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Unpacking the tracks: Diving into high-speed rail marketing research trends (2014–2024) and shaping the future of the field

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Abstract

This study addresses the critical gap in understanding High-Speed Rail (HSR) marketing strategies in emerging Southeast Asian markets, such as Indonesia, where unique cultural, economic, and infrastructural factors require tailored approaches. Employing bibliometric analysis, the present study delves deeper into the evolution of HSR marketing from 2014 to 2023, analyzing 138 Scopus-indexed articles through R Studio (bibliometrix) and VOSviewer. The study identifies key trends, including the emphasis on pricing strategies, consumer behavior, and sustainability. An increase in publications, especially from emerging markets, indicates a growing interest in the marketing dynamics of HSR. Co-authorship networks and citation analysis highlight prominent authors and institutions, while keyword clustering reveals a shift toward customer satisfaction and environmental concerns. A significant gap in research emerges pertinent to HSR marketing strategies in Southeast Asia, pointing toward the need for region-specific approaches. The findings reveal a research gap in emerging markets like Indonesia, where themes such as "willingness to pay" and "tourism development" remain underexplored. As indicated by the low keyword density and thematic map results, future studies should focus more on consumer behavior and localized marketing strategies to support HSR adoption in diverse socio-economic contexts.

Introduction

High-speed rail (HSR) has emerged as a pivotal component of modern transportation systems, particularly in Asia, where countries like Japan and China have successfully implemented extensive networks. Japan's Shinkansen, operational since 1964, set the benchmark for high-speed rail travel, showcasing efficiency and safety (Zeng & Xiao-jun, 2023). In recent years, China's HSR network has expanded rapidly, now encompassing over 38,000 kilometers, making it the largest in the world (Straulino et al., 2023). This expansion has not only facilitated domestic travel but has also stimulated economic growth per se through enhancing connectivity between major urban centers (Morley, 2024).

Emerging markets, such as Indonesia, are also beginning to adopt HSR technologies, with projects like the Whoosh, which aims to connect Jakarta and Bandung, promising to reshape the transportation landscape in Southeast Asia (Kang et al., 2022). The Whoosh project exemplifies how HSR can catalyze regional development, particularly in emerging markets where transportation infrastructure is often lacking (D'Alfonso et al., 2015). The integration of HSR into

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the Indonesian transportation network is expected to alleviate traffic congestion, reduce travel times, and promote economic growth, in turn positioning the country as a significant player in Southeast Asia's transportation landscape (Fingleton & Szumilo, 2019).

The potential of HSR extends beyond mere transportation; it addresses critical environmental, economic, and social challenges. HSR is often viewed as a more sustainable alternative to air travel and automobile transport, significantly reducing greenhouse gas emissions per passenger kilometer (Xu & Zhu, 2023). Furthermore, the economic implications are profound, as investments in HSR can lead to increased regional economic activity, job creation, and enhanced property values along the rail corridors (He, 2023). The social benefits, including improved accessibility and mobility for underserved populations, further underscore the importance of HSR in contemporary transportation planning (Chi & Lei, 2023).

Marketing plays a crucial role in the successful adoption of HSR by influencing consumer perceptions and behaviors. Understanding consumer behavior is essential for effective brand positioning and communication strategies that resonate with potential passengers (Lu et al., 2022). Research indicates that factors such as pricing, customer satisfaction, and brand trust significantly impact the decision-making process of travelers considering HSR as a transportation option (Zhou, 2023). For instance, studies have shown that competitive pricing strategies can enhance the attractiveness of HSR compared to other modes of transport, such as air travel (Yang et al., 2020).

Given the above, this study aims to address several research questions as follows:

1. How have the research trends related to high-speed rail (HSR) in the context of marketing evolved from 2014 to 2024, based on a bibliometric approach through Performance Analysis and Science Mapping?
2. How can the analysis of trends and the identification of gaps in HSR research be utilized to define future research agendas in the context of marketing?

Literature Review

Research on high-speed rail (HSR) marketing has evolved considerably over the past decade, reflecting the increasing importance of consumer-centric approaches in public transportation. Early studies emphasized technical attributes such as speed, energy efficiency, and scheduling optimization (Chen, 2019; Ge, 2021). However, more recent literature has shifted towards understanding behavioral and psychological factors that influence passengers' mode choice decisions. Pricing strategies, for instance, are found to affect willingness to pay significantly, particularly when bundled with perceived value elements like comfort, punctuality, and service reliability (Pan, 2024; Mou et al., 2021). These factors have become central to marketing strategies designed to position HSR as a viable alternative to air or conventional rail travel.

Moreover, service quality dimensions such as onboard cleanliness, staff behavior, digital accessibility, and station connectivity are highlighted as pivotal drivers of consumer satisfaction and loyalty (Wang et al., 2020; Tang et al., 2023). Trust in HSR operators—developed through consistent service delivery and transparent communication—has been shown to enhance brand equity, influence intention to reuse, and foster positive word-of-mouth (Gao et al., 2016; Kang et al., 2022). This underlines the growing role of branding and integrated marketing communication (IMC) strategies in shaping travel behavior in competitive transport markets.

To track the evolution of research priorities and thematic shifts within HSR marketing literature, scholars have increasingly employed bibliometric analysis. As documented by Yuan-yuan (2021), bibliometric mapping enables researchers to visualize citation networks, identify influential scholars and publications, and uncover thematic clusters that dominate the field. These bibliometric insights are not part of the analytical method used in the present study, but rather serve as a conceptual foundation to contextualize how HSR marketing discourse has developed across geographies and disciplines (Chen et al., 2022; Zhang et al., 2022).

Several bibliometric studies reveal that HSR marketing research is heavily concentrated in high-income countries, particularly China, Japan, and parts of Western Europe—where HSR infrastructure is well established (Qi, 2023; Yu, 2024). In contrast, emerging markets such as Southeast Asia, Latin America, and Africa remain underrepresented in the literature, resulting in

limited empirical knowledge about the cultural, infrastructural, and economic factors influencing HSR adoption in these contexts. For example, Indonesia's newly launched Whoosh HSR project offers a rich context for studying how first-time exposure, digital literacy, income segmentation, and local travel culture intersect with marketing effectiveness areas scarcely addressed in prior studies (Malabanan et al., 2023; Wong, 2021).

In line with the theory of planned behavior (TPB) and related behavioral models, current research increasingly integrates psychological constructs such as attitudes toward sustainability, subjective norms, and perceived behavioral control in explaining passengers' HSR usage intentions (Zhao, 2023; Xu & Shen, 2021). While these models have been well-validated in developed contexts, their application in culturally diverse and infrastructure-limited settings remains sparse. This suggests the need to expand theoretical models and empirical research frameworks to capture better the multi-dimensional realities of HSR adoption in developing countries.

In response to these gaps, recent calls for research emphasize the necessity of localized and inclusive marketing strategies that resonate with community values, travel habits, and digital competencies of underserved populations (Chen, 2024; Chi & Lei, 2023). Factors such as tourism integration, regional connectivity, and multi-modal transport linkages are emerging as focal points in marketing literature—indicating a transition from product-centric to ecosystem-based approaches in transport planning (Tang et al., 2023). Furthermore, the intersection of marketing with public policy, environmental sustainability, and urban planning presents a promising frontier for interdisciplinary research that bridges the gap between academic theory and societal impact.

In this context, the present study draws upon the conceptual frameworks provided by these prior works to analyze HSR marketing literature through a comprehensive bibliometric lens. This approach, while analytical, is positioned here not as a method description but as a conceptual foundation of the literature—offering a scholarly mapping of influential contributions, thematic trajectories, and geographical gaps that justify the present research focus.

Materials and Methods

Research Approach Section

This study adopts a bibliometric analysis approach to explore trends and gaps in high-speed rail (HSR) marketing research from 2014 to 2024. Bibliometric analysis is a quantitative technique for analyzing academic research that allows structuring, synthesizing, and mapping the body of knowledge (Xuesong, 2022). By focusing on patterns and trends in the literature, this study aims to provide an objective evaluation of the research landscape and identify directions for future inquiry. Specifically, this analysis seeks to answer three key questions: What are the key themes and trends in HSR marketing research? Why is marketing crucial for HSR adoption, especially regarding consumer behavior and engagement? So what actionable insights can be derived to enhance future marketing strategies for HSR globally, with an emphasis on developing markets like Indonesia? This analysis combines performance analysis, which measures productivity through publication counts and impact through citations, with science mapping, which identifies the current state and evolution of research themes, collaboration networks, and keyword clustering. These bibliometric methods provide a comprehensive understanding of how research on HSR marketing has evolved. To ensure reliability and consistency, only Scopus-indexed publications were included in this study, as Scopus is recognized for its comprehensive and high-quality academic content.

Inclusion and Exclusion Criteria Section

The bibliometric analysis of high-speed rail (HSR) marketing, adoption strategies, and consumer behavior was conducted using well-defined inclusion and exclusion criteria to ensure the relevance and quality of the selected literature. The articles included in this analysis were published between 2014 and December 2023, a timeframe chosen to capture recent trends and developments in HSR marketing and consumer behavior, reflecting the dynamic nature of the field (Zhang et al., 2022; Huang, 2024). Only articles published in English were considered to ensure accessibility and comprehension for the research team and the intended audience (Yuan et al., 2016; Tang, 2024).

The articles were required to be indexed in Scopus, a reputable database known for its rigorous selection criteria, ensuring the inclusion of high-quality research (Ge, 2021; Yue, 2023). Additionally, the articles needed to focus on disciplines related to Business, Management, and Accounting or Social Sciences, as these directly relate to the marketing and consumer behavior aspects of HSR (Chi & Lei, 2023; Lu et al., 2022; Kamga, 2015). The studies were expected to address the marketing implications of HSR, including consumer behavior and adoption strategies, while those focusing solely on technical aspects without marketing relevance were excluded (Zhou, 2023; Albalate et al., 2015; Sallan, 2023).

Articles that exclusively examined the technical dimensions of HSR, such as engineering or operational efficiency, without discussing marketing implications, were excluded to maintain a consumer-oriented perspective (Qi, 2023; Wang et al., 2021; Jin, 2014). Studies lacking empirical data or methodological rigor were also omitted to ensure the reliability and integrity of the analysis (He, 2023; Kong et al., 2022; Liu & Chen, 2021). Furthermore, articles that did not relate to marketing strategies or consumer behavior were excluded to maintain a focused dataset (Wang et al., 2020; Lubis et al., 2019; Hu et al., 2021).

To ensure a systematic and transparent selection process, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was adapted. This framework provided a structured approach for identifying, screening, and including articles that aligned with the research focus. An initial search yielded 448 articles, which were meticulously refined based on the established inclusion and exclusion criteria. This rigorous process resulted in a final dataset of 138 high-quality articles for further analysis, ensuring the research findings are grounded in robust and relevant literature (Huang, 2024; Noviarti, 2023). Detailed results of the filtering process, based on the inclusion criteria, and following the PRISMA and SPAR-4-SLR approaches, are presented in Table 1.

Table 1. Results of the Inclusion Criteria based on the PRISMA and SPAR-4-SLR Approaches

Phase(s)	Consideration	Results for Systematic Literature Review
Assembling/Identification	Search focus	High-speed rail marketing research trends from 2014 to 2024
	Search (keyword) string	"high speed rail" OR "high-speed railway" OR high-speed train" OR "hsr" OR "fast train" OR "bullet train" AND "user behavior" OR "travel behavior" AND "marketing strategies" OR "strategic marketing" promotion strategies" AND "customer adoption" AND "consumer behavior" AND "passenger preferences" AND "service quality" AND "customer satisfaction" AND "transportation mode choice" AND "travel intention" AND "sustainable mobility"
	Search period	2014 up to December 3, 2024
	Search database	Scopus
	Search field	Article title, abstract, keywords
	Search results	448 documents found
Arranging/Screening and Eligibility	Document type	Include "Article"
	Language	Include "English"
	Publication stage	Include "Final"
	Source type	Include "Journal"
	Subject (research) areas	Include "Business, Management and Accounting" AND "Social science"
	Filtered results	138 documents found
Assessing/Inclusion	Analysis method	Bibliometric analysis - Performance analysis - Science mapping
	Agenda proposal method	Trend analysis and gap spotting

Note: The presentation of the table refers to Lim et al. (2024).

Procedure Section

The bibliometric analysis conducted in this study was structured into three distinct stages: data collection, data cleaning, and data analysis. Each stage was meticulously designed to ensure the integrity and reliability of the findings, leveraging established methodologies and software tools widely recognized in the field of bibliometrics.

The initial stage involved data collection exclusively from the Scopus database, which is esteemed for its extensive coverage of high-quality, peer-reviewed literature. A comprehensive keyword string was formulated to capture relevant articles, incorporating terms such as "high-speed rail," "marketing strategies," "consumer behavior," "service quality," and "sustainable mobility" (Table 1) (Widaryanti, 2024; Muchiri et al., 2022; Najmaei & Sadeghinejad, 2022). This approach ensured a robust dataset that included essential metadata, such as author names, institutional affiliations, countries of origin, article titles, abstracts, keywords, citations, and references. The dataset formed the foundation for subsequent performance analysis and science mapping, aligning with established practices in bibliometric research (Tian et al., 2022; Briones-Bitar et al., 2020).

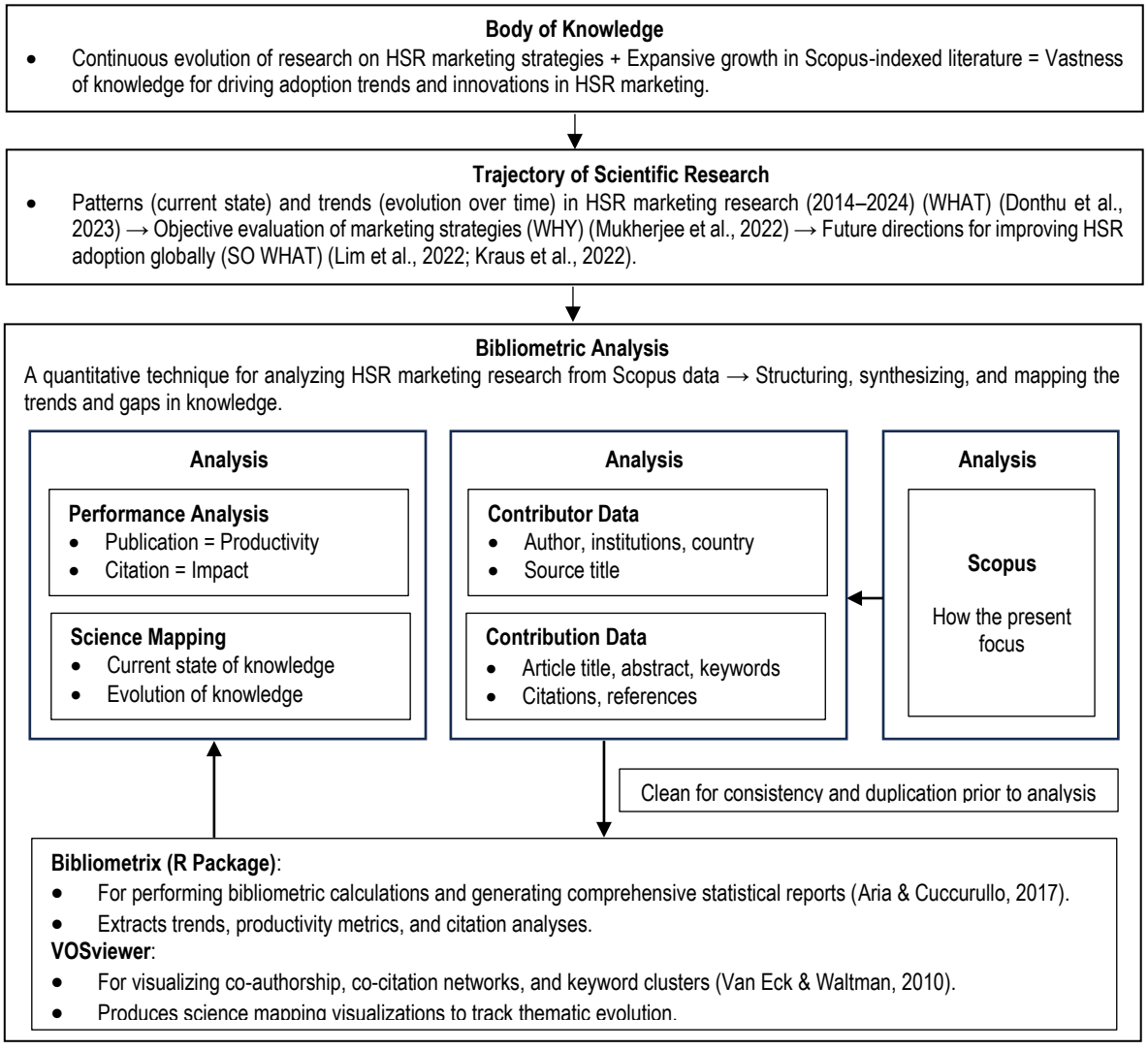


Figure 1. Framework for Bibliometric Analysis of High-Speed Rail Marketing Research Trends adapted and synthesized from Donthu et al. (2021), Mukherjee et al. (2022), Lim and Kumar (2024), and Lim et al. (2024).

The second stage focused on data cleaning, employing a dual approach that utilized Microsoft Excel and OpenRefine. Initially, Microsoft Excel was employed for organizing the dataset, which involved filtering duplicates, correcting formatting inconsistencies, and preparing the data for further refinement (Nobanee et al., 2021). Following this, OpenRefine was utilized for

advanced data cleaning tasks, including standardizing author names, institutional affiliations, and keywords. This two-tiered cleaning process was crucial for ensuring a consistent and high-quality dataset, free from redundancies, thereby maintaining the integrity and reliability of the bibliometric analysis (Arumdani et al., 2023; Santosa, 2023).

In the final stage, the cleaned dataset was subjected to analysis using two primary software tools: Bibliometrix and VOSviewer. Bibliometrix, an R package, was employed to perform performance analysis, evaluating metrics such as publication productivity, citation impact, and the contributions of individual authors, institutions, and journals (Brika et al., 2022; Farliana et al., 2023). VOSviewer, a standalone visualization software, facilitated science mapping, enabling the exploration of co-authorship networks, co-citation patterns, and keyword clusters. This visualization process was instrumental in elucidating the intellectual structure and thematic evolution of high-speed rail marketing research over the past decade (Hallinger, 2023; Mendes et al., 2022). The integration of these tools provided a comprehensive framework for identifying research trends, gaps, and emerging areas of interest, ultimately guiding future academic inquiries and practical implementations in enhancing marketing strategies for high-speed rail adoption globally, particularly in emerging markets such as Indonesia (Brika, 2022; Lal, 2023). By systematically integrating these methodological steps, the study achieved a thorough understanding of the current state and evolution of high-speed rail marketing research, underscoring the significance of bibliometric analysis in elucidating complex research landscapes.

Overall, this section on materials and methods is summarized in Figure 1, which provides the Framework for Bibliometric Analysis of High-Speed Rail Marketing Research Trends (2014–2024). The figure encapsulates the key methodological components, including the trajectory of scientific research, bibliometric analysis processes, and the integration of data sources, analysis methods, and tools, ensuring a comprehensive approach to structuring, synthesizing, and mapping the body of knowledge in HSR marketing research.

Results and Discussion

Performance Analysis

Key information of relevant sources

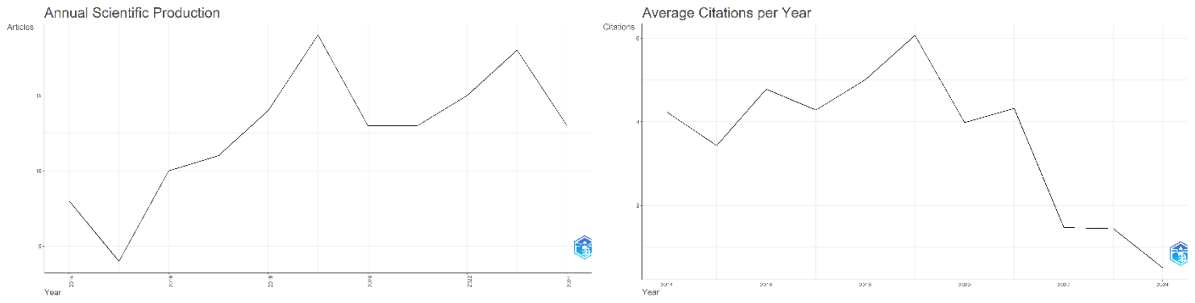
The bibliometric analysis of high-speed rail (HSR) marketing research from 2014 to 2024 reveals steady growth and significant academic impact, with 138 documents published across 56 sources, an annual growth rate of 4.97%, and an average of 26.07 citations per document. The collaborative nature of this field is evident, with 449 authors contributing, an average of 3.51 co-authors per document, and 34.78% of publications involving international co-authorship, reflecting its global relevance. The use of 528 keywords underscores the thematic diversity of this research, covering topics such as consumer behavior, marketing strategies, and sustainability; however, this broad scope suggests a potential lack of depth in specific areas. Despite the relatively young and evolving nature of this literature, with an average document age of 5.28 years, the moderate growth rate indicates that HSR marketing remains a niche focus. These findings highlight the need for more targeted research addressing marketing challenges in emerging markets like Indonesia, where HSR adoption is nascent, as well as the expansion of international collaboration to amplify the field's global impact. Additionally, there is an opportunity for future studies to explore how innovative marketing strategies can accelerate HSR adoption, making it a cornerstone of sustainable transportation globally.

Productivity and impact evaluated through publication and citation trends

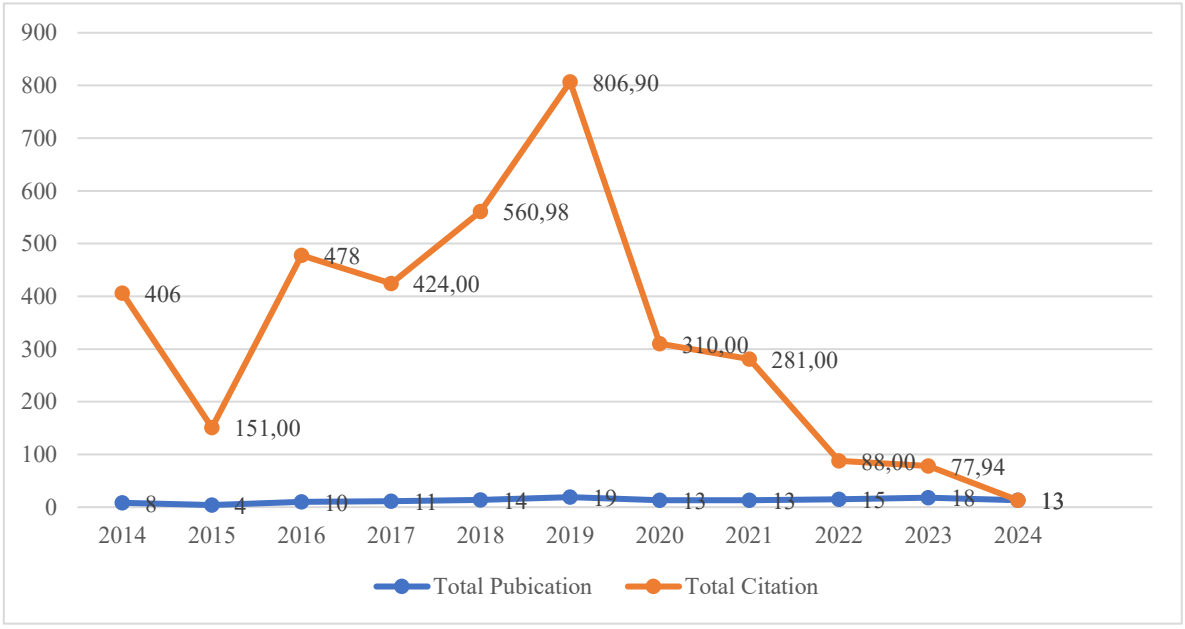
The bibliometric analysis of high-speed rail (HSR) marketing research highlights significant trends in publication and citation activities over the period 2014–2024. Annual Scientific Production (Panel A) reveals a steady increase in the number of publications from 2014, peaking in 2019 with 19 articles, followed by a notable decline in subsequent years, culminating in 13 publications in 2024. This trajectory suggests that while HSR marketing research gained substantial momentum during its initial growth phase, particularly around 2019, it has struggled to sustain similar levels of

engagement in recent years. This decline may reflect shifts in research priorities or external factors affecting the academic landscape, such as global economic or societal changes.

Average Citations Per Year (Panel B) further illustrates the fluctuating impact of publications over the same period. The average citations per article peaked around 2018–2019, corresponding with the period of high academic activity, but subsequently declined sharply from 2020 onwards, reaching the lowest point by 2024. This decline indicates that recent publications have not achieved the same level of influence or visibility as earlier works. The reduction in citation averages suggests potential limitations in the novelty, applicability, or accessibility of recent research outputs.



Panel A. Publication and citation trends of high-speed rail marketing research trends from 2014 to 2024 generated through Bibliometrix's Biblioshiny (Aria & Cuccurullo, 2017; Lim et al., 2024)



Panel B. Publication and citation trends of high-speed rail marketing research generated through Excel

Figure 2. Productivity and Impact of High-Speed Rail Marketing Research

When examined together with Total Citations and Publications (Panel C), the data reveal a marked disparity between the steady output of publications and the declining citation performance. While the total citation count reached its apex in 2019 with 806.90 citations, subsequent years experienced a steep drop, with only 77.94 citations in 2023 and 13 citations in 2024. This pattern suggests a possible saturation in research themes or a failure of recent studies to address emerging challenges and opportunities in HSR marketing. Furthermore, the disconnect between consistent publication levels and diminishing citations raises questions about the alignment of recent research with evolving academic and industry needs.

The findings underscore a dual dynamic in HSR marketing research: a phase of rapid expansion and high impact during its early years, followed by a period of declining engagement and influence. This shift reflects the complex interplay between research production, academic visibility, and citation impact, highlighting the need for continued evaluation of the factors driving

these trends. The bibliometric data offers a comprehensive lens to understand the evolution of HSR marketing research, emphasizing the critical role of academic relevance and adaptability in sustaining momentum within the field.

Key contributions identified from the most prolific journals, authors, institutions, and countries

The analysis of key contributions in high-speed rail (HSR) marketing research, as shown in Table 2, highlights a dominant focus on operational challenges, passenger behavior, and multimodal integration. Chen and Wang (2019) lead the field with their highly cited study on the impacts of severe weather on HSR and aviation delays, published in Transportation Research Part D: Transport and Environment, with a total of 60 citations and a Tcpy of 8.571. This is followed by Li et al. (2020), who examined intercity multimodal choice behavior in the Journal of Transport Geography (49 citations, Tcpy 8.167), and Tang et al. (2018), who analyzed passenger travel time utilization in Transportation (45 citations, Tcpy 5.625). Publications in leading journals such as Transportation Research and Journal of Transport Geography dominate the field, reflecting its interdisciplinary nature and practical relevance. The concentration of studies in Asian markets, particularly China, underscores the regional focus of HSR research. At the same time, the data in Table 2 highlights distinct trends in citation impact, with operational efficiency and consumer behavior emerging as critical themes.

Table 2. Most Prominent Contributions High-Speed Rail Marketing Research

Rank	Author(s)-Years	Article Title	Journal Title	Total Citations	Tcpy
1	Chen & Wang (2019)	Impacts of Severe Weather Events on High-Speed Rail and Aviation Delays	Transportation Research Part D: Transport and Environment	60	8.571
2	Li et al. (2020)	Assessing Intercity Multimodal Choice Behavior In A Touristy City: A Factor Analysis	Journal of Transport Geography	49	8.167
3	Tang et al. (2018)	How Do Passengers Use Travel Time? A Case Study of Shanghai–Nanjing High Speed Rail	Transportation	45	5.625
4	Xu et al. (2018)	Itinerary Choice And Advance Ticket Booking for High-Speed-Railway Network Services	Transportation Research Part C: Emerging Technologies	44	5.5
5	Liu and Shi (2019)	How Inter-City High-Speed Rail Influences Tourism Arrivals: Evidence From Social Media Check-In Data	Current Issues In Tourism	36	5.143
6	Ren et al. (2019)	Impact of High-Speed Rail on Intercity Travel Behavior Change: The Evidence from The Chengdu-Chongqing Passenger Dedicated Line	Journal of Transport and Land Use	29	4.143
7	Larue et al. (2018)	Is It Safe to Cross? Identification of Trains and Their Approach Speed at Level Crossings	Safety Science	23	2.875
8	Beanland et al. (2017)	To Stop or not to Stop: Contrasting Compliant and Non-Compliant Driver Behaviour at Rural Rail Level Crossings	Accident Analysis and Prevention	23	2.556
9	Zhen et al. (2019)	The Role of Access and Egress In Passenger Overall Satisfaction With High Speed Rail	Transportation	20	2.857
10	Schouten et al. (2022)	Cohort Analysis of Driving Cessation and Limitation Among Older Adults	Transportation	12	3

Key contributions identified from the most prolific journals, authors, institutions, and countries

Table 3 highlights the dominance of Chinese institutions and scholars in HSR marketing research, reflecting China's leadership in HSR development. While global journals contribute diverse perspectives, the overwhelming focus on developed HSR markets reveals a gap in addressing the unique challenges of emerging markets. Indonesia's modest representation accentuates the need for localized strategies that consider socio-economic and cultural nuances. To advance the field, future research ought to balance insights from established systems with tailored approaches for developing regions, bridging the gap between global expertise and local applicability.

Table 3. Most Prominent Contributions of High-Speed Rail Marketing Research

Panel A. Journals	Art	Panel B. Authors	Art	Panel C. Institutions	Art	Panel D. Countries	Art
Sustainability (Switzerland)	9	Rantala, Tero	2	Ankara University	7	China	85
IEEE access	4	Ukko, Juhani	2	International Centre Of Insect Physiology And Ecology(Icipe)	7	Mexico	42
Technological Forecasting and Social Change	4	Abdelfattah, Fadi	1	FPT University	6	India	36
Applied Mathematics and Nonlinear Sciences	3	Abdijabar, Zeana	1	School Of Engineering And Sciences	6	UK	36
Australasian Journal of Educational Technology	3	Abdildayeva, Assel	1	The University Of Queensland	6	USA	26
IEEE Transactions on Engineering Management	3	Abusorrah, Abdullah	1	University Of Aveiro	6	Italy	25
Journal of Cleaner Production	3	Adeoti, John	1	University Of Sheffield	6	Australia	23

Science Mapping

Uncovering the knowledge produced by the field through a tree field plot, a tree map, and keyword co-occurrence analysis

The research on high-speed rail (HSR) has revealed significant strengths and gaps within the field, as illustrated by various visualizations such as Sankey diagrams and tree maps. The Sankey diagram (Figure 3) highlights the dominance of themes like "travel behavior," "quality of service," and "travel satisfaction," which are predominantly driven by a limited number of prolific authors and institutions.

This concentration of focus raises concerns regarding thematic redundancy and a lack of diversification in research topics. For instance, studies have shown that while the quality of service significantly influences passenger satisfaction, other critical areas remain underexplored, such as agent-based simulation and societal impacts of HSR (Xu, 2024). The emphasis on these popular themes, while valuable, signals a need for broader research inquiries that encompass less-examined dimensions of HSR.

The tree map (Figure 4) further emphasizes a geographical bias towards China, which is justified given its leadership in HSR development. Nevertheless, this focus also highlights a significant underrepresentation of studies addressing HSR adoption and its nuanced challenges in emerging markets, particularly in Southeast Asia (He, 2023). The existing literature predominantly centers on technical aspects, such as numerical models and travel time, often overshadowing critical social dimensions like accessibility, equity, and regional integration (Tang et al., 2023). This

geographical and thematic concentration indicates an urgent need for interdisciplinary research approaches that can address these overlooked dimensions, thereby fostering a more holistic understanding of HSR's transformative potential.

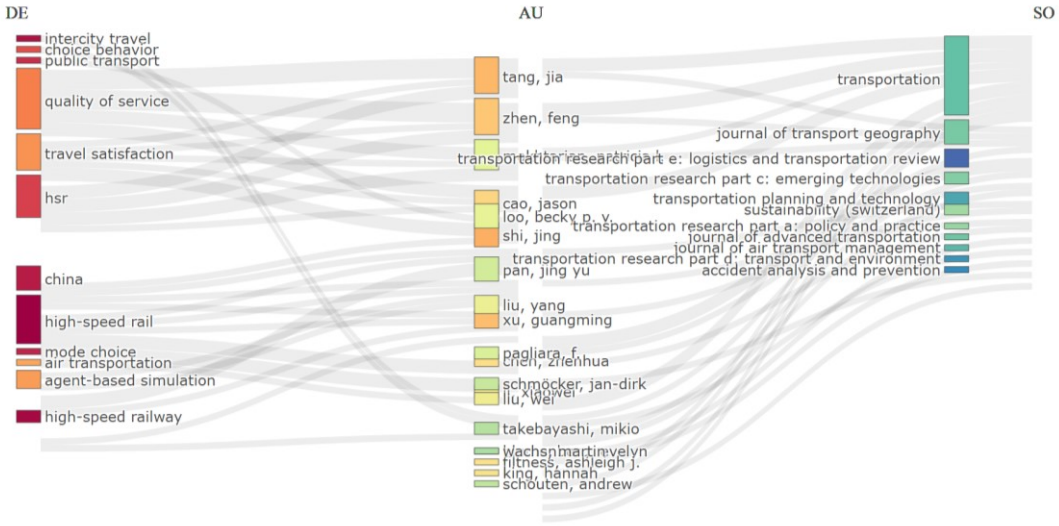


Figure 3. Tree Field Plot in High-Speed Rail Research (Sankey Diagram)

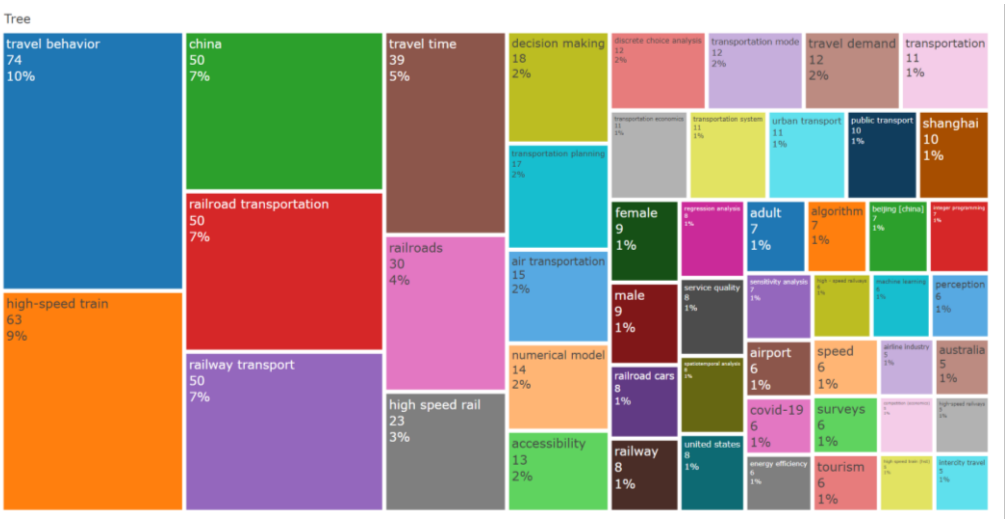


Figure 4. Research Focus in High-Speed Rail Marketing (Tree Map)

The visualizations underscore the necessity for expanding the geographical scope of HSR research and exploring its societal impacts beyond mere efficiency and infrastructure. For instance, studies have indicated that high-speed rail can significantly influence urban economic dynamics and travel behavior. However, the socio-economic implications of these changes are often inadequately addressed ("A comparative study on the effects of high-speed rail and ordinary rail on regional economic growth–empirical research based on DlD model") (Yang et al., 2022). The call for diverse contributions from underrepresented regions has been crucial, in that it can lead to a more balanced interplay between technical rigor and societal relevance in future studies. Furthermore, the integration of cultural, environmental, and policy implications into HSR research is essential for understanding the broader context in which these systems operate (Malabanan et al., 2023).

In addition to the need for diversification in research topics, the findings also suggest that the current focus on technical efficiency may neglect the importance of user experience and satisfaction. For instance, studies have shown that passenger satisfaction is influenced by various factors, including service quality, safety, and convenience (Mou et al., 2021). However, the existing literature often prioritizes quantitative measures of efficiency over qualitative assessments of user

experience, which can lead to a skewed understanding of HSR's impact on travel behavior (Fang, 2024). This gap highlights the importance of incorporating user-centered perspectives into HSR research, which can enhance the relevance and applicability of findings to real-world contexts.

The keyword co-occurrence network in Figure 5, supported by the thematic clusters summarized in Table 4, reveals the core areas of research in high-speed rail (HSR) marketing. The thematic clusters derived from the keyword co-occurrence network provide a comprehensive overview of the current research landscape surrounding high-speed rail marketing. The emphasis on travel behavior, urban transport integration, infrastructure planning, and regional economic development highlights the multifaceted nature of HSR's impact. As research continues to evolve, it will be essential to explore these interconnected themes further to maximize the benefits of high-speed rail systems and ensure their alignment with contemporary societal and environmental goals.

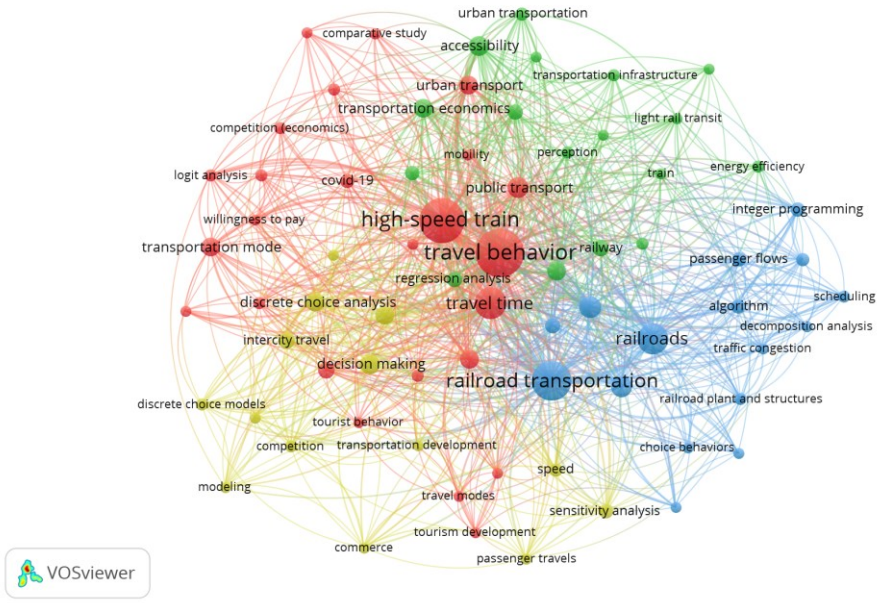


Figure 5. Network of Keyword Co-occurrence

The red cluster, which focuses on Travel Behavior and Decision Making, underscores the necessity of comprehending passenger preferences. This is evidenced by the prevalence of keywords such as "travel behavior," "decision making," and "travel time," which highlight the reliance on discrete choice models to ascertain factors influencing consumer mode selection. Such models facilitate the development of data-driven marketing strategies aimed at enhancing HSR adoption, as they allow for a nuanced understanding of passenger preferences and behaviors (Kang et al., 2022; Chen et al., 2022). The integration of these models into marketing strategies is crucial for tailoring services that meet the specific needs of potential HSR users, thereby increasing ridership and overall satisfaction.

In parallel, the green cluster, which emphasizes Urban Transport and Accessibility, illustrates the role of HSR in urban transportation systems. Keywords such as "accessibility," "public transport," and "transportation economics" signify HSR's potential to alleviate urban congestion and enhance intermodal connectivity. The alignment of HSR with sustainable transportation goals, particularly through the inclusion of "energy efficiency," further emphasizes its role in reducing environmental impacts while addressing urban mobility demands (Chen, 2024). This aspect is particularly relevant in the context of global sustainability efforts, where reducing carbon footprints and promoting efficient public transport systems are paramount. The integration of HSR into urban transport networks not only enhances accessibility but also contributes to the overall sustainability of urban environments.

The blue cluster, which delves into Railroad Infrastructure and Planning, addresses the technical and operational dimensions of HSR systems. Keywords such as "railroads," "passenger flows," and "schedule optimization" reflect ongoing efforts to enhance infrastructure capacity,

manage demand, and improve service reliability (He, 2023; Ge, 2021). The focus on schedule optimization is particularly critical in ensuring that HSR services are not only efficient but also responsive to passenger needs. By optimizing schedules, HSR can better accommodate peak travel times and enhance the overall user experience, thereby fostering greater public acceptance and usage of high-speed rail services.

Lastly, the yellow cluster, termed Tourism and Regional Connectivity, focuses on the synergy between high-speed rail and tourism development, emphasizing its role in passenger travel, integration with other modes of transport, and enhancing regional competitiveness. Collectively, these clusters provide a multidimensional perspective on the strategic positioning of high-speed rail within the transportation and marketing landscape.

Table 4. Cluster and Keywords of High-Speed Rail Marketing Revealed through Keyword Co-occurrence Analysis

Cluster Color	Cluster Name	Key Keywords
Red	Travel Behavior and Decision-Making	High-speed train, travel behavior, travel time, decision making, discrete choice models, transportation mode.
Green	Urban Transport and Accessibility	Urban transportation, accessibility, transportation economics, public transport, energy efficiency.
Blue	Railroad Infrastructure and Planning	Railroads, transportation planning, traffic congestion, passenger flows, and schedule optimization.
Yellow	Tourism and Regional Connectivity	Tourism development, passenger travels, transportation mode, integration, competitiveness.

Mapping Research Themes and their Relationship

The thematic map analysis of high-speed rail (HSR) marketing research reveals a structured landscape characterized by various research themes, their relevance, and developmental stages (Figure 6). The Basic Themes quadrant, which includes core themes such as travel behavior, high-speed train, and railroad transportation, signifies foundational topics that are crucial for understanding the dynamics of HSR marketing. These themes are not only highly relevant but also serve as the bedrock for further exploration in the field, because they encompass essential aspects of consumer behavior and transportation systems (Zhao, 2023; He, 2023). The foundational nature of these themes is supported by extensive literature, indicating their critical role in shaping marketing strategies and operational frameworks for HSR systems.

In contrast, the Motor Themes quadrant highlights rapidly developing topics such as forecasting and train operations, which reflect an increasing emphasis on predictive modeling and operational efficiency within the HSR research domain. The growing interest in these areas suggests a shift towards data-driven approaches that can enhance decision-making processes and improve service delivery in high-speed rail systems (Tang et al., 2023; Ge, 2021; Kang et al., 2022). This trend aligns with the broader movement towards integrating advanced analytics and machine learning techniques in transportation research, which can lead to more efficient and responsive HSR operations. The emphasis on forecasting indicates a recognition of the importance of anticipating passenger demand and optimizing resource allocation accordingly.

The Niche Themes quadrant, which includes specialized topics such as safety, anthropology, and railroad crossings, indicates areas of depth but limited connectivity to broader research discussions. These themes, while important, may not yet have achieved the same level of integration into mainstream HSR marketing research, suggesting opportunities for further exploration and interdisciplinary collaboration (Zhou, 2023; Wang & Lei, 2021). The depth of these niche areas can provide valuable insights into specific challenges and considerations within the HSR context, such as safety protocols and the sociocultural implications of high-speed rail systems.

Emerging or Declining Themes, which encompass topics related to gender (female, male, adult), suggest either waning relevance or a lack of thorough exploration in the current research landscape. This observation raises questions about the inclusivity of HSR marketing research and the need for a more comprehensive understanding of diverse passenger demographics (Zhang et

al., 2022; Chi & Lei, 2023). The identification of these themes highlights the importance of addressing gaps in the literature and ensuring that research efforts reflect the full spectrum of passenger experiences and preferences.

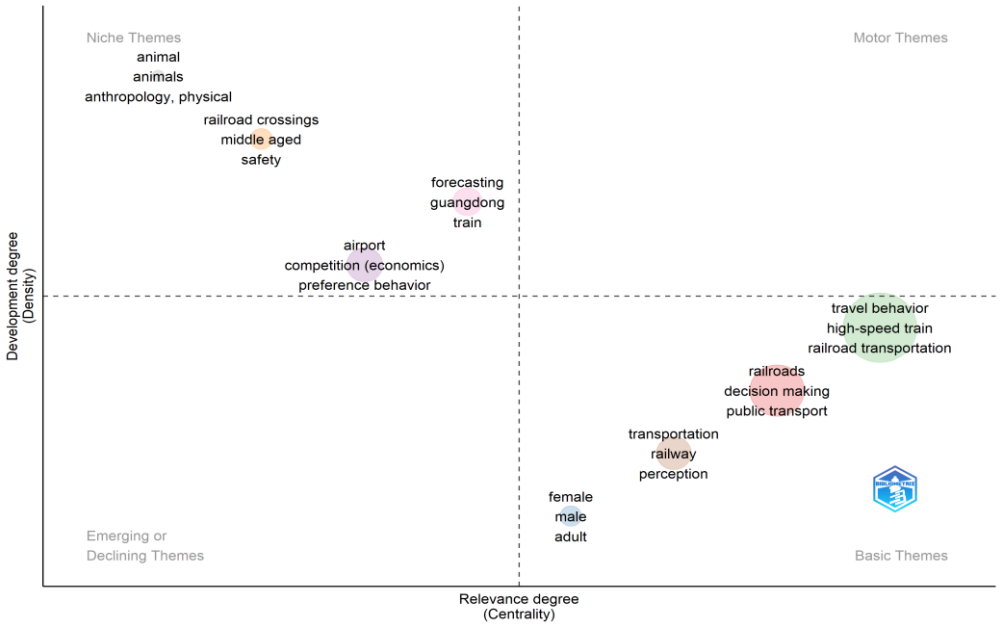


Figure 6. Thematic Map

The analysis of tropical trends in High-Speed Rail (HSR) from 2014 to 2024 indicates a significant paradigm shift from technical considerations to a more consumer-centric and marketing-oriented approach. Initially, from 2017 to 2019, the literature predominantly focused on technical advancements, including algorithms for operational efficiency and energy consumption (Chou et al., 2018). However, starting in 2020, there has been a marked increase in studies addressing consumer behavior, willingness to pay, and the integration of tourism with HSR services, as evidenced by the emergence of keywords such as "travel behavior" and "passenger flows" (Qiu, 2023). This transition reflects a growing recognition of the importance of understanding user preferences and market dynamics in shaping HSR strategies (Xu & Shen, 2021). Moreover, the competitive landscape between HSR and other transport modes, particularly air travel, has been explored extensively, highlighting the need for HSR to adapt its marketing strategies to enhance user attraction and service sustainability (Wang et al., 2015). Future research opportunities are abundant, particularly in areas such as willingness to pay analysis and the integration of green innovations into HSR marketing strategies, which are essential for fostering a sustainable transport ecosystem (Gera, 2024). This evolving focus is crucial for initiatives like the Whoosh high-speed rail in Indonesia, which intends to leverage these insights to improve service offerings and attract a broader user base (Zgonc et al., 2019).

The Density Visualization (Figure 8) indicates that the keywords "high-speed train," "travel behavior," and "railroad transportation" are prominently featured in the literature, reflecting a substantial focus on these areas within recent research. Numerous studies have explored the implications of travel time and operational efficiency of high-speed trains through discrete choice analysis, which has become a critical tool for understanding passenger preferences and behaviors in transportation contexts (Šimeček, 2019). For instance, discrete choice models have been effectively utilized to evaluate how various factors influence travel decisions, thereby enhancing the operational strategies of high-speed rail systems (Šimeček, 2019; Xiao et al., 2020). Conversely, topics such as "tourism development," "passenger flows," and "willingness to pay" exhibit lower density, suggesting that these areas remain under-explored and present opportunities for further research (Mensah & Jumah, 2021; Bhattacharya, 2018). This gap highlights the potential for integrating marketing strategies and user preferences into high-speed rail systems, particularly in developing nations like Indonesia, where enhancing the attractiveness of rail travel could

significantly impact tourism and economic growth (Wong, 2021). As such, expanding research into these less dense themes could yield valuable insights that contribute to the overall efficiency and appeal of high-speed rail networks.

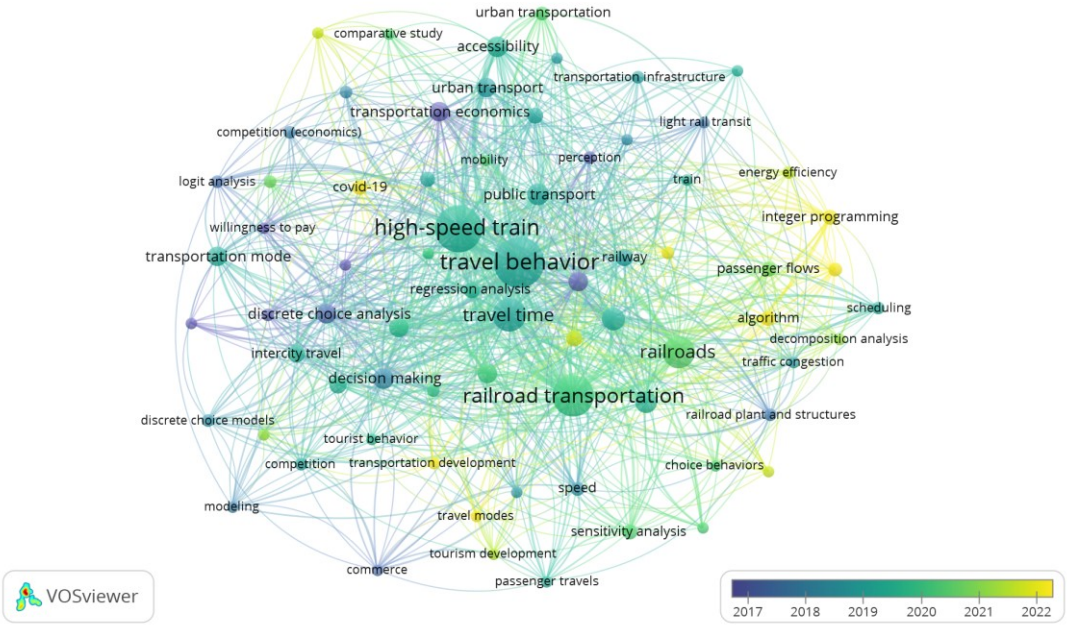


Figure 7. Topical Trend

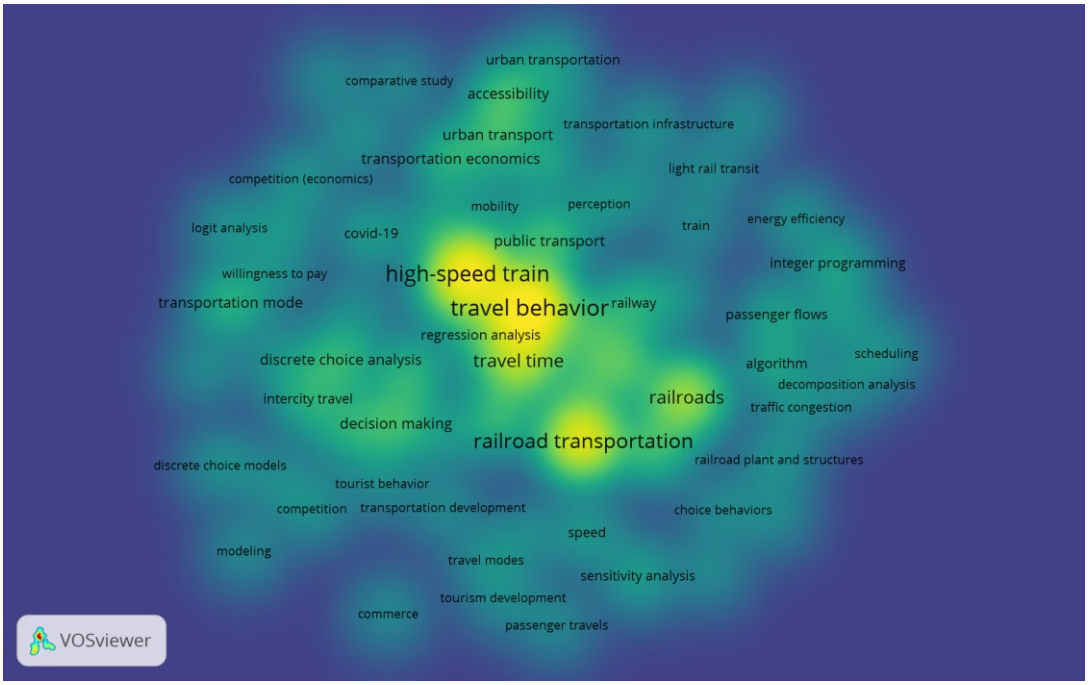


Figure 8. Density Visualization

Mapping Thematic Findings of High-Speed Rail Marketing Research and Its Implications for Theory, Practice, and Future Research Direction

The thematic findings generated from the bibliometric analysis of high-speed rail (HSR) marketing research underscore several significant trends and patterns that have emerged in the literature. First, a clear focus on consumer behavior and adoption factors is evident, with studies highlighting the influence of perceived convenience, time savings, and environmental considerations on HSR adoption. In addition, the bibliometric mapping reveals an increasing body of research examining the role of socio-economic variables such as income, education, and awareness in shaping

consumer preferences for HSR. This aligns with theoretical frameworks like the theory of planned behavior (TPB), where factors such as attitudes, subjective norms, and perceived control influence behavioral intention. The findings also disclose that research on marketing strategies for HSR has increasingly concentrated on targeting specific demographic segments, particularly those emphasizing environmental sustainability and technological innovation. From a practical perspective, the findings suggest that marketing strategies for HSR should be tailored to the needs and preferences of distinct consumer groups. Furthermore, future research should explore unexplored areas, such as the impact of technological advancements and cross-national comparisons, to better grasp and understand the extent to which marketing strategies can be adapted across different cultural contexts. Longitudinal studies examining evolving consumer behavior as HSR infrastructure expands will also be essential for long-term strategic planning in the HSR sector.

Conclusion

The evolution of high-speed rail marketing research from 2014 to 2024, as revealed through performance analysis and science mapping, exhibits both consistent growth and thematic shifts. Performance analysis indicates that academic productivity peaked in 2019 with 19 publications and the highest citation impact, followed by a noticeable decline in both volume and influence in subsequent years. This suggests a potential stagnation in novelty or the overemphasis on recurring themes. Science mapping results support this interpretation, with keyword co-occurrence and thematic clusters identifying a strong focus on travel behavior, service quality, and schedule optimization. These topics dominate the red and green clusters in the keyword network and are positioned in the basic and motor themes quadrants, reflecting their maturity within the field. However, limited research engagement with topics such as tourism development, willingness to pay, and digital marketing—found in emerging and niche quadrants—suggests that the field, while thematically rich, remains concentrated and underexplored in several strategically important areas. The bibliometric findings also demonstrate a regional bias, with China contributing the majority of influential works, whereas Southeast Asia, including Indonesia, remains significantly underrepresented.

Based on the trends and gaps identified through bibliometric mapping, several directions can be proposed to guide future research in high-speed rail marketing. The underrepresentation of themes such as tourism integration, digital engagement, and user willingness to adopt HSR services indicates the need for a more interdisciplinary and user-centric research approach. The topical trend analysis shows that since 2020, emerging interests such as environmental sustainability, smart mobility, and behavioral economics have begun to appear, although they remain relatively low in density. These findings suggest an opportunity to expand the theoretical framework of HSR marketing by incorporating concepts from consumer psychology, green marketing, and technology acceptance. Furthermore, the lack of studies focusing on developing markets underscores the importance of contextualizing marketing strategies to account for cultural, infrastructural, and socio-economic variability. Therefore, future research agendas should prioritize comparative studies across regions, the development of localized marketing models, and the exploration of innovative communication strategies to enhance HSR adoption. By addressing these gaps, the field can contribute more effectively to both the academic discourse and the practical advancement of sustainable transport solutions.

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