ALTO HSR Citizen Research Initiative
Research Literature Review

What Passengers Actually Want:

Determinants of Rail User Satisfaction

A Literature Assessment

April 2026

Executive Summary

This literature review synthesises the empirical evidence on what drives rail passenger satisfaction, drawing on national passenger surveys, structural equation modelling, revealed preference studies, and systematic reviews across North America, Europe, Australia, and Asia. Seven primary domains are examined: reliability and punctuality; travel time and productive use; comfort; safety; station access and egress; price sensitivity and value for money; and information and customer service.

The table below summarises the hierarchy of factors as the evidence supports it. Tier 1 factors are universal threshold requirements—deficiencies here drive modal abandonment. Tier 2 factors are strong independent determinants of ridership and satisfaction. Tiers 3 and 4 are significant but secondary contributors.

Tier	Factor	Evidence basis
1	**Reliability / Punctuality**	Most consistent primary driver across all major national surveys (GB NRPS, Dutch NS, French TER, Asian HSR studies). Chronic unreliability depresses ridership in long run more than any single-incident analysis implies.
1	**Safety (objective + perceived)**	Platform crowding creates direct hazards. Perceived safety is a primary functional service quality dimension for HSR. Health-safety perceptions became the dominant factor in post-pandemic demand recovery.
2	**Seat availability / crowding**	Crowding and inability to sit on long-distance services are among the highest-impact satisfaction drivers. Passengers may relocate housing or employment to avoid chronic crowding.
2	**Price / Value for money**	Leisure travellers show HSR fare elasticities of −1.1 to −1.9 (elastic demand). Long-run elasticities 2–3× short-run. Value-for-money is an independent satisfaction dimension; premium pricing without premium service quality depresses ridership independently of objective service levels.
2	**Access and egress quality**	Journey-chain research shows access/egress dissatisfaction propagates strongly to overall journey satisfaction. Remote or poorly-connected stations underperform demand projections.
3	**Travel time / speed**	Valued, but benefits substantially mediated by whether passengers can use time productively. Clock-time savings models overstate benefits when conditions are poor.
3	**Thermal comfort / cleanliness**	Independent satisfaction dimensions across all markets. Air conditioning failures and uncleanliness generate acute dissatisfaction and negative reviews.
3	**Information quality**	Especially during disruption. Real-time information provision significantly moderates satisfaction loss during delays.

Tier	Factor	Evidence basis
4	**Noise / vibration / ride quality**	Increasingly important at higher speeds. Engineering investment required to maintain acceptable aural pressure and vibration comfort above ~250 km/h.
4	**Connectivity / Wi-Fi**	Growing importance for business travellers; strongly influences productive use of travel time.
4	**Ticketing ease**	Consistently rated as a high-importance dimension; affects willingness to use and re-use service.

Three findings have particular relevance for the assessment of new rail proposals. First, reliability consistently outranks raw speed: passengers on long-distance leisure trips—the dominant market on most intercity corridors—prefer a dependable service over a faster but uncertain one. Second, station location is not incidental: access and egress dissatisfaction propagates strongly to overall journey satisfaction, and remotely-sited stations systematically underperform demand forecasts. Third, leisure travellers exhibit elastic price sensitivity to HSR fares (elasticities of −1.1 to −1.9), meaning ridership projections that assume low price sensitivity will overstate patronage whenever fares are set at a premium.

Overview

A large and growing body of empirical research—drawing on national passenger surveys, structural equation modelling, revealed preference studies, and systematic literature reviews across North America, Europe, Australia, and Asia—has converged on a consistent set of factors that determine whether rail travellers report satisfaction with their experience and whether they choose to continue using, or return to, rail services.

This review synthesises that evidence across seven primary domains: reliability and punctuality; travel time and its productive use; comfort; safety; station access and egress; price sensitivity and value for money; and information and customer service. A final section addresses the heterogeneity of passenger preferences—an increasingly important finding for any demand-forecasting exercise.

1. Reliability and Punctuality

Across virtually every study of developed-country rail markets, punctuality and travel-time reliability emerge as the single most important driver of overall passenger satisfaction. Brons and Rietveld (2009), whose Dutch Railways dataset became a foundational reference, established that travel-time reliability is among the most important quality attributes of railway passengers, and that unreliability increases what they term 'scheduling costs'—the friction passengers absorb when they cannot depend on arrival times. As reliability on a given route deteriorates, the probability of passengers switching to alternative modes increases.

A major British meta-analysis of Great Britain's National Rail Passenger Survey (Wardman & Batley, 2021) synthesised 252 elasticity observations from 17 studies spanning 2003–2019. Its key finding was that rail industry guidance has tended to overstate the demand impact of punctuality improvements—but the direction of the relationship is unambiguous: lateness depresses ridership, with effects that vary by trip type, distance, and ticket type. Long-run elasticities substantially exceed short-run effects, meaning the cumulative damage of chronic unreliability is greater than any single-incident analysis implies.

Wardman et al. (2020) further investigated passengers' valuation of 'recovery time'—the scheduling buffer inserted into timetables to improve on-time performance. The study found that leisure travellers have a stronger preference for reliability over raw journey-time reduction than commuters, because a single delay to a leisure trip (theatre attendance, connecting flight, family occasion) carries high disutility. By contrast, frequent commuters who have adapted to unreliability—building in their own buffers or catching earlier trains—may in certain circumstances prefer a faster but less reliable service. This preference heterogeneity has direct implications for corridor planning: a long-distance leisure market may value reliability more highly than headline speed.

A 2023 British study using latent class modelling on the National Rail Passenger Survey (de Vos et al., 2023) confirmed that punctuality/reliability is the primary driver for the largest passenger segment, but identified two further groups for whom its marginal impact on satisfaction was weaker. This finding—that the role of punctuality in determining overall satisfaction is more complex than previously assumed in the literature—does not undermine the centrality of reliability; it underscores that passenger markets are not homogeneous.

> **Key finding:** *Punctuality and travel-time reliability are the single most consistent predictor of overall rail satisfaction across international literature. Chronic unreliability depresses ridership significantly more than any single delay event.*

2. Travel Time and Productive Use

Journey time matters to passengers—but the relationship is more nuanced than the raw time savings claimed in standard benefit-cost ratio analyses. Research has established that the perceived value of travel time is shaped by what passengers can do during the journey and under what conditions.

Lyons et al. (2007) demonstrated that in-vehicle activities—working, reading, relaxing—have a meaningful positive effect on how travellers evaluate time spent on trains. The implication is that 'dead time' is not fixed; comfortable, connected, uncrowded trains convert it into productive or restorative time, reducing the disutility passengers assign to journey duration. A subsequent study in the Auvergne-Rhône-Alpes region of France (Fainstein et al., 2024), applying machine learning to passenger satisfaction data, found that the inability to conduct activities because of space constraints or excessive vibration has a statistically significant negative effect on overall satisfaction—stronger than the effect of moderate delays.

For intercity travel, perceived comfort and perceived value of time are identified as the necessary conditions for high-speed rail travel behaviour intention (Chu et al., 2025). This contrasts with air travel, where additional factors—perceived tangibility, inertia, and convenience—are also necessary conditions. The implication is that HSR competes primarily on the in-vehicle experience, not simply on clock-time reduction.

The perceived trip time reliability (PTR) literature further refines this picture. Crowding and seat availability are not merely comfort factors; they enter directly into how passengers experience and remember journey time. Research on multi-modal rail networks (He et al., 2021) developed Perceived Trip Time metrics that incorporate crowding, seat availability, and transfer frequency—finding that PTR is substantially worse than clock-based measures imply when trains are heavily loaded or require transfers. This has direct implications for the monetisation of travel time savings in economic appraisals.

> **Key finding:** *Time savings are most valuable when passengers can use travel time productively. Space constraints, vibration, and crowding erode the benefit of faster journeys—and are not captured in standard travel-time savings models.*

3. Comfort

Comfort is a multi-dimensional and partially subjective construct. A comprehensive review of the ride comfort literature (Jiang et al., 2022) identifies six distinct sub-dimensions of railway ride comfort: static comfort (seating design and ergonomics); vibration comfort; noise comfort; aural pressure comfort (particularly relevant at high speed in tunnels); thermal comfort; and visual comfort. Each has distinct engineering drivers and distinct passenger thresholds.

Seating is consistently one of the highest-ranked comfort attributes in passenger surveys. Research on long-distance travel (Seriani et al., 2024) confirms that passengers on journeys of significant length strongly prefer seated travel. The availability of a seat is not merely a comfort issue—it enters the perceived travel time calculation. Standing passengers on long-distance services report markedly lower satisfaction than seated passengers, and a French study found that standing 'one trip in two' generated a greater negative impact on satisfaction than standing always, because intermittent deprivation is perceived as a specific frustration rather than a background condition.

Thermal comfort is frequently identified as a pain point in passenger surveys. Research on Indian Railways documented high-temperature and poor-ventilation complaints as a dominant driver of negative evaluations. The adaptive thermal comfort literature suggests that passengers adjust expectations to context—but that failures of air conditioning on long-distance services, or cold waiting environments at stations, generate acute dissatisfaction.

Noise and vibration are particularly significant at high operating speeds. Above approximately 200 km/h, aerodynamic noise becomes a primary vibration source, and tunnel pressure transients create aural pressure discomfort unless trains and tunnels are specifically engineered to manage them. These factors are not incidental; they shape the subjective 'ride quality' that passengers associate with a premium or standard service.

Cleanliness is a recurring dimension in satisfaction studies across all world regions. In the SERVQUAL framework widely applied to rail (Parasuraman et al., applied by multiple rail scholars), tangibility—encompassing cleanliness of vehicles and stations—is one of five foundational service quality dimensions. Gender differences in cleanliness sensitivity have been documented in Indian Railways data, with female passengers rating cleanliness disproportionately in their overall satisfaction evaluations.

> **Key finding:** *Comfort encompasses seating availability, thermal conditions, noise/vibration, and cleanliness. Each dimension is independently significant. At high speeds, engineering for vibration and aural pressure comfort requires substantial additional investment compared to conventional rail.*

4. Safety—Objective and Perceived

Safety in the rail satisfaction literature operates on two distinct levels: objective safety (actual accident rates and injury statistics) and perceived safety (passengers' subjective sense of security). Both matter for ridership.

The SERVQUAL dimension of 'assurance'—staff competence and ability to convey trust and safety—is consistently among the higher-weighted service quality dimensions in intercity rail contexts. Post-pandemic research (Champahom et al., 2023) on rail service intentions in Thailand found that health-safety perceptions became a dominant mediating factor in willingness to use rail, overlaying the traditional service quality dimensions. The finding generalises: any salient safety concern—whether health, security, or accident risk—can substantially erode otherwise positive satisfaction scores.

Crowding and platform density interact directly with perceived safety. Swiss Federal Railways research (Leuenberger et al., 2021) found a strong relationship between crowd density at station platforms, subjective comfort, and perceived safety—with elevated density correlating with both reduced safety perception and increased risk-taking behaviour (encroachment on the danger zone adjacent to passing trains). The implication is that overcrowded platforms do not merely reduce comfort; they create demonstrable safety hazards.

The British literature on crowding, stress, health, and safety (Cox et al., 2006) established that passengers are highly sensitive to crowding and, in extreme cases, alter their employment or residential location to avoid routinely crowded rail travel. This represents the most severe revealed preference signal in the satisfaction literature: passengers vote with their feet—and their address.

For high-speed rail specifically, the sense-of-security dimension—defined in survey instruments as 'sense of security against accidents while travelling'—consistently loads as a primary functional service quality factor, alongside noise and vibration. Passengers boarding a high-speed service form safety expectations that must be met by both the vehicle and the infrastructure.

> **Key finding:** *Both objective safety and perceived safety are independent determinants of rail satisfaction and ridership. Platform crowding generates direct safety risks and reduces perceived safety. For HSR, safety assurance is a primary functional service quality dimension.*

5. Station Access, Egress, and the Journey Chain

Passenger satisfaction is not determined solely by the in-vehicle experience. The entire journey chain—from origin to destination—contributes to overall evaluation, and research has established that access and egress segments are disproportionately influential on overall journey satisfaction relative to their share of total travel time.

A landmark study of high-speed rail in China (Hou et al., 2018) decomposed HSR passenger satisfaction into four journey segments: access to the HSR station, waiting, line-haul (the train journey itself), and egress from the HSR station. Satisfaction with access and egress segments independently and significantly predicted overall HSR satisfaction—a finding with major implications for station location decisions. Stations that are inconvenient to reach by public transport, that require long taxi queues, or that involve complex car parking arrangements generate access-egress dissatisfaction that depresses ratings of even a high-quality line-haul segment.

Dutch Railways research established that improvements to access services can substitute for improvements in rail service quality in driving overall satisfaction—meaning that a marginal investment in station access connectivity may yield higher satisfaction dividends than equivalent investment in on-board amenities. This finding has been widely cited in network planning literature.

Passenger flow management at station entrances and concourses is independently significant. Research on Moscow stations (Prozorov et al., 2023) demonstrated that the intensity of passenger flow at entrance groups—effectively, queuing and congestion at station entry—directly affected satisfaction scores with station functioning, and that even distribution of passenger flows increased both satisfaction and preference for rail as a travel mode.

Station facilities—seating, food and beverage, restrooms, wayfinding signage, accessibility infrastructure—are consistently evaluated as independent service quality dimensions. For accessibility-dependent travellers (elderly, mobility-impaired, parents with young children), step-free access, elevator availability, and assistance services are threshold requirements: their absence can make the service effectively unusable regardless of train quality.

> **Key finding:** *Access and egress generate substantial satisfaction effects independent of the line-haul journey. Station location decisions—particularly distance from population centres and quality of onward connections—directly shape ridership outcomes. Remote or poorly-connected stations systematically underperform demand projections.*

6. Price Sensitivity and Value for Money

Price occupies a distinctive position in the rail passenger satisfaction literature: it is consistently identified as important—particularly as a factor in mode choice and in the decision to travel at all—yet it does not dominate overall satisfaction scores in the same way that reliability and comfort do for existing users. The key insight from the research is that price sensitivity is highly heterogeneous across passenger segments, and that passengers evaluate fare not in isolation but as a component of generalised cost, weighed against perceived value for money.

The Spanish high-speed rail literature provides some of the clearest fare elasticity estimates for HSR specifically. Research by Ortega, Guzman, Preston and Vassallo found that for combined HSR and air users on major corridors, direct price elasticities ranged from −0.71 to −0.92 overall, but rose sharply to between −1.11 and −1.94 for leisure travellers—who constitute the majority of passengers on many corridors (approximately 53% on the routes studied). The implication is significant: while HSR fare increases may be tolerable for business travellers, they generate elastic demand responses from leisure and family-purpose travellers, potentially resulting in substantial ridership loss for each percentage increase in fares.

This leisure-business asymmetry is consistently documented across the literature. Business travellers are less price-sensitive because their employers often cover costs and their travel is less discretionary—they have limited ability to cancel or postpone. Leisure travellers, by contrast, have multiple substitutable options (car, bus, staying home) and make trip decisions with household budget constraints in mind. A Chinese HSR segmentation study using Gaussian Mixture Models (Zhu et al., 2024) identified four distinct passenger groups on the Nanning-Guangzhou corridor—Price-Sensitive, General Business, Peak-Hours Enthusiastic, and Leisure Experience Focused—confirming that fare weighting varies substantially across these groups, with price-sensitive passengers requiring markedly different service and pricing strategies than business passengers.

For conventional rail, fare elasticities in developed markets are lower than the HSR figures above. Litman's widely-cited synthesis of North American transit research estimates typical rail fare elasticities in the range of −0.18 to −0.46 (varying by peak/off-peak and market type), substantially lower than bus elasticities—reflecting that rail users in major cities tend to have fewer viable alternatives and higher incomes. However, Litman's analysis also establishes that long-run elasticities are two to three times the short-run values, meaning that the cumulative ridership impact of sustained fare increases significantly exceeds what any single-year analysis implies. Passengers who acquire cars or restructure their travel patterns in response to higher fares are unlikely to return when fares stabilise.

Value for money—the relationship between perceived fare and perceived service quality—is an independent satisfaction dimension, distinct from absolute price level. The SERVQUAL and consumption-values frameworks applied to rail consistently find that passengers evaluate price relative to the quality bundle they receive. A service that is expensive but reliable, fast, comfortable, and well-connected can score well on value for money; a service that is cheaper but unreliable and crowded will score poorly. This distinction matters for HSR planning: if a new high-speed service is priced at a significant premium over existing options but fails to deliver consistently on reliability, comfort, or access convenience, the value-for-money deficit will depress ridership regardless of the objective time savings.

The ratchet asymmetry documented in the HSR pricing literature is also noteworthy for demand modelling: passengers react more strongly to price increases than to equivalent price decreases. Demand models that apply symmetric elasticities to both up and down price movements will therefore underestimate the ridership damage from fare increases and overestimate the ridership benefit from fare reductions. For new greenfield HSR services—

where initial fares must be set before the service has established a reputation—this asymmetry implies that opening fares have a disproportionate effect on ridership trajectory.

The competitive pricing context further shapes fare sensitivity. When HSR competes directly with a low-cost airline option on a corridor, cross-price elasticities are substantial: research on the Sweden domestic air market found cross-price elasticities between rail and air of 0.43 to 0.50. Where the alternative is principally car travel—particularly relevant for Eastern Ontario corridor distances—fare competition is against the generalised cost of driving (fuel, time, tolls), and price sensitivity will vary with fuel prices and highway congestion levels.

> **Key finding:** *Price sensitivity is highly heterogeneous. Leisure travellers (often the majority on HSR corridors) have elastic demand with HSR fare elasticities as high as −1.1 to −1.9. Long-run fare elasticities are 2–3× short-run values. Value for money—fare relative to service quality—is an independent satisfaction dimension; premium pricing that is not matched by premium service quality will underperform ridership projections.*

7. Information, Customer Service, and Disruption Management

Across multiple SERVQUAL-framework applications to rail, the dimensions of responsiveness (willingness to help passengers), assurance (staff competence and trust), and empathy (individualised attention) consistently emerge as significant independent predictors of satisfaction. 'Clarity of information' is identified in the literature review by Ibrahim et al. (2020) as one of nine core factors affecting rail passenger satisfaction, alongside availability, accessibility, ticketing, punctuality, customer service quality, comfort, and safety.

Information during disruption is a particularly high-stakes moment. Passenger dissatisfaction peaks not at the point of delay itself, but when disruption occurs without clear, timely, and accurate information. Research in 13 Chilean cities (reported in the PMC crowding literature, 2023) found that real-time information provision has a significant moderating effect on passenger satisfaction across varying service quality levels—meaning that even when service is poor, well-communicated explanations and alternatives mitigate satisfaction loss.

Digital connectivity and Wi-Fi availability on trains have become increasingly significant satisfaction factors, particularly for business travellers on medium and long-distance services. The inability to work productively due to poor connectivity—documented as a reason for not being able to conduct activities in the French satisfaction study—generates satisfaction losses beyond the mere absence of a service amenity: it forecloses the productive use of travel time that constitutes a primary benefit of rail over driving.

Ticketing ease—simplicity of purchasing, pricing transparency, and integration with multimodal journeys—is ranked by passengers as a high-importance dimension. The Jakarta-Bandung HSR evaluation (Santoso et al., 2024) found that ease of ticket purchasing and accuracy of train operation information both scored among the highest satisfaction-relevant attributes in an importance-performance analysis.

> **Key finding:** *Information quality during normal operations and disruptions, digital connectivity, and ticketing simplicity are independent satisfaction drivers. Their absence depresses overall ratings even when line-haul performance is strong.*

8. Passenger Heterogeneity

A critical methodological finding that runs through the recent literature is that rail passengers do not form a homogeneous market. Satisfaction models that treat all passengers as having the same preferences—averaging across trip purposes, journey lengths, and personal circumstances—systematically obscure the most policy-relevant findings.

Three dimensions of heterogeneity are consistently documented:

- **Trip purpose:** Commuters, business travellers, and leisure travellers weight service attributes differently. Business travellers place high value on reliability, connectivity, and productivity-enabling conditions (seating, power, Wi-Fi). Leisure travellers are highly sensitive to punctuality at specific moments—missing a connection, arriving late for an event—and may value comfort more than headline speed. Commuters are somewhat more accustomed to chronic unreliability but react strongly to crowding.
- **Journey distance:** For short urban trips, crowding avoidance, service frequency, and journey time dominate. For long-distance intercity services, seating availability, comfort dimensions (thermal, noise, vibration), and the ability to use travel time productively become primary. Demand projections that apply urban or commuter satisfaction weights to long-distance HSR markets will systematically misestimate the value of service improvements.
- **Demographic factors:** Age and gender moderate the relationship between service quality dimensions and satisfaction. Elderly passengers place higher weight on accessibility infrastructure and staff assistance. Female passengers tend to weight cleanliness and perceived security more highly. These heterogeneities are masked in aggregate satisfaction scores.

Latent class modelling applied to the GB National Rail Passenger Survey (de Vos et al., 2023) identified three distinct passenger segments with significantly different preference weightings across service attributes. Importantly, segment membership was not fully predicted by observed variables (trip purpose, demographics)—indicating that unobserved factors (income, alternatives available, past experience) also drive preference variation. This finding has direct implications for stated preference surveys used in demand modelling: survey designs that assume homogeneous preferences will produce biased willingness-to-pay estimates.

> **Key finding:** *Passenger markets are heterogeneous in ways that aggregate satisfaction scores conceal. Demand models and willingness-to-pay estimates derived from surveys that assume homogeneous preferences will systematically misrepresent the benefits of rail investment.*

9. Summary: The Hierarchy of Passenger Needs

While the literature does not produce a universally agreed ranking, a consistent hierarchy emerges from the evidence. The hierarchy table is presented in the Executive Summary at the front of this document for ease of reference. In brief:

- **Tier 1 — universal thresholds:** Reliability/punctuality and safety. Failure on either drives passengers away from rail entirely.
- **Tier 2 — strong independent determinants:** Seat availability and crowding; price and value for money; station access and egress quality. Each is independently predictive of both satisfaction and ridership.
- **Tier 3 — significant secondary factors:** Travel time and speed; thermal comfort and cleanliness; information quality during disruption.

- **Tier 4 — important for specific markets:** Noise, vibration and ride quality (especially at high speed); digital connectivity; ticketing simplicity.

10. Implications for Rail Planning and Demand Modelling

Several implications of this evidence base are directly relevant to the assessment of new rail proposals:

- **Fare pricing is a critical demand variable, especially for leisure travel:** Leisure travellers—who typically constitute the majority of passengers on HSR corridors—show elastic demand responses to fare increases (elasticities of −1.1 to −1.9 on Spanish HSR). Long-run fare elasticities are two to three times short-run values. Ridership projections that assume inelastic demand, or that apply business-traveller price sensitivity to a predominantly leisure market, will systematically overstate patronage.
- **Reliability over speed:** The literature consistently shows that a reliable, moderately fast service generates higher satisfaction and stronger ridership retention than a faster but unreliable one. Ridership projections that treat journey-time reduction as the primary benefit, without accounting for the reliability of the new system, will overstate net benefits.
- **Station location is a primary variable:** Access and egress satisfaction is independently predictive of overall journey satisfaction and ridership. Proposals that site stations away from existing population centres, or that depend on transfers from poorly-integrated connecting services, face structural ridership deficits that are not offset by line-haul speed.
- **Crowding and capacity adequacy:** Insufficient seating capacity on flagship services triggers some of the strongest negative satisfaction responses in the literature—in extreme cases, residential relocation. Demand models should incorporate realistic seat-load factors, not average occupancy projections, when estimating satisfaction outcomes.
- **Perceived time savings are not clock-time savings:** Standard travel-time savings calculations use a uniform value of travel time. The literature establishes that this value varies substantially with crowding, comfort, connectivity, and the ability to use time productively. Social cost-benefit analyses that apply uniform VoT multipliers will misestimate the consumer surplus of rail investment.
- **Heterogeneity invalidates aggregate models:** Ridership projections and willingness-to-pay estimates derived from surveys assuming homogeneous preferences—or calibrated against commuter markets and applied to long-distance leisure markets—will systematically produce biased outputs. Independent validation against relevant market segments is required.

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