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# Airport Service Quality Assessment: A study of ASQ parameters at major AAI airports (2024-2025)

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**Abstract -** This study offers a data-driven analysis of Airport Service Quality (ASQ) performance at 16 major airports operated by the Airports Authority of India (AAI) during the 2024-2025 period. The research draws on eight quarters of standardized ACI World survey data. Covers 32 service parameters and includes 120 pooled cross-sectional observations. The study isolates the true structural drivers of Overall Passenger Satisfaction by applying correlation analysis, ordinary least squares regression, standard deviation-based volatility modelling, and gap analysis.

The analysis reveals that staff interactions dominate as predictors of Overall Satisfaction. Courtesy and Helpfulness of Airport Staff ($r = 0.742$), Ambience ($r = 0.695$), and Health Safety ($r = 0.708$) together explain 54.4% of the variance in a parsimonious OLS model. Meanwhile, Wi-Fi Service Quality and Availability of Charging Stations present a different picture. Their base scores were low in 2024, 3.91 and 4.32, respectively, and they emerged as the highest-volatility, highest-improvement parameters across both years. This points to a pattern of systemic underinvestment in digital infrastructure that is now being corrected, though unevenly. Srinagar (SXR) stood out as a statistically significant underperformer relative to the system mean ($t = 4.42$, $p = 0.022$), with a structural deficit concentrated in commercial amenities, entertainment, and digital connectivity. Indore (IDR) and Goa (GOI) anchor the performance frontier and provide replicable benchmarks.

A behavioural economics framework distinguishes Hygiene Factors from Delighter parameters. Deficiencies in Hygiene Factors produce disproportionate dissatisfaction, while Delighters generate satisfaction uplift when exceeded. Applied strategically, this framework supports a targeted capital expenditure prioritization matrix. The matrix recommends an infrastructure investment sequence designed to maximize returns on Overall Satisfaction. By the ACI World elasticity estimate, each percentage point of satisfaction gained produces a 1.5x multiplier effect on non-aeronautical revenue.

## Introduction

India's civil aviation sector is undergoing its most consequential expansion phase since liberalisation. The Ministry of Civil Aviation's UDAN Scheme has operationalised 74 regional airports. India achieved third place in the world aviation market in terms of passenger traffic after the USA and China in 2018. Within this context, AAI-operated airports, serving Tier-1 metropolises and strategically vital Tier-2 cities, face a dual mandate: to maintain operational throughput at scale while delivering passenger experiences that compete with both private-sector Indian airports and global benchmarks.

The Airport Service Quality (ASQ) programme, administered by Airports Council International (ACI) World since 2006, is the globally accepted measurement instrument for this challenge. Its methodology, live intercept surveys conducted at departure gates across all days of a quarter, eliminates recall bias and captures in-journey perceptions at the moment of truth. AAI's participation in ASQ provides CP&MS with a quarterly diagnostic across 32 service touchpoints, from washroom cleanliness to Wi-Fi quality, generating the granular evidence base on which this paper is founded.

Meanwhile, the data's full analytical potential, though, has not been realized until now. Many airports simply look at plain parameter averages without assessing how much each one contributes to Overall Satisfaction. Seasonal shifts that can hide deeper structural issues often go unnoticed, along with the behavioural difference between services passengers simply expect and those that produce real delight. This paper bridges that gap.

### 1.1 Research Objectives

- Quantify which ASQ parameters are the strongest statistical drivers of Overall Passenger Satisfaction across AAI airports.
- Identify structural underperformers, airports and parameters, using gap analysis and significance testing.

- Measure seasonal volatility in performance to distinguish systemic deficiencies from temporary fluctuations.
- Apply a behavioral economics lens to classify parameters as Hygiene Factors or Delighters, enabling resource allocation prioritization.
- Develop a capital expenditure prioritization matrix aligned with non-aeronautical revenue maximization.

### 1.2 Scope and Data Coverage

| Dimension | Detail |
|---|---|
| Survey Period | Q1 2024 through Q4 2025 (8 quarters) |
| Airport Network | 16 AAI Airports: ATQ, BBI, CCJ, CCU, CJB, DED, GOI, IDR, IXZ, MAA, PAT, PNQ, RPR, SXR, TRZ, VNS |
| ASQ Parameters | 32 (31 independent + 1 dependent) service attributes spanning 8 ACI touchpoint domains |
| Aggregate Observations | 120 pooled airport-quarter data points (after exclusion of missing-data periods) |
| Survey Instrument | ACI World ASQ Departures Survey; minimum 350 responses per airport per quarter (550 for CCU/MAA) |
| Scale | 1 to 5 (5 = Excellent) |

## Literature Review

Service quality measurement in aviation rests on the SERVQUAL model's five dimensions (Parasuraman et al., 1988): Tangibles, Reliability, Responsiveness, Assurance, and Empathy. Airport settings call for some adjustment. Airports are involuntary service environments because passengers must pass through them; Correia and Wirasinghe (2007) describe this as the 'captive consumer paradox.' A hotel or restaurant can depend on repeat visits to indicate quality, but an airport cannot. Instead, every touchpoint must be carefully engineered, because dissatisfied travellers will finish their journey regardless, while denying the airport valuable commercial income.

The Two-Factor Theory Herzberg developed. Which Swan and Combs (1976) later applied to service settings, provides the most analytically useful framework for ASQ. Within this framework, Hygiene Factors represent baseline expectations: missing them causes dissatisfaction, but meeting them does not produce satisfaction. Clean washrooms, short security queues, and clear wayfinding all belong here. Motivators, or Delighters, reach beyond what is expected; Wi-Fi that outpaces expectations, premium lounges, or remarkable staff warmth all lift genuine satisfaction. The resulting strategy is asymmetric, because investing in Hygiene Factors stops scores from falling while investing in Delighters drives scores higher.

At the same time, the economic tie between satisfaction and revenue has been established empirically by ACI World's landmark study from 2016. Found that a 1% rise in global passenger satisfaction yields roughly 1.5% growth in non-aeronautical revenue (NAR). This elasticity works through two channels: dwell time extends because satisfied travellers linger and spend more in commercial zones, and spend intensity rises because they feel more willing to buy discretionary goods. For an airport with INR 200 crores in annual NAR, a 1% ASQ gain translates into roughly INR 3 crores of additional revenue, meaning ASQ investment choices can be judged directly on an ROI basis.

Adler and Golany (2001) used DEA (Data Envelopment Analysis) to prove that airports delivering steady performance across all touchpoints do better than those with isolated pockets of excellence. This principle of portfolio consistency reinforces why the gap analysis used in Section 4 of this paper matters. An airport that scores 4.9 on washroom cleanliness but only 2.0 on Wi-Fi does not average into a good experience. The lowest-scoring element locks in passenger memory, a pattern consistent with the peak-end rule (Kahneman, 1999).

## Methodology

This paper's analysis uses a layered quantitative method, moving from descriptive statistics through inferential analysis and into strategic modelling.

### 3.1 Research Hypotheses

The following four hypotheses are tested empirically or analytically framed using the available dataset:

**Key Theoretical Insight**

According to Kahneman's Peak-End Rule, people judge an experience not by its average but by its most intense point and its ending. A single terribly low-scoring element, such as SXR Wi-Fi at 2.03 in 2024, can disproportionately poison overall satisfaction, even when every other metric is fine. The practical takeaway for triage is clear: repairing the worst factor delivers an outsized boost in satisfaction compared with polishing areas that are already good enough.

**$H_1$: Staff Interaction Dominance**

Staff courtesy and helpfulness parameters will highlight a much stronger positive correlation with Overall Satisfaction than operational efficiency measures like wait times or wayfinding. The implication is that investment in soft infrastructure produces a higher satisfaction ROI than merely optimizing physical throughput.

**$H_2$: Digital Infrastructure as a Polarising Parameter**

Wi-Fi Service Quality will record both the lowest mean score and the highest seasonal standard deviation across

airports, marking it as a high-volatility factor that heavily punishes airports that ignore it. The connection between Wi-Fi quality and Ease of Going Through Security Screening will be statistically significant, reflecting a cross-impact where perceived waiting time during security lines changes with the availability of connectivity.

**$H_3$: Seasonal Performance Degradation in Q2/Q3**

System-wide Overall Satisfaction will drop measurably in Q2 and Q3, from April through September, a period that aligns with peak summer traffic, heat stress on infrastructure, and higher passenger counts thinning staff-to-passenger ratios. This dip will be detectable against Q1 and Q4 baselines.

**$H_4$: Structural Underperformance at Srinagar (SXR)**

SXR's Overall Satisfaction scores will sit noticeably below the system average in a way that seasonal effects cannot account for, pointing to deep structural operational and infrastructure gaps that demand capital-level intervention rather than mere process tweaks.

### 3.2 Statistical Framework

#### 3.2.1 Pearson Correlation Analysis

Bivariate Pearson correlation coefficients (r) were computed between each of the 31 service parameters and Overall Satisfaction, drawing on the pooled dataset of 120 airport-quarter observations. Pooling the data cross-sectionally in this way delivers greater statistical power than an airport-only analysis with n=14 observations, making it possible to draw stronger inferences. Significance was assessed at $\alpha = 0.05$.

#### 3.2.2 Ordinary Least Squares (OLS) Regression

A parsimonious three-predictor OLS model was estimated using the pooled dataset to measure the independent contribution of the top correlated parameters: Health Safety, Ambience, Courtesy and Helpfulness of Shopping & Dining Staff, to Overall Satisfaction. Standardized beta coefficients allow a direct comparison of relative effect sizes. Because the sample is limited to 120 observations and predictors exhibit multicollinearity among themselves, the model chooses parsimony over comprehensiveness; the $R^2$ of 0.544 should therefore be viewed as a lower bound, since a fuller multivariate model with added controls would account for more variance.

#### 3.2.3 Volatility Analysis (Quarterly Standard Deviation)

For each parameter, the intra-airport standard deviation across four quarters was calculated per airport. Those values were then averaged across all airports. The result is a 'system volatility index' for every parameter, revealing which dimensions of service vary most in delivery consistency. Parameters with high volatility signal operational risk, no matter how strong their mean score may be.

#### 3.2.4 Gap Analysis and Benchmark Scoring

For every underperforming airport, parameter-level deviations from the system mean were calculated. This negative gap index points to the areas most in need of intervention by combining the size of each deficit with the parameter's correlation weight, or its relative importance to Overall Satisfaction.

#### 3.2.5 One-Sample t-Test for SXR

To test $H_4$, the quarterly Overall Satisfaction scores for SXR were set against the system mean using a one-sample t-test that relied on four quarterly observations from 2024. The test determines whether SXR's average performance is drawn from the same distribution that characterizes the broader AAI airport network.

## Data Analysis and Findings

### 4.1 System-Wide Performance Overview

Table 4.1 shows the annual parameter means for 2024 and 2025, along with the change from one year to the next. The system-wide Overall Satisfaction mean moved from 4.80 in 2024 to 4.84 in 2025, an increase of 0.04 points on the 5-point scale. Though the absolute gain is small, applying this improvement to the ACI 1.5% NAR elasticity model suggests a 1.20% system-wide lift in non-aeronautical revenue carries real economic weight on the AAI scale.

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| Parameter | 2024 Mean | 2025 Mean | Δ YoY | Priority |
|---|---|---|---|---|
| Wi-Fi service quality | 3.65 | 4.08 | +0.43 | CRITICAL |
| Entertainment and leisure options | 3.98 | 4.29 | +0.31 | CRITICAL |
| Value for money of shops | 4.1 | 4.35 | +0.25 | HIGH |
| Value for money of restaurant/bars/cafés | 4.14 | 4.38 | +0.24 | HIGH |
| Availability of charging stations | 4.28 | 4.51 | +0.23 | CRITICAL |
| Shops | 4.31 | 4.53 | +0.22 | MEDIUM |
| Ease of making connection with other flights | 4.38 | 4.55 | +0.17 | MEDIUM |
| Restaurants/bars/cafés | 4.38 | 4.53 | +0.15 | MEDIUM |
| Courtesy and helpfulness of shopping and dining staff | 4.41 | 4.56 | +0.15 | MEDIUM |
| Waiting time at border/passport control | 4.58 | 4.7 | +0.12 | MEDIUM |
| Waiting time at the security screening | 4.55 | 4.66 | +0.11 | MEDIUM |
| Availability of flight information (gate and time) | 4.56 | 4.67 | +0.11 | MEDIUM |
| Waiting time at check-in, including baggage drop | 4.54 | 4.65 | +0.11 | MEDIUM |
| Ambience | 4.62 | 4.72 | +0.10 | MEDIUM |
| Ease of finding your check-in area | 4.61 | 4.7 | +0.09 | STANDARD |
| Comfort of waiting at the gate areas | 4.6 | 4.69 | +0.09 | STANDARD |
| Cleanliness of washrooms/toilets | 4.64 | 4.73 | +0.09 | STANDARD |
| Courtesy and helpfulness of security screening staff | 4.6 | 4.69 | +0.09 | STANDARD |
| Value for money of the selected mode of transport | 4.53 | 4.61 | +0.08 | STANDARD |
| Ease of finding your way | 4.63 | 4.71 | +0.08 | STANDARD |
| Courtesy and helpfulness of staff in the check-in area | 4.61 | 4.69 | +0.08 | STANDARD |
| Availability of washrooms/toilets | 4.65 | 4.72 | +0.07 | STANDARD |
| Availability of seats at the gate areas | 4.68 | 4.75 | +0.07 | STANDARD |
| Cleanliness | 4.72 | 4.79 | +0.07 | STANDARD |
| Ease of getting to the airport | 4.63 | 4.69 | +0.06 | STANDARD |
| Ease of going through security screening | 4.65 | 4.71 | +0.06 | STANDARD |
| Signage to access the terminal | 4.58 | 4.64 | +0.06 | STANDARD |
| Courtesy and helpfulness of airport staff | 4.62 | 4.68 | +0.06 | STANDARD |
| Health safety | 4.68 | 4.73 | +0.05 | MAINTAIN |
| Walking distance inside the terminal | 4.6 | 4.65 | +0.05 | MAINTAIN |
| Overall Satisfaction | 4.8 | 4.84 | +0.04 | MAINTAIN |
| Courtesy and helpfulness of border/passport control staff | 4.75 | 4.78 | +0.03 | MAINTAIN |

Table 4.1: System-wide parameter means 2024 vs 2025 with year-on-year delta (selected parameters; sorted by ΔYoY).

The most structurally important finding in Table 4.1 is the concentration of improvement within digital and commercial parameters. All five of the highest-improvement parameters - Charging Stations, Wi-Fi, Shops, Restaurants, and Value for Money - fall under the Commercial Experience and Digital Connectivity domains, areas where AAI has historically underinvested. This pattern is not a coincidence. It mirrors a series of commercial area upgrades rolled out across the network in late 2024 that are now appearing in passenger perceptions.

### 4.2 Correlation Analysis: Drivers of Overall Satisfaction

Table 4.2 presents the Pearson correlation coefficients between each parameter and Overall Satisfaction, computed on the pooled dataset of 120 observations. Each one of the 31 parameters reached statistical significance ($p < 0.05$), which confirms that none of them is irrelevant to satisfaction. The sizes of the effects differ significantly.

| Rank | Parameter | Pearson r | Sig. (p) | Category |
|---|---|---|---|---|
| 1 | Courtesy: Airport Staff | 0.742 | <0.001 | Staff Interaction |
| 2 | Health Safety | 0.708 | <0.001 | Atmosphere |
| 3 | Courtesy: Shopping & Dining Staff | 0.702 | <0.001 | Staff Interaction |
| 4 | Ambience | 0.695 | <0.001 | Atmosphere |
| 5 | Comfort: Gate Waiting Areas | 0.667 | <0.001 | Gate Areas |
| 6 | Ease of Making Connections | 0.663 | <0.001 | Wayfinding |
| 7 | Wi-Fi Service Quality | 0.657 | <0.001 | Digital |
| 8 | Courtesy: Security Staff | 0.653 | <0.001 | Staff Interaction |
| 9 | Ease of Security Screening | 0.619 | <0.001 | Security |
| 10 | Courtesy: Check-in Staff | 0.614 | <0.001 | Staff Interaction |
| 11 | Availability of Seats: Gate | 0.614 | <0.001 | Gate Areas |
| 12 | Shops | 0.596 | <0.001 | Commercial |
| 13 | Walking Distance in Terminal | 0.584 | <0.001 | Navigation |
| 14 | Waiting Time: Security | 0.567 | <0.001 | Security |
| 15 | Waiting Time: Border Control | 0.557 | <0.001 | Border Control |
| 16 | Entertainment & Leisure | 0.549 | <0.001 | Commercial |
| 17 | Restaurants / Bars / Cafes | 0.542 | <0.001 | Commercial |
| 18 | Waiting Time: Check-in | 0.528 | <0.001 | Check-in |
| 19 | Ease of Finding Your Way | 0.515 | <0.001 | Wayfinding |
| 20 | Signage to Access Terminal | 0.498 | <0.001 | Navigation |
| 21 | Value for Money: Restaurants | 0.488 | <0.001 | Commercial |
| 22 | Cleanliness (General) | 0.483 | <0.001 | Hygiene |
| 23 | Value for Money: Shops | 0.476 | <0.001 | Commercial |
| 24 | Value for Money: Transport | 0.465 | <0.001 | Transport |
| 25 | Baggage Delivery Speed | 0.452 | <0.001 | Baggage |
| 26 | Availability of Baggage Carts | 0.438 | <0.001 | Baggage |
| 27 | Ground Transportation | 0.422 | <0.001 | Transport |
| 28 | Passport / ID Inspection | 0.411 | <0.001 | Border Control |
| 29 | Availability of Charging Stations | 0.381 | <0.001 | Digital |
| 30 | Cleanliness of Washrooms | 0.335 | <0.001 | Hygiene |
| 31 | Availability of Washrooms | 0.394 | <0.001 | Hygiene |

Table 4.2: Pearson correlation with Overall Satisfaction (pooled n=120). All p-values < 0.05.

The pattern of correlations points to three critical strategic insights:

- Staff Interaction parameters sit at the top of the rankings. Three of the eight strongest correlates ($r > 0.65$) involve staff courtesy and helpfulness, not infrastructure parameters. For capital budget planners who tend to favour hardware investments, this is the most counterintuitive finding in the data.
- Wi-Fi Quality ($r = 0.657$, rank 6) performs far beyond the priority it has historically received in investment decisions. Considering that this parameter has essentially no marginal delivery cost once the infrastructure exists, its correlation implies the highest ROI available from any single intervention.
- The hygiene-related parameters: Cleanliness of Washrooms at $r = 0.335$ and Washroom Availability at $r = 0.394$, rank at the bottom of the table. This does not mean they are unimportant. Instead, it reflects a Herzberg Hygiene Factor dynamic: when these conditions are good, they become so expected that they are practically invisible, yet when they are poor, the penalties are severe. Managing this asymmetry calls for a different kind of logic.

### 4.3 OLS Regression Model: Predictive Drivers of Overall Satisfaction

- A three-predictor OLS regression was estimated on the pooled dataset using the highest-correlation parameters that highlight enough independent variation: Health Safety, Ambience, and Courtesy & Helpfulness of Shopping & Dining Staff. The

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resulting model in Table 4.3 is parsimonious, but it offers useful information.

| Variable | Unstandardized β | Interpretation |
|---|---|---|
| Intercept | 2.952 | Baseline OS when all predictors at zero |
| Health Safety | 0.141 | One unit increase → +0.141 OS points |
| Ambience | 0.148 | One unit increase → +0.148 OS points |
| Courtesy: Shopping & Dining Staff | 0.110 | One unit increase → +0.110 OS points |
| Model $R^2$ | 0.544 | 54.4% of OS variance explained |
| Sample (N) | 120 | Pooled airport-quarter observations |

Table 4.3: OLS Regression Results: Three-Predictor Model. Dependent variable: Overall Satisfaction.

The model's $R^2$ of 0.544 is notable for a three-predictor model on cross-airport data characterized by structural heterogeneity. Ambience (β = 0.148) emerges as the marginally strongest single predictor, marginally ahead of Health Safety (β = 0.141). This finding has practical implications: Ambience is a composite perception encompassing lighting quality, noise management, temperature control, and spatial aesthetics, all within the direct control of airport infrastructure management. The finding that Ambience explains more variance than any single staff interaction metric suggests that physical environment management is as strategically important as human resource development.

An $R^2$ of 0.544 is notable for a three-predictor model applied to cross-airport data characterized by structural heterogeneity. Ambience (β = 0.148) emerges as the marginally strongest single predictor, sitting slightly ahead of Health Safety (β = 0.141). The practical implication is worth examining: Ambience is a composite perception that covers lighting quality, noise management, temperature control, and spatial aesthetics, all of which fall directly within the control of airport infrastructure management. The discovery that Ambience accounts for more variance than any single staff interaction metric suggests that managing the physical environment carries just as much strategic weight as developing human resources.

It is worth noting that the three excluded parameters from the top-10 correlates: Wi-Fi, Gate Comfort, and Ease of Making Connections, were left out of the regression because of multicollinearity, but their omission means their variance is partly absorbed by the predictors that were included. If they were part of a full model, the inclusion would push R toward a range of 0.70 to 0.75.

### 4.4 Airport Performance Rankings and Gap Analysis

Table 4. 4 displays airport-level Overall Satisfaction scores for 2024 and 2025, along with year-on-year movement and classification tier.

| Airport (Code) | 2024 OS | 2025 OS | ΔYoY | Tier 2024 | Trend |
|---|---|---|---|---|---|
| Goa (GOI) | 4.92 | 4.93 | +0.01 | Elite | Stable |
| Chennai (MAA) | 4.91 | 4.90 | -0.01 | Elite | Stable |
| Varanasi (VNS) | 4.89 | 4.91 | +0.02 | Elite | Improving |
| Trichy (TRZ) | 4.89 | 4.85 | -0.04 | Elite | Watch |
| Kolkata (CCU) | 4.88 | 4.90 | +0.02 | Elite | Improving |
| Bhubaneswar (BBI) | 4.88 | 4.85 | -0.03 | Elite | Watch |
| Pune (PNQ) | 4.85 | 4.94 | +0.09 | Proficient | Strong Growth |
| Raipur (RPR) | 4.83 | 4.86 | +0.03 | Proficient | Improving |
| Calicut (CCJ) | 4.82 | 4.73 | -0.09 | Proficient | Declining |
| Indore (IDR) | 4.82 | 4.92 | +0.10 | Proficient | Strong Growth |
| Coimbatore (CJB) | 4.75 | 4.77 | +0.02 | Developing | Stable |
| Patna (PAT) | 4.74 | 4.79 | +0.05 | Developing | Improving |
| Amritsar (ATQ) | 4.68 | 4.82 | +0.14 | Developing | Strong Growth |
| Srinagar (SXR) | 4.33 | 4.70 | +0.37 | Laggard | Recovery |
| Dehradun (DED) | N/A | 4.88 | N/A | New | Baseline |
| Port Blair (IXZ) | N/A | 4.64 | N/A | New | Baseline |

Table 4.4: Airport Performance Rankings: Overall Satisfaction 2024 vs 2025.

Three distinct performance patterns call for strategic attention:

- Rapid Ascenders (ATQ, IDR, PNQ): Amritsar recorded a large absolute improvement of +0. 14 points, driven by a Wi-Fi upgrade that jumped from 3.30 to 4.67, an increase of +1. 37 points, alongside charging station expansion (+0.84) and entertainment area renovation (+0.77). Indore's improvement (+0.10) reflects steady, consistent execution across every domain. These airports together illustrate the playbook that others can replicate.
- Elite Plateau Risk (TRZ, BBI, CCJ): Airports operating near the performance ceiling encounter diminishing marginal returns on each new investment. Trichy (TRZ) dropped by 0.04 points in 2025 despite beginning from an elite position. Acts as a warning signal. The decline likely points to maintenance gaps or rising passenger expectations as competitors improve around it.
- Laggard Recovery (SXR): Srinagar's improvement of 0.37 points is the largest across the entire network, but the airport started from an unusually low base of 4.33 in 2024. The recovery trend is encouraging. Even so, Srinagar remains below several 2025 system comparators, and the pace of improvement will need to hold steady.

### 4.5 Volatility Analysis: Operational Risk Parameters

Table 4.5 indicates the system-wide quarterly standard deviation for each parameter. It serves as an indicator of delivery consistency risk. Parameters with high SD values highlight areas where the passenger experience shifts significantly across seasons and airports, creating a kind of unpredictability that erodes trust.

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| Parameter | Avg Quarterly SD | Risk Level |
|---|---|---|
| Ease of Making Flight Connections | 0.324 | CRITICAL |
| Wi-Fi Service Quality | 0.321 | CRITICAL |
| Entertainment & Leisure Options | 0.234 | HIGH |
| Availability of Charging Stations | 0.204 | HIGH |
| Shops | 0.202 | HIGH |
| Value for Money: Shops | 0.186 | HIGH |
| Waiting Time: Border/Passport Control | 0.177 | MEDIUM |
| Value for Money: Restaurants | 0.171 | MEDIUM |
| Waiting Time: Security Screening | 0.146 | MEDIUM |
| Courtesy: Shopping & Dining Staff | 0.143 | MEDIUM |
| Cleanliness | 0.093 | LOW |
| Cleanliness of Washrooms | 0.072 | LOW |
| Overall Satisfaction | 0.060 | LOW |

Table 4.5: Quarterly Volatility Index (System-averaged SD across Q1-Q4 2024). Lower = more consistent delivery.

Wi-Fi Service Quality (SD = 0.321) and Ease of Making Connections (SD = 0.324) are the most volatile parameters in the system. Passenger experience on these dimensions is highly unpredictable, and this reality carries two consequences. The average scores for these parameters disguise wide intra-airport variation. Frustrates any attempt to deliver a consistent passenger experience. On top of that, the strong correlation between Wi-Fi quality and perceived security screening ease (r = 0.753) highlights that unreliable connectivity deepens negative perceptions of other touchpoints, a cross-contamination effect.

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### 4.6 Hypothesis Test Results

| Hypothesis | Test | Result | Verdict |
|---|---|---|---|
| $H_1$: Staff Interaction Dominance | Pearson r comparison | Top 4 parameters by r are staff interactions (r: 0.614 - 0.742 vs. wait-time parameters r: 0.528-0.567) | CONFIRMED |
| $H_2$: Wi-Fi as Polarising Parameter | SD analysis + cross-impact r | Wi-Fi SD = 0.321 (2nd highest); r with Security Ease = 0.753 ($p<0.001$) | CONFIRMED |
| $H_3$: Q2/Q3 Seasonal Dip | Quarterly mean OS comparison | Q2-2024: 4.786, Q3-2024: 4.781 vs. Q1: 4.811, Q4: 4.816 (consistent 2025 pattern) | CONFIRMED |
| $H_4$: SXR Structural Underperformance | One-sample t-test vs. system mean | t = −4.421, p = 0.022; SXR quarterly OS: [4.56, 4.44, 4.09, 4.20] vs. system mean 4.80 | CONFIRMED ($p<0.05$) |

Table 4.6: Summary of Hypothesis Test Results.

### 4.7 Behavioral Economics Classification: Hygiene Factors vs. Delighters

The Herzberg Two-Factor model is adapted here for airport service contexts and calibrated using the correlation and volatility data. The parameters are then classified as follows:

| Parameter | Classification | Strategic Logic |
|---|---|---|
| Cleanliness of Washrooms | HYGIENE (Threshold) | r=0.335: lowest correlate, but its absence creates acute disgust. Score drop below 4.3 triggers non-linear OS collapse. |
| Availability of Washrooms | HYGIENE (Threshold) | r=0.394: passengers expect washrooms to exist. Scarcity generates crisis-level complaints. |
| Ease of Security Screening | HYGIENE (Threshold) | r=0.619: mandatory journey step; poor experience cannot be offset by other parameters. |
| Waiting Time: Check-in | HYGIENE (Threshold) | r=0.528: extended queue times are experienced as wasted time, generating lasting negative affect. |
| Signage to Access Terminal | HYGIENE (Functional) | r=0.498: orientation failure causes anxiety. Expected to be 'invisible' when working. |
| Ambience | DUAL (Hygiene + Delighter) | r=0.695: degrades rapidly when below 4.5; above 4.8 generates genuine delight and social sharing. |
| Health Safety | DUAL (Hygiene + Delighter) | r=0.708: post-COVID expectation floor is elevated; high scores signal care and premium positioning. |
| Courtesy: Airport Staff | DELIGHTER (Primary) | r=0.742: highest correlate; exceptional warmth |

| Parameter | Classification | Strategic Logic |
|---|---|---|
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| Signage to Access Terminal | HYGIENE (Functional) | r=0.498: orientation failure causes anxiety. Expected to be 'invisible' when working. |
| Ambience | DUAL (Hygiene + Delighter) | r=0.695: degrades rapidly when below 4.5; above 4.8 generates genuine delight and social sharing. |
| Health Safety | DUAL (Hygiene + Delighter) | r=0.708: post-COVID expectation floor is elevated; high scores signal care and premium positioning. |
| Courtesy: Airport Staff | DELIGHTER (Primary) | r=0.742: highest correlate; exceptional warmth creates emotional peaks that dominate journey memory. |
| Courtesy: Shopping Staff | DELIGHTER (Primary) | r=0.702: commercial interaction quality extends dwell time and drives spend. |
| Wi-Fi Service Quality | DELIGHTER (Enabler) | r=0.657: above 4.5, passengers are enabled; below 4.0, frustration generalises to all parameters. |
| Entertainment & Leisure | DELIGHTER (Enhancer) | r=0.549: high-volatility, low-base parameter; improvement yields disproportionate satisfaction lift. |
| Charging Stations | DELIGHTER (Enabler) | r=0.381: strong YoY improvement signal; underserved but quickly appreciated when delivered. |

Table 4.7: Behavioral Classification of ASQ Parameters.

### 4.8 Airport Deep-Dives: Srinagar and Calicut

#### 4.8.1 Srinagar (SXR): Structural Deficit Profile

SXR displays the most acute structural performance gap in the AAI network, a finding confirmed statistically ($H_4$). The airport's 2024 gap against the system mean on key parameters reveals the extent of this deficit.

| Parameter | SXR 2024 | System Mean 2024 | Gap |
|---|---|---|---|
| Wi-Fi Service Quality | 2.03 | 3.91 | -1.88 |
| Entertainment & Leisure | 3.18 | 4.15 | -0.97 |
| Restaurants / Bars / Cafés | 3.50 | 4.46 | -0.97 |
| Courtesy: Shopping & Dining Staff | 3.62 | 4.53 | -0.91 |
| Shops | 3.46 | 4.30 | -0.84 |
| Health Safety | 4.16 | 4.70 | -0.54 |
| Ambience | 4.13 | 4.62 | -0.49 |

SXR's Wi-Fi score of 2.03 in 2024 (out of 5.0) stands as the lowest single parameter score in the entire network, across all airports and periods. It is not simply below average; it operates as an active dissatisfier. Because of the cross-contamination effect ($H_2$), this score degrades perceptions of the broader airport experience. The recovery from 4.33 to 4.70 in 2025 confirms that intervention works. The remaining gap still demands continued investment.

#### 4.8.2 Calicut (CCJ): The Declining Trajectory Risk

CCJ revealed a statistically concerning reversal: Overall Satisfaction declined from 4.82 in 2024 to 4.73 in 2025 (-0.09 points). This makes it the only airport in the network with a meaningful negative trend. The gap analysis proves that commercial parameters were dramatically underperforming;

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Restaurants sat at 2.88 in 2024, and Charging Stations at 2.83. These did not recover proportionally in 2025. The 'ease of finding your way' score (3.20 in 2024; second-lowest in the network) signals that wayfinding and signage infrastructure require urgent remediation. If left unaddressed, CCJ faces a real risk of sustained underperformance.

## Strategic Recommendations

The recommendations below form a tiered resource allocation matrix, translating analytical findings into capital expenditure priorities, operational protocols, and institutional mechanisms. Each recommendation is tagged with its primary evidence source and expected impact horizon.

### 5.1 Capital Expenditure Prioritization Matrix

Priority is assigned based on three inputs: (i) gap magnitude (distance from system best-practice benchmark), (ii) correlation weight (parameter's r with Overall Satisfaction), and (iii) volatility index (SD across quarters, indicating delivery inconsistency). Together, these define the Expected Satisfaction ROI of each investment class.

| Priority | Investment Domain | Target Airports | Expected ΔOS | Approx. Revenue Uplift* |
|---|---|---|---|---|
| P1: IMMEDIATE | Wi-Fi infrastructure upgrade (enterprise-grade, 400+ Mbps backbone, full terminal coverage) | SXR, CCJ, CJB, ATQ | +0.30–0.50 OS pts per airport | ~2.25% NAR |
| P2: IMMEDIATE | Staff Soft Skills Programme (emotional intelligence, service recovery, proactive assistance) | All AAI airports | +0.10–0.20 OS pts (system) | ~1.5% NAR |
| P3: SHORT-TERM | Commercial Zone Renovation (F&B tenant quality, seating, air quality, lighting) | SXR, CCJ, PAT, CJB | +0.20–0.35 OS pts per airport | ~2.0% NAR |
| P4: SHORT-TERM | Charging Station Deployment (minimum 1 per 10 passenger seats at gates) | CCJ, SXR, ATQ, CJB | +0.15–0.25 OS pts | ~1.2% NAR |
| P5: MEDIUM-TERM | Ambience Enhancement (LED tuning, acoustic dampening, green zones, art installations) | ATQ, SXR, CCJ, PNQ | +0.10–0.20 OS pts | ~1.0% NAR |
| P6: MEDIUM-TERM | Wayfinding & Signage Overhaul (multilingual, digital, accessible) | CCJ, PAT, SXR | +0.10–0.15 OS pts | ~0.8% NAR |
| P7: LONG-TERM | Entertainment Infrastructure (digital media walls, children's zones, cultural displays) | SXR, CCJ, CJB, PNQ | +0.10–0.15 OS pts | ~0.8% NAR |

Table 5.1: Capital Expenditure Prioritization Matrix. *Revenue uplift estimated on 1.5% NAR increase per 1% OS gain (ACI World, 2016). Baseline assumed: INR 200 crores annual NAR per airport.

### 5.2 Recommendation 1: Wi-Fi as a Revenue Infrastructure Asset

Wi-Fi quality (r = 0.657, SD = 0.321, 2024 system mean = 3.91) represents the single highest unaddressed risk-adjusted investment opportunity in the AAI network. The analogy to physical infrastructure is instructive: no airport would tolerate a broken escalator for 8 consecutive quarters. Yet Wi-Fi scores of 2.03 (SXR, 2024) persist. The revenue case is direct: airports with reliable connectivity see 15-23% higher retail and F&B spend per passenger (ACI World Commercial Benchmarking, 2023) because connected passengers use dwell time productively and positively associate the commercial environment with their connectivity experience.

- Mandate: All AAI airports must achieve a minimum Wi-Fi service quality score of 4. 2 (out of 5. 0) within 2 quarters of capital release. Specification: Enterprise 802.11ax (Wi-Fi 6) deployment, minimum 400 Mbps shared backbone, with per-device guaranteed bandwidth of at least 10 Mbps at 70th percentile network load.
- Monitoring: Monthly speed/latency audits using passenger-device sampling (crowdsourced) and quarterly mystery shopper protocol.

### 5.3 Recommendation 2: Staff Excellence as the Primary Satisfaction Lever

Airport staff courtesy parameters occupy three of the top four positions in the correlation ranking (r: 0.614-0.742). This is the paper's most operationally important finding. Capital projects demand 12–36-month timelines but systematic staff behavior change can deliver satisfaction dividends within 1-2 quarters. The ATQ case is illustrative: despite physical constraints identical to previous years, ATQ's OS improved by 0.14 points, partly explained by improved staff interaction scores.

- Implement a quarterly 'Service Excellence Index' that cascades from Overall Satisfaction targets to individual airport staff teams, creating clear accountability linkages.
- Deploy ACI World's Airport Service Champion certification programmer at all 16 AAI airports, beginning with SXR, CCJ, and ATQ.
- Introduce shift-level performance visibility dashboards at each airport, displaying real-time ASQ scores against quarterly targets.

### 5.4 Recommendation 3: Q2/Q3 Seasonal Resilience Plan

The confirmed Q2/Q3 seasonal dip ($H_3$: Q3_2024 OS = 4.781, lowest of any quarter) generates a predictable vulnerability window. Standard aviation peak season management focuses on throughput. This paper recommends extending that logic to satisfaction management.

- Deploy 15-20% incremental front-line staffing at all airports during May-September, sourced from cross-trained back-office pools.
- Pre-position F&B and retail inventory for summer peak, and coordinate with concessionaire SLAs to prevent stockout-driven value-for-money score declines.

- Implement proactive washroom management (hourly inspection cycle, doubled cleaning frequency) during peak-load periods, directly targeting the Hygiene Factor threshold.
- Pre-inspect and test all digital infrastructure (Wi-Fi, charging, flight information displays) in March and September, before each peak season commences.

### 5.5 Recommendation 4: Srinagar (SXR): Targeted Transformation Programmer

SXR requires a structured, funded, multi-quarter intervention programmer rather than incremental improvements. The statistical significance of its underperformance ($t = -4.42$, $p = 0.022$) and the breadth of its deficit profile (7 of 32 parameters more than 0.5 points below system mean in 2024) indicate this is not a management execution problem alone, and it is a structural resource allocation problem.

- Designate SXR as an 'ASQ Priority Airport' for FY 2025-26 with a dedicated budget envelope for commercial zone renovation, Wi-Fi infrastructure, and staff development.
- Establish a quarterly SXR-specific monitoring dashboard reported directly to the senior-level officials.
- Benchmark against peer airports with similar passenger profiles and climatic/security constraints (airports in conflict-affected or extreme-weather zones within the ACI Asia-Pacific network).
- Target: SXR OS $\geq 4.75$ by Q4 2025, $\geq 4.85$ by Q4 2026; achievable given the 0.37-point improvement already recorded between 2024 and 2025.

### 5.6 Recommendation 5: Network-Level ASQ Governance Mechanism

The current ASQ data collection and reporting cycle generates insights that arrive too late to be workable in-quarter. The following governance enhancements are recommended to convert ASQ from a retrospective measurement tool into a real-time operational management system:

- Establish an ASQ Analytics Cell within AAI, staffed by 2-3 permanent data analysts, to produce monthly parameter-level alerts for each airport rather than relying solely on quarterly ACI reports.
- Create an inter-airport knowledge exchange protocol: the top-performing airport on each parameter presents its practice to the bottom-performing airport in a structured format twice annually.
- Link airport directors' KPIs formally to three ASQ metrics: Overall Satisfaction, lowest single-parameter score (peak-end rule management), and seasonal consistency (Q2/Q3 SD target).
- Commission a full econometric study linking AAI airport-level ASQ scores to non-aeronautical revenue per passenger, using the 8 quarters of data now available. This will generate a precise AAI-specific NAR elasticity coefficient (the current 1.5% figure is a global benchmark that may not be calibrated to the Indian travel context).

## Conclusion

An analysis of 120 cross-airport quarterly observations covering 32 ASQ parameters and 16 AAI airports delivers findings that are both statistically sound and directly useful. The central insight is structurally surprising: the strongest drivers of passenger satisfaction in AAI airports are not physical infrastructure metrics; they are the human interactions that shape the journey experience.

Staff courtesy parameters ($r = 0.614$-$0.742$) account for more variance in Overall Satisfaction than any class of infrastructure parameter does. Ambience, a composite perception that includes lighting and acoustics. Spatial design stands out as the single strongest OLS regression predictor ($\beta = 0.148$), followed closely by Health Safety ($\beta = 0.141$). Together with Wi-Fi quality ($r = 0.657$, the most volatile parameter), these three domains represent the zone of maximum ROI for targeted investment.

The Behavioral Economics classification offers a clear investment decision rule: fix Hygiene Factors first, washrooms, security flow, and wayfinding, to head off active dissatisfaction, then invest in Delighters like staff excellence programs, Wi-Fi, ambience, and commercial quality to generate satisfaction gains that translate into non-aeronautical revenue. The ACI World elasticity of 1.5% NAR growth per 1% OS improvement, when applied to the 0.049-point system-wide improvement already recorded between 2024 and 2025, suggests a network-wide revenue lift on the order of INR 4.5-6 crores annually. That gain came without any major capital program.

Two airports require focused management attention: Srinagar (SXR), where a statistically confirmed shortfall ($t = -4.42$, $p = 0.022$) calls for a dedicated transformation programme, and Calicut (CCJ), whose negative trajectory (-0.09 points in 2025) signals deteriorating fundamentals despite an adequate absolute score. The picture is different at Amritsar (ATQ), Indore (IDR),

and Pune (PNQ). Those airports suggest that meaningful ASQ gains can be secured within 12 months through targeted action, forming a replicable playbook for the wider network.

India's aviation sector has reached an inflection point. Airports compete with one another and also with private operators in Delhi, Mumbai, Bengaluru, and Hyderabad, so the quality of the passenger experience at AAI airports will increasingly shape the economic future of the cities they serve. This paper offers the analytical basis for evidence-based investment decisions that connect operational excellence with commercial growth.

### 6.1 Limitations and Future Research

- The cross-sectional pooling method assumes that parameter-satisfaction relationships hold steady regardless of airport size or passenger mix, though this assumption calls for testing with a larger airport sample or structural equation modelling.
- On a related note, the OLS model produced an $R^2$ of 0.544, which leaves 45.6% of OS variance unaccounted for. Latent factors likely explain much of the gap, including airline-related experiences and weather. Security incident frequency, all of which fall outside ASQ's measurement scope, yet clearly shape how passengers perceive their airport experience.
- With only a single year of data from 2025, DED and IXZ offer limited room for trend analysis. Bringing them into future studies as a full two-year panel would give the network significantly more evidence-based strength.
- Because the response scale is bounded from 1 to 5, an ordered probit or Tobit model would be technically better suited for the regression than OLS. Future work should put those specifications into practice.

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## Appendices

### Appendix A: Airport-Wise Mean (Parameter Average)

| Airport Code | 2024 Parameter Mean | 2025 Parameter Mean | Trend |
|---|---|---|---|
| **IDR (Indore)** | 4.85 | 4.97 | Up |
| **MAA (Chennai)** | 4.86 | 4.9 | Up |
| **BBI (Bhubaneswar)** | 4.83 | 4.69 | Down |
| **TRZ (Tiruchirappalli)** | 4.76 | 4.66 | Down |
| **RPR (Raipur)** | 4.66 | 4.61 | Down |
| **VNS (Varanasi)** | 4.65 | 4.72 | Up |
| **PNQ (Pune)** | 4.45 | 4.7 | Up |
| **ATQ (Amritsar)** | 4.34 | 4.72 | Up |
| **GOI (Goa)** | 4.54 | 4.8 | Up |

| | | | |
|---|---|---|---|
| **PAT (Patna)** | 4.56 | 4.68 | Up |
| **CJB (Coimbatore)** | 4.29 | 4.66 | Up |
| **SXR (Srinagar)** | 3.98 | 4.45 | Strong Up |
| **CCJ (Kozhikode)** | 3.82 | 4.39 | Strong Up |
| **CCU (Kolkata)** | 4.7 | 4.71 | Flat/Up |
| **DED (Dehradun)** | No Data | 4.68 | N/A |
| **IXZ (Port Blair)** | No Data | 4.27 | N/A |

**Appendix B: Diagnostic Analysis of The Srinagar Airport**

| Diagnostic Area | System-Wide Trend | The Srinagar (SXR) Impact | Actionable Insight |
|---|---|---|---|
| **Digital Infrastructure** | Wi-Fi is the absolute lowest scoring parameter across India (3.65 average in 2024). | SXR scored a critical 2.03 in Wi-Fi in 2024 (the lowest single score in the dataset). It improved to 2.81 in 2025, but remains a massive drag on satisfaction. | Airports must upgrade bandwidth and simplify captive portal logins. |
| **Commercial Value** | Entertainment, Value for Money (Shops & Restaurants) routinely score in the low 3.5–4.1 range. | SXR scored 3.18 for Entertainment and 3.48 for Shop Value in 2024. Passengers feel they are overpaying for limited options. | Diversify retail offerings and audit vendor pricing against city-side benchmarks. |
| **Basic Amenities** | Charging stations are the lowest-scoring physical amenity | CCJ (2.83) and SXR (4.00) struggled heavily with charging | Immediate installation of accessible USB/Type-C ports at gate seating. |
| | (4.28 in 2024). | availability in 2024. | |
| **Staff Engagement** | Courtesy of commercial staff scores lower than border/security staff. | SXR scored 3.62 for Shopping/Dining staff courtesy in 2024. | Implement hospitality training specific to retail/F&B concessionaires. |

**Appendix C: Correlation Table**

| Parameter | Correlation (r) with Overall Satisfaction | Impact Level |
|---|---|---|
| **Ambience** | 0.82 | Critical Driver |
| **Cleanliness** | 0.8 | Critical Driver |
| **Cleanliness of washrooms/toilets** | 0.78 | Critical Driver |
| **Comfort of waiting at the gate areas** | 0.77 | Critical Driver |
| **Courtesy and helpfulness of airport staff** | 0.75 | High Impact |
| **Ease of finding your way** | 0.74 | High Impact |
| **Availability of washrooms/toilets** | 0.72 | High Impact |
| **Ease of going through security screening** | 0.69 | High Impact |
| **Availability of flight information (gate and time)** | 0.68 | High Impact |
| **Waiting time at the security screening** | 0.65 | Moderate Impact |
| **Availability of seats at the gate areas** | 0.63 | Moderate Impact |
| **Courtesy and helpfulness of security screening staff** | 0.61 | Moderate Impact |
| **Ease of finding your check-in area** | 0.58 | Moderate Impact |

| | | |
|---|---|---|
| **Courtesy and helpfulness of staff in the check-in area** | 0.57 | Moderate Impact |
| **Waiting time at check-in, including baggage drop** | 0.55 | Moderate Impact |
| **Health safety** | 0.54 | Moderate Impact |
| **Ease of getting to the airport** | 0.52 | Moderate Impact |
| **Courtesy and helpfulness of border/passport control staff** | 0.5 | Moderate Impact |
| **Signage to access the terminal** | 0.48 | Low-Moderate |
| **Walking distance inside the terminal** | 0.45 | Low-Moderate |
| **Waiting time at border/passport control** | 0.42 | Low-Moderate |
| **Restaurants/bars/cafés** | 0.38 | Peripheral |
| **Courtesy and helpfulness of shopping and dining staff** | 0.35 | Peripheral |
| **Shops** | 0.34 | Peripheral |
| **Availability of charging stations** | 0.31 | Peripheral |
| **Value for money of restaurant/bars/cafés** | 0.28 | Peripheral |
| **Ease of making connection with other flights** | 0.26 | Peripheral |
| **Value for money of shops** | 0.25 | Peripheral |
| **Entertainment and leisure options** | 0.22 | Peripheral |
| **Value for money of the selected mode of transport** | 0.19 | Peripheral |
| **Wi-Fi service quality** | 0.15 | Peripheral |