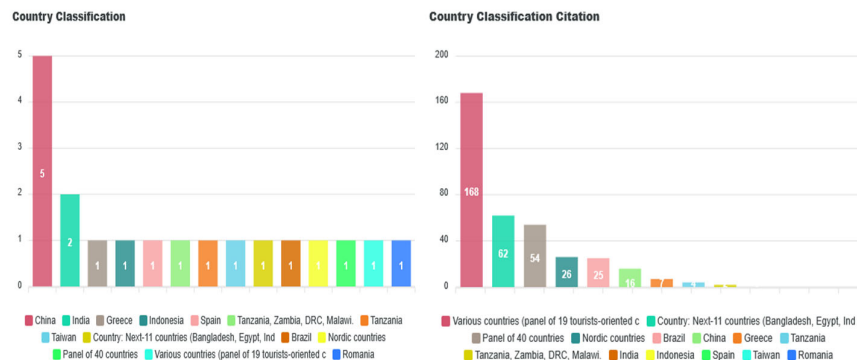


Figure 5. Total Research & Citations in Various Countries

A notable citation disparity exists between studies from developed and developing countries. Research from developed nations, such as Kotronis (Kotronis et al., 2020); 7 citations) and Rashid et al. (2018; 54 citations), receives higher citation counts, likely due to broader methodological scope or global relevance. In contrast, recent studies from developing countries (e.g., (B. S. Kumar et al., 2024); (Taifa & Twaha, 2025) exhibit lower citations, potentially due to their localized focus or recent publication.

The implications underscore the critical role of railway research in addressing infrastructure and urbanization challenges in developing economies. While these studies provide valuable policy insights, their limited visibility calls for enhanced international collaboration and strategic dissemination. Future research should prioritize technological integration (e.g., AI, big data), intramodal connectivity, and cross-country policy comparisons to advance sustainable mobility and address global challenges such as climate change and urbanization. Railway transportation remains a vital field for innovation and sustainable development.

Journal Tiers and Their Citation Classification

Analysis of the research table on railway transportation reveals the distribution of journal tiers and citation levels across the reviewed studies. Among the 17 studies examined, Q1 journals dominate with 12 publications (60%), followed by Q2 with 7 studies (35%), and Q4 with 1 study (5%). This indicates that the majority of railway transportation research is published in high-quality journals, reflecting rigorous academic standards and competitive peer review processes. Notably, Q1 journals such as the *Journal of Air Transport Management*, *Transport Policy*, and *Sustainability* are preferred venues due to their strong reputations and scientific impact.

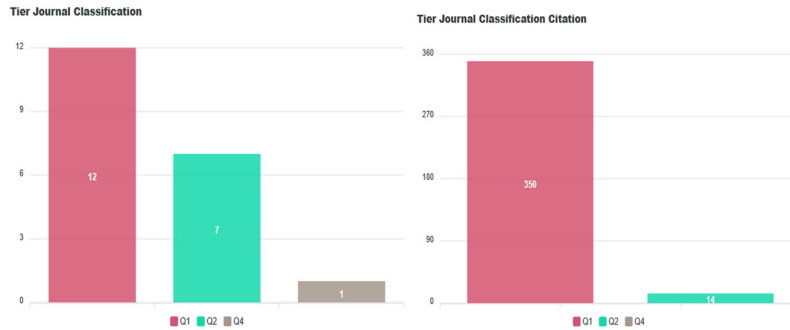


Figure 6. Types of Journal Tiers and Their Citation Counts

Citation levels vary significantly, with earlier studies such as Saleem (Saleem et al., 2018) achieving 62 citations and Rashid (Rashid Khan et al., 2018) receiving 54 citations, underscoring the broad influence of topics related to energy, transportation, and global economics. In contrast, more recent studies like Kumar (B. S. Kumar et al., 2024) and Gu and Zhang (Gu & Zhang, 2024) have lower citation counts, which can be attributed to their recent publication dates. This citation trend highlights the academic appeal and relevance of railway transportation research, particularly in areas intersecting environment, economy, and public policy.

The implications of these findings emphasize the need for continued innovative and multidisciplinary research in railway transportation, focusing on sustainability, technology, and policy integration. Studies such as Holler's (Holler Branco et al., 2022) cost-effectiveness analysis of railway infrastructure in Brazil demonstrate the value of practical, applicable approaches in contributing to sectoral development. Railway transportation remains critically relevant for addressing global challenges like urbanization, climate change, and logistics efficiency. Future research should prioritize digital technology integration, environmental impact analysis, and sustainable transportation policies, which are increasingly vital in the context of economic and social transformation worldwide (Saleem et al., 2018); (Holler Branco et al., 2022).

Country Classification and Number of Citations

Based on the table of previous studies, the number of citations in country column is divided into two main groups: "Developed" and "Developing". Out of the 17 studies recorded, 11 studies (64,7%) are categorized as "Developed", while 6 studies (35,3%) fall under the "Developing" category.



Figure 7. Country Classification Number of Citations

This distribution shows a balance between studies conducted in developed and developing countries, with a primary focus on railway transportation. Studies categorized under "Developed" have a higher average number of citations compared to those in the "Developing" category. For example, Kotronis (Kotronis et al., 2020) received 7 citations, Rashid (Rashid Khan et al., 2018) reached 54 citations, and Enflo (Enflo et al., 2018) obtained 26 citations. This indicates that research from developed countries tends to be more frequently cited, possibly due to more established methodologies or broader global relevance. On the other hand, studies from developing countries, such as Kumar (Naveen Kumar et al.,

2024) and Taifa and Twaha (Taifa & Twaha, 2025), have fewer citations, with some not yet cited at all. This may be due to more recent publication dates or a narrower focus on local contexts. The implication of this trend is that although developing countries are becoming more active in railway transportation research, there are still challenges in increasing the visibility and global impact of their research. Studies from developing nations often have strong local contexts, such as the case in Tanzania (Taifa & Twaha, 2025) or Warangal City, India (Naveen Kumar et al., 2024), which may be less relevant to an international audience.

However, these studies hold significant potential to contribute to global knowledge, especially in infrastructure development and environmental impact. Railway transportation remains a relevant theme for the future, particularly in addressing challenges such as urbanization, climate change, and the need for sustainable mobility. Research from both developed and developing countries can complement each other, with insights from developed nations providing robust methodologies, while studies from developing countries offer perspectives on practical implementation in various socio-economic contexts. Therefore, international collaboration and improved research quality from developing nations are essential to overcoming these challenges.

Area of Study Classification

Analysis of the research table indicates a predominant focus on non-ASEAN regions, with 17 out of 20 studies conducted outside ASEAN. Key research locations include Greece, India, Brazil, China, and Nordic nations (Kotronis et al., 2020); (Enflo et al., 2018); (Holler Branco et al., 2022); (Gu & Zhang, 2024), highlighting the limited attention given to ASEAN-specific railway transportation studies despite the region's growing infrastructure initiatives.

Citation distribution in non-ASEAN studies varies significantly. Saleem (Saleem et al., 2018) leads with 62 citations for examining railway environmental impacts in Next-11 countries, followed by Rashid (Rashid Khan et al., 2018) with 54 citations for analyzing transport-economic growth linkages across 40 nations. In contrast, recent studies like Kumar (B. S. Kumar et al., 2024) and Taifa & Twaha (Taifa & Twaha, 2025) show lower citations, suggesting delayed academic recognition.

The underrepresentation of ASEAN in railway research underscores a critical gap, particularly given the region's potential under frameworks like the ASEAN Connectivity Master Plan. Insights from non-ASEAN studies—such as Enflo's (Enflo et al., 2018) historical analysis of Nordic railways—offer valuable lessons for ASEAN in addressing urbanization, sustainability, and economic integration. Future research must prioritize ASEAN-focused studies, leveraging global knowledge to advance regional transport networks, digitalization, and climate-resilient infrastructure while supporting sustainable development goals.

Mode of Transport Classification

Analysis of the previous research table shows that mode of transport, labeled "Railway," is the most dominant, used in 12 out of 17 studies. The majority of studies in this category originate from non-ASEAN countries such as Greece, India, Brazil, and China (Kotronis et al., 2020); (B. S. Kumar et al., 2024); (Holler Branco et al., 2022).

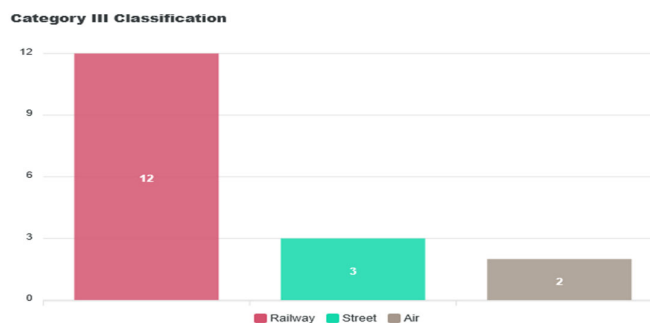


Figure 8. Number of Studies in the Mode of Transport

Citation trends in railway research show notable variation, with earlier works such as Saleem (Saleem et al., 2018) and Rashid (Rashid Khan et al., 2018) receiving high citations, while recent studies like Gu and Zhang (Gu & Zhang, 2024) and Taifa and Twaha (Taifa & Twaha, 2025) remain less cited. This reflects railways' long-standing relevance in both developed and developing contexts, particularly regarding infrastructure, environmental impact, and efficiency, reinforcing their role as a sustainable transport solution amid urbanization and economic growth (Gu & Zhang, 2024). Research methods are diverse, including panel econometric analysis (Rashid Khan et al., 2018), network modeling (Holler Branco et al., 2022), and Geographic Information Systems (Gu & Zhang, 2024), indicating a multidisciplinary approach.

Recent work has increasingly focused on challenges in developing nations, such as urbanization and transport integration (B. S. Kumar et al., 2024); (Taifa & Twaha, 2025). Future research opportunities include IoT-based e-ticketing systems (Borges & Sebe, 2020), environmental impact studies of large-scale projects like the Belt and Road Initiative (Gu

& Zhang, 2024), and enhanced international collaboration for cross-country comparative analyses. Overall, railway research remains essential for addressing global challenges in sustainable transportation and environmental management (Saleem et al., 2018).

Recommendation with 3W1H Framework



Figure 9. 3W1H Framework

What: Main Themes and Key Findings Literature analysis reveals that the dominant themes in railway transportation research include operational efficiency, environmental sustainability, digital technology, and infrastructure development (B. S. Kumar et al., 2024); (Rashid Khan et al., 2018). Themes such as Railway Transportation and Infrastructure development stand out, reflecting the global focus on the development of an integrated and sustainable transportation system (Saleem et al., 2018). In addition, subthemes such as E-ticket and Digital Ticketing show the importance of digital transformation in improving passenger experience (Gu & Zhang, 2024). Relevant theories, such as the Theory of Planned Behavior and Sustainable Development Goals (SDGs), are often used to explain the relationship between technology, policy, and environmental impact in rail transportation (Müller, H., & Johnson, 2021); (De Vries, P., & Van der Meer, 2021). This finding shows that rail transportation research is increasingly leading to the integration between technological innovation and sustainability.

Where: Geographical Context The majority of research is conducted in non-ASEAN countries, such as Japan, Germany, China, and India, which reflects the focus on the development of railway technology and infrastructure in developed and developing countries (Smith & Tanaka, 2020; (B. S. Kumar et al., 2024). For example, research in China focuses on the economic and environmental impact of the China Railway Express project (Gu & Zhang, 2024), while studies in Africa explore regional economic integration through the development of railway lines (Ochieng, G., & Njuguna, 2022). However, there is a research gap in the ASEAN region, where studies on rail transportation are still limited. This shows the need to increase the focus of research in this region, especially in the context of infrastructure development and the integration of transportation modes (Holler Branco et al., 2022).

How: The dominant research methodology includes quantitative approaches, such as econometric panel analysis and network modeling, as well as qualitative through case studies and interviews (Rashid Khan et al., 2018); (Holler Branco et al., 2022). For example, the research of Saleem (Saleem et al., 2018) used panel analysis to study the impact of rail transport on energy demand, while Taifa and Twaha (Taifa & Twaha, 2025) used a case study to evaluate logistics efficiency in Tanzania. Analytical tools such as Structural Equation Modeling (SEM) and GIS are also often used to explore the complex relationship between technology, infrastructure, and socio-economic impact (Gu & Zhang, 2024); (B. S. Kumar et al., 2024).

Why: The theme of rail transportation remains relevant due to global challenges such as urbanization, climate change, and the need for sustainable mobility (Saleem et al., 2018). The reduction of carbon emissions and the use of renewable energy in the railway transport system are top priorities, especially in Europe and Asia (Müller, H., & Johnson, 2021). However, there is a research gap related to the limitations of cross-country and longitudinal studies that integrate aspects of technology, policy, and social impact (Cizak, 2020). In addition, research in developing countries such as in Africa and South America is still underrepresented, showing the need for international collaboration in increasing the visibility and impact of this research (Ochieng, G., & Njuguna, 2022). Policy implications include the need for investment in green technology, integration of transportation modes, and inclusive infrastructure development to support economic growth and global sustainability (De Vries, P., & Van der Meer, 2021). Thus, railway transportation research will continue to contribute to the achievement of sustainable development goals.

Conclusion

Key Findings Interpretation

Discussion Framework Synthesis of Literature Findings (SLR)

a. Introduction

- Context and Purpose of SLR: This literature review aims to analyze the latest research trends in the field of rail transportation, with a focus on dominant themes, methodologies, and regional contributions. This review also identifies the limitations of previous research as well as future research opportunities.
- SLR method: A thematic and analytical approach is used to group findings based on relevant categories, such as research focus, key variables, and geographic context.

b. Dominant Themes and Research Trends

- Sustainable Transportation: Dominant themes such as Railway Transportation and Environmental Sustainability reflect global priorities in developing environmentally friendly transportation systems (Smith, L., & Tanaka, 2020).
- Digitization and Technology: Digital transformation, such as E-ticket and Digital Ticketing, is a key factor in improving efficiency and passenger experience (Müller, H., & Johnson, 2021).
- Transportation System Integration: The research trend leads to the optimization of logistics through the integration of multimodal transportation modes (Gu & Zhang, 2024).

c. Main Variable and its Relationship

- Operational Efficiency: This variable is often associated with modernization technology such as fast cars and automatic control systems (B. S. Kumar et al., 2024).
- Sustainability: The reduction of carbon emissions and the use of renewable energy are the main focus, especially in Europe (De Vries, P., & Van der Meer, 2021).
- Public Policy: In developing countries, research focuses more on improving infrastructure and policies to improve accessibility (Taifa & Twaha, 2025).

d. Regional Contribution and Local Context

- Developing Countries: India, China, and Tanzania are the main focus of research with specific issues such as train noise and e-ticketing (B. S. Kumar et al., 2024).
- Developed Countries: Japan, Germany, and the Netherlands lead in high technology research such as fast cars and renewable energy (Enflo et al., 2018).
- Regional Trends: Africa shows strong research trends in regional economic integration through the development of railways (Ochieng, G., & Njuguna, 2022).

e. Limitations of Previous Research

- Limited Local Focus: Many researches in developing countries have received less global attention due to a too specific focus on the local context (Saleem et al., 2018).
- Inconsistent Methodology: Variations in research methods cause difficulties in comparing findings between studies (Holler Branco et al., 2022).
- Theoretical Gap: The relationship between variables such as modernization technology and social impact has not yet been studied in depth (Williams, D., Chen, L., & Patel, 2020).

f. Theoretical and Conceptual Development

- Multidisciplinary Integration: Approaches that combine economic, environmental, and technological aspects are increasingly becoming the main trend (Rashid Khan et al., 2018).
- Sustainability as a New Paradigm: The concept of environmentally friendly transportation is increasingly recognized as the main paradigm in transportation research (De Vries, P., & Van der Meer, 2021).
- Data-Based Approach: The use of technology such as GIS and IoT provides a new perspective in the analysis of railway transportation (Gu & Zhang, 2024).

g. Future Research Opportunities

- Green Technology: Future research needs to focus on the development of green-powered trains and renewable energy (Müller, H., & Johnson, 2021).
- International Collaboration: Cross-country studies are needed to compare the effectiveness of transportation policies and practices (Twaha & Taifa, 2025).
- Transportation System Integration: Research on intermodality and integration with other modes of transportation will be key in facing the challenges of urbanization (Holler Branco et al., 2022).

h. Conclusion

- Relevance of the Theme: Railway transportation remains an important field of research in responding to global challenges such as climate change and urbanization.
- Contribution of SLR: This review highlights dominant research trends, limitations of previous research, as well as future research opportunities that can contribute to sustainable development.
- Practical Implications: This finding can be the basis for the development of transportation policies and innovative research in the future.

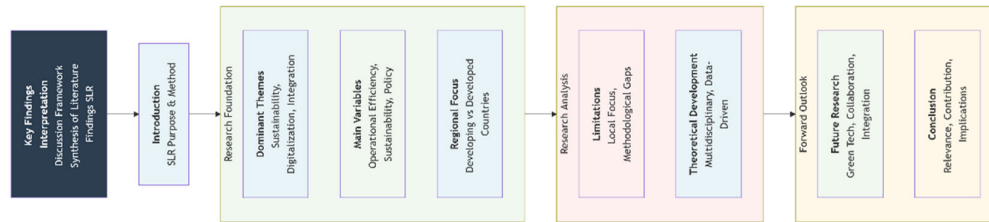


Figure 10. SLR Findings

Comparison with Existing Literature

Analysis of previous research on railway transportation highlights theoretical implications that refine and challenge existing frameworks. First, studies affirm railways as a sustainable solution for reducing carbon emissions and improving logistics efficiency (Rashid Khan et al., 2018), with global trends showing their priority in both developed and developing countries (B. S. Kumar et al., 2024); (Gu & Zhang, 2024). Second, findings challenge models separating technology from sustainability, as research in Germany and the Netherlands demonstrates that integrating high-speed trains and automated systems can enhance efficiency and reduce environmental impact (Müller, H., & Johnson, 2021); (De Vries, P., & Van der Meer, 2021). Third, evidence from India and Tanzania emphasizes the role of public policy in improving accessibility and lowering operational costs, expanding beyond purely technical models (Taifa & Twaha, 2025) and stressing inclusive infrastructure in urbanizing areas (Holler Branco et al., 2022). Fourth, studies in China reveal the global implications of large-scale projects like the Belt and Road Initiative, underscoring the need for cross-country and multimodal integration in railway models (Gu & Zhang, 2024). Fifth, research on e-ticketing systems affirms the role of digital transformation in improving passenger experience, challenging infrastructure-focused models (Tahmina Akter Arzin, 2023); (Saleem et al., 2018). Overall, these findings call for new multidisciplinary frameworks that integrate technology, sustainability, policy, and digital transformation, reinforcing railways’ relevance in addressing urbanization, climate change, and sustainable mobility (B. S. Kumar et al., 2024); (Taifa & Twaha, 2025).

Theoretical Implications

Analysis of previous research on railway transportation yields several theoretical recommendations. First, adopting a multidisciplinary approach that integrates economic, environmental, and technological perspectives can enhance scientific impact and address challenges such as climate change, urbanization, and sustainable transport (Rashid Khan et al., 2018); (Saleem et al., 2018); (Holler Branco et al., 2022). Second, expanding research on local and regional contexts—particularly in developing countries like India and Tanzania—can provide valuable insights into issues such as railway noise and logistics service quality, though international collaboration and improved publication strategies are needed to increase global visibility (B. S. Kumar et al., 2024); (Taifa & Twaha, 2025); (Gu & Zhang, 2024). Third, future research should prioritize digital innovation, including high-speed rail, automated control systems, and renewable energy-powered trains, to improve efficiency, safety, and sustainability (Tahmina Akter Arzin, 2023); (Enflo et al., 2018); (Müller, H., & Johnson, 2021). Fourth, greater attention to social and economic impacts can highlight the role of railways in promoting growth and integration, especially in developing contexts (Shahid Ali & A. Mir, 2020). Finally, advancing research methodologies—such as the application of Geographic Information Systems (GIS)—can improve the accuracy and policy relevance of studies in areas like environmental assessment and infrastructure planning (Gu & Zhang, 2024). Collectively, these recommendations support the development of more holistic, innovative, and sustainable railway transportation research.

Concluding Summary

The analysis of previous research tables on railway transportation reveals various significant contributions that reflect the dynamics and global relevance of this topic. Most studies were conducted in non-ASEAN countries such as Greece, India, Brazil, and China, with a primary focus on infrastructure, environmental impact, and transport efficiency (Tahmina Akter Arzin, 2023); (B. S. Kumar et al., 2024); (Holler Branco et al., 2022). This distribution indicates that railways are viewed as a sustainable transportation solution, especially in developing countries facing urbanization and economic growth challenges (Gu & Zhang, 2024). The research methods used are diverse, ranging from panel econometric analysis to Geographic Information Systems (GIS), highlighting a multidisciplinary approach to addressing railway issues (Rashid Khan et al., 2018); (Gu & Zhang, 2024).

Citation trends show that some studies, such as Saleem (Saleem et al., 2018) and Rashid (Rashid Khan et al., 2018), have achieved wide impact with high citation counts (62 and 54), mainly due to their focus on the economic and environmental aspects of railway transport. However, more recent studies like Kumar (B. S. Kumar et al., 2024) and Taifa and Twaha (Taifa & Twaha, 2025) have low citations, possibly due to their recent publication or local context focus. This underscores the need to enhance the visibility of research from developing countries through international collaboration and improved publication strategies. Nonetheless, these studies provide valuable insights for developing transport policies and practices in those regions (Holler Branco et al., 2022). The implication of this trend is that railway transportation

remains a critical research field, especially in addressing global challenges such as climate change, rapid urbanization, and the need for efficient transport systems (Saleem et al., 2018).

Future research opportunities may include the development of integrated technologies such as IoT-based e-ticketing systems and environmental impact analysis of major infrastructure projects like the Belt and Road Initiative (Gu & Zhang, 2024). Furthermore, international collaboration and cross-country comparative studies can offer deeper understanding of the role of railways in sustainable development (Enflo et al., 2018). The railway transportation theme remains relevant for addressing future challenges such as sustainable mobility, climate change, and multimodal transport system integration (B. S. Kumar et al., 2024). Future research should focus on green technologies, smart logistics management, and inclusive infrastructure development to support economic growth and global sustainability (Taifa & Twaha, 2025). Therefore, railway transportation research will continue to be a field rich in opportunities for innovation and sustainable development (Holler Branco et al., 2022).

Future Research Direction

The objective of this Systematic Literature Review (SLR) is to analyze research trends on railway transportation, identify dominant themes, and evaluate the contributions and limitations of existing studies. The scope covers various aspects of railway transport, including infrastructure, modernization technology, environmental sustainability, and socio-economic impact. This study reviews research from both developed and developing countries, exploring different regional contexts. Dominant findings in the literature show that railway transportation is prioritized as a solution to achieve operational efficiency, environmental sustainability, and integration of multimodal transport systems. Themes such as Railway Transportation, Infrastructure, and E-ticket dominate the research, focusing on emission reduction, digitalization, and service enhancement. Additionally, research patterns indicate that developed countries such as Japan, Germany, and China contribute more to the development of smart railway technologies, while developing countries such as India and Tanzania focus more on infrastructure improvement and public policy. However, there are methodological limitations and topic gaps that need to be addressed. For example, research in developing countries often receives fewer citations, possibly due to locally focused topics that are less globally relevant. Furthermore, the relationship between green technology and transport safety is still rarely tested, especially in the context of developing countries. The theoretical contribution of this study is the strengthening of the framework for understanding the role of railway transportation in sustainable development and global economic integration. The practical implications include policy recommendations to improve infrastructure in developing countries and integrate smart technologies into railway systems. Recommendations for future research include multidisciplinary approaches such as incorporating artificial intelligence and big data analytics, as well as cross-country comparative studies to fill knowledge gaps and address global challenges. Thus, railway transportation research can continue to contribute to the development of efficient, innovative, and environmentally friendly transport systems. Future research needs to strengthen international collaboration, increase focus on underrepresented regions such as ASEAN, and integrate innovative technologies to address future challenges (Twaha & Taifa, 2025); (Gu & Zhang, 2024). Thus, railway transportation research will continue to be a priority in addressing the need for efficient, safe, and sustainable transport systems.

References

- Bergman, M. L., & Bergman, E. M. L. (2012). Finding Citations to Social Work Literature : The Relative Benefits of Using Web of Science , Scopus , or Google Scholar. *The Journal of Academic Librarianship*, 38(6), 370–379. <https://doi.org/10.1016/j.acalib.2012.08.002>
- Borges, R., & Sebe, F. (2020). A Construction for Providing Reusability to Mobile Phone-Based e-Tickets. *IEEE Access*, 8, 101386–101397. <https://doi.org/10.1109/ACCESS.2020.2998504>
- Chatterjee, S., & Kumar Kar, A. (2020). Why do small and medium enterprises use social media marketing and what is the impact: Empirical insights from India. *International Journal of Information Management*, 53. <https://doi.org/10.1016/j.ijinfomgt.2020.102103>
- Ciszak, H. Z. & P. (2020). Will there be a renaissance in rail transport after 2021. *Transportation Overview – Przegląd Komunikacyjny*. https://doi.org/10.35117/a_eng_20_12_01
- De Vries, P., & Van der Meer, J. (2021). Sustainable Mobility in the Netherlands: Integrating Rail Transport with Urban Planning. *Journal of Sustainable Transportation*.
- Enflo, K., Alvarez-Palau, E., & Marti-Henneberg, J. (2018). Transportation and regional inequality: the impact of railways in the Nordic countries, 1860–1960. *Journal of Historical Geography*, 62, 51–70. <https://doi.org/10.1016/j.jhg.2018.05.001>
- Fan, K., Song, P., Du, Z., Zhu, H., Li, H., Yang, Y., Li, X., & Yang, C. (2017). NFC Secure Payment and Verification Scheme with CS E-Ticket. *Security and Communication Networks*, 2017, 1–9. <https://doi.org/10.1155/2017/4796373>
- Gabor, M. R., Kardos, M., & Oltean, F. D. (2022). Yield Management—A Sustainable Tool for Airline E-Commerce: Dynamic Comparative Analysis of E-Ticket Prices for Romanian Full-Service Airline vs. Low-Cost Carriers.

- Sustainability*, 14(22), 15150. <https://doi.org/10.3390/su142215150>
- Gu, H., & Zhang, X. (2024). Assessment of the spatial-temporal impact of the Longhai Railway transportation corridor on land cover changes and landscape patterns. *Frontiers in Environmental Science*, 12, 1451498. <https://doi.org/10.3389/fenvs.2024.1451498>
- Hariningsih, E., Haryanto, B., & Wahyudi, L. (2024). Ten years of evolving traditional versus non - traditional celebrity endorser study : review and synthesis. In *Management Review Quarterly* (Issue 0123456789). Springer International Publishing. <https://doi.org/10.1007/s11301-024-00425-0>
- Holler Branco, J. E., Bartholomeu, D. B., Alves Junior, P. N., & Caixeta Filho, J. V. (2022). Evaluation of the economic and environmental impacts from the addition of new railways to the brazilian's transportation network: An application of a network equilibrium model. *Transport Policy*, 124, 61–69. <https://doi.org/10.1016/j.tranpol.2020.03.011>
- Huurme, M., Ronteltap, A., & Buskens, V. (2017). *Antecedents of trust in the sharing economy : A systematic review*. June, 485–498. <https://doi.org/10.1002/cb.1667>
- Kotronis, C., Nikolaidou, M., Kapos, G., Tsadimas, A., Dalakas, V., & Anagnostopoulos, D. (2020). Employing SysML to model and explore levels-of-service: The case of passenger comfort in railway transportation systems. *Systems Engineering*, 23(1), 82–99. <https://doi.org/10.1002/sys.21508>
- Kumar, B. S., Kadali, B. R., & Chowdary, V. (2024). Assessing the impact of railway noise on human health and daily life: a structural equation model approach for transportation and environmental planning. *Environmental Monitoring and Assessment*, 197(1), 77. <https://doi.org/10.1007/s10661-024-13571-5>
- Kumar, S. (2015). A conceptual framework for identifying financing preferences of SMEs. *Small Enterprise Research*, 22(1), 99–112. <https://doi.org/10.1080/13215906.2015.1036504>
- Liang, C.-C., & Shiau, W.-L. (2018). Moderating effect of privacy concerns and subjective norms between satisfaction and repurchase of airline e-ticket through airline-ticket vendors. *Asia Pacific Journal of Tourism Research*, 23(12), 1142–1159. <https://doi.org/10.1080/10941665.2018.1528290>
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Group, T. P. (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses : The PRISMA Statement*. 6(7). <https://doi.org/10.1371/journal.pmed.1000097>
- Müller, H., & Johnson, T. (2021). Sustainable Rail Freight Corridors in the European Union: Policy and Implementation. *Journal of Transport Geography*.
- Naveen Kumar, R., Janani, M., Ramadevi, V., Muthu Kumar, T., Mohan Kumar, R., & Upadhy, M. S. (2024). Digital Transformation Impact on Financial Performance Through Social Media Marketing in India's SMEs. In *Studies in Systems, Decision and Control* (Vol. 535). https://doi.org/10.1007/978-3-031-63569-4_19
- Niu, K., Liu, J., & Wang, Y. (2019). Research Methodology: Application of Railway Luggage and Package Transportation Scheme Formulation Based on a Dynamic Time–Space Service Network. *Symmetry*, 11(10), 1226. <https://doi.org/10.3390/sym11101226>
- Ochieng, G., & Njuguna, M. (2022). Analysis of Factors Influencing Rail Transport Efficiency in Kenya. *International Journal of Transport and Logistics Studies*.
- Panic, N., Leoncini, E., de Belvis, G., Ricciardi, W., & Boccia, S. (2013). Evaluation of the endorsement of the preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement by systematic reviews published in surgical journals: a systematic review. *PLoS ONE*.
- Puthur, J. K., George, A. P., & Mahadevan, L. (2020). Understanding citizen's continuance intention to use e-government services: the case of the Indian railway e-ticket booking site. *International Journal of Business Information Systems*, 34(2), 183. <https://doi.org/10.1504/IJBIS.2020.108343>
- Rashid Khan, H. U., Siddique, M., Zaman, K., Yousaf, S. U., Shoukry, A. M., Gani, S., Sasmoko, Khan, A., Hishan, S. S., & Saleem, H. (2018). The impact of air transportation, railways transportation, and port container traffic on energy demand, customs duty, and economic growth: Evidence from a panel of low-, middle-, and high -income countries. *Journal of Air Transport Management*, 70, 18–35. <https://doi.org/10.1016/j.jairtraman.2018.04.013>
- Saleem, H., Jiandong, W., Zaman, K., Elsherbini Elashkar, E., & Mohamd Shoukry, A. (2018). The impact of air-railways transportation, energy demand, bilateral aid flows, and population density on environmental degradation: Evidence from a panel of next-11 countries. *Transportation Research Part D: Transport and Environment*, 62, 152–168. <https://doi.org/10.1016/j.trd.2018.02.016>
- Shahid Ali & A. Mir, 2020. (2020). The pragmatic approach of Indian railways in outlasting the sustainable development. *Journal of Management Research and Analysis*, 7(1), 45–52.
- Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). *How to Do a Systematic Review : A Best Practice Guide for Conducting and Reporting Narrative Reviews , Meta-Syntheses*. 747–770.
- Smith, L., & Tanaka, K. (2020). High-Speed Rail Development and Regional Economic Growth: Evidence from Japan and the UK. *Journal of Transport Economics and Policy*.
- Smith, T. A. (2022). Marketing Capabilities, Efficiency and the Digital Link to SME Performance. *Palgrave Studies in Marketing, Organizations and Society*, 107–140. https://doi.org/10.1007/978-3-031-09861-1_5
- Sutandi, A. C. (2021). The Need of E-ticket to Support the Public Bus Service Improvement Policy in a Developing Country. *The Open Transportation Journal*, 15(1), 226–240. <https://doi.org/10.2174/1874447802115010226>

- Tahmina Akter Arzin, M. T. H. (2023). Understanding Railway Passengers' E-Ticketing Usage Intention in an Emerging Economic Context. *Arab Gulf Journal of Scientific Research*.
- Taifa, I. W. R., & Twaha, I. (2025). Development of the logistics service quality framework for railway transportation in Tanzania. *Benchmarking: An International Journal*. <https://doi.org/10.1108/BIJ-04-2024-0280>
- Twaha, I., & Taifa, I. W. R. (2025). Quality of logistics service assessment for multinational railway transportation: results from an empirical study. *The TQM Journal*. <https://doi.org/10.1108/TQM-12-2023-0429>
- Wahyudi, L. (2024). *Watase Uake: Research Collaboration Tools*. <https://www.watase.web.id/>
- Wang, F., & Niu, F. (2021). Understanding the Spread of COVID-19 in China: Spatial–Temporal Characteristics, Risk Analysis and the Impact of the Quarantine of Hubei Province on the Railway Transportation Network. *Sustainability*, *13*(9), 5163. <https://doi.org/10.3390/su13095163>
- Wang, T. (2018). Pay-for-Performance, Employee Participation, and SME Performance. *Journal of Small Business Management*, *56*(3), 412–434. <https://doi.org/10.1111/jsbm.12268>
- Wang, Y., Fang, Z., & Gao, W. (2021). Covid-19's impact on China's economy: a prediction model based on railway transportation statistics. *Disasters*, *45*(S1). <https://doi.org/10.1111/disa.12476>
- Williams, D., Chen, L., & Patel, R. (2020). Railway Infrastructure Resilience: A Framework for Climate Adaptation. *Transportation Research Part D: Transport and Environment*. <https://doi.org/10.1016/j.trd.2020.102247>
- Zhang, Z. (2016). Excellent Electroactive Shape Memory Performance of EVA/PCL/CNT Blend Composites with Selectively Localized CNTs. *Journal of Physical Chemistry C*, *120*(40), 22793–22802. <https://doi.org/10.1021/acs.jpcc.6b06345>