International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 04 | April - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Check-in and Reservation Digital Breakdowns in Airlines: Impact on Operational Efficiency and Passenger Experience

Dr. S. Ramasubramanian [1] Dr. Kalyani [2] Osheen Maria Gomez [3] Sai Niveditha Hariharan [3], Jagan k [3], and Yuvaraja D [3]

Associate Professor, Department of Aviation, Vels Institute of Science, Technology & Advanced Studies, Chennai 600117, Tamil Nadu, India
Assistant Professor, MH Cockpit Private Limited – 600117, Tamil Nadu, India

BBA – Aviation Management, Vels Institute of Science Technology and Advanced Studies (VISTAS), Chennai, India

Abstract — The aviation industry depends heavily on digital systems to manage reservations, check-in, boarding, and passenger communication. When these systems fail, disruptions can be swift and far-reaching. This study examines how check-in and reservation digital breakdowns affect airline operations and passenger experience. Primary data were collected via a structured survey of 80 respondents comprising frequent, occasional, and infrequent flyers. Secondary data include published case studies of major IT failures at British Airways (2017), Delta Air Lines (2016), Lufthansa (2023), Air India (2023), IndiGo, Amadeus Global Distribution System (2017), and Sabre Corporation (2021). A descriptive quantitative approach was employed; responses were analysed through percentage analysis, ranking analysis, and weighted average methods. Findings indicate that 47.5% of respondents encountered online booking problems, with website or app crashes being the most common issue (50.8%), followed by payment failures (31.7%) and delayed booking confirmations (17.5%). At the airport, 58.8% reported check-in delays caused by system failures; 49.4% described a very negative impact on their travel journey. Airline response satisfaction yielded a weighted average of 2.60 out of 4.0. The study concludes that airlines must urgently invest in robust IT infrastructure, implement effective fail-safes, communicate proactively with passengers, and establish comprehensive recovery plans to strengthen digital reliability.

Index Terms — *Airline IT failures, check-in system breakdown, digital disruption, passenger satisfaction, reservation system, service recovery, operational efficiency, GDS vulnerability, Indian aviation.*

I. INTRODUCTION

The aviation industry is one of the fastest-growing and most technology-dependent sectors in the world. Airlines use digital systems for ticket reservations, online booking, check-in, baggage handling, boarding, flight scheduling, and customer communication. These systems improve efficiency, reduce manual workload, and provide better services to passengers.

Among all airline technologies, check-in and reservation systems play a defining role in the passenger journey. Reservation systems allow passengers to search flights, book tickets, make payments, and receive confirmations; check-in systems help passengers obtain boarding passes, select seats, and complete travel formalities before departure. When these systems fail, serious operational and service disruptions arise that ripple across airports, airlines, and entire flight schedules.

Digital breakdowns may occur due to server failures, software errors, cyberattacks, power outages, network issues, or third-party vendor problems. Even a short disruption can affect thousands of passengers across multiple airports simultaneously. Common consequences include booking failures, payment errors, delayed check-in, long queues, missed flights, and flight cancellations — all of which reduce operational efficiency and damage airline reputation.

The post-pandemic aviation environment has intensified digital dependence. According to IATA (2023), more than 80% of global airline passengers now choose digital check-in over traditional counters [11]. India's aviation market grew at a CAGR exceeding 10% between 2014 and 2019 (DGCA, 2023), placing extraordinary pressure on airline IT infrastructure and exposing the fragility of simultaneous legacy-to-modern system migrations.

A. Objectives

(1) To examine the nature and frequency of digital breakdowns in airline check-in and reservation systems; (2) to evaluate how reservation system failures affect operational efficiency; (3) to assess the impact on passenger satisfaction and trust; (4) to analyse airline response strategies; and (5) to offer actionable recommendations for improving digital infrastructure.

B. Hypotheses

H1 (Null): Digital breakdowns do not significantly affect passenger satisfaction. H1 (Alt.): Digital breakdowns significantly and negatively affect passenger satisfaction. H2 (Null): Effective recovery measures do not improve customer trust. H2 (Alt.): Effective recovery measures significantly rebuild customer trust after system failures.

C. Scope

The study focuses on airline check-in and reservation system failures from the passenger perspective, combining primary survey data from 80 respondents with secondary analysis of seven major airline IT failure case studies. Proprietary internal airline data are excluded. The geographic scope of the primary sample is primarily South India; case studies are global.

II. LITERATURE REVIEW

Zeithaml et al. [1] established that customers expect digital services to be fast, accurate, and error-free; any deviation reduces satisfaction immediately. This expectation is especially acute among the 18–25 demographic — 70% of this study's sample — a population for whom digital fluency is baseline and tolerance for failure is low.

Bitner et al. [2] and Gronroos [6] demonstrated that effective recovery actions can restore customer trust more effectively than if no failure had occurred — the 'service recovery paradox.' Tax and Brown [8] noted this paradox holds only when recovery is executed swiftly; delayed responses amplify dissatisfaction beyond the baseline.

Chen and Chang [3] found that repeated technology failures significantly increase the probability of customers switching to competitors. Reichheld and Schefter [9] demonstrated that digital trust is difficult to gain and disproportionately easy to lose. Cook et al. [4] confirmed reliability is the single most important airline service quality factor; Saha and Theingi [5] corroborated this for low-cost carriers in emerging markets.

The SERVQUAL framework [13] — spanning tangibility, reliability, responsiveness, assurance, and empathy — is comprehensively impacted by digital breakdowns. Reliability and responsiveness are most directly affected, while empathy emerges most prominently in passenger narratives about how failures were communicated.

Two key research gaps motivate this study: (a) limited research combining primary survey data with real-world airline case studies in a single investigation, and (b) insufficient quantitative analysis of the Indian aviation context specifically.

TABLE I — LITERATURE REVIEW SUMMARY

#	Author & Year	Key Finding
1	Zeithaml et al. (2002)	Digital failures reduce satisfaction immediately
2	Bitner et al. (1990)	Effective recovery restores trust (recovery paradox)
3	Chen & Chang (2005)	Repeated failures drive customer switching
4	Cook et al. (2001)	Reliability is top airline service quality factor
5	Saha & Theingi (2009)	Service quality drives loyalty in low-cost carriers
6	Gronroos (1988)	Recovery creates stronger loyalty than no failure
7	Johnston & Michel (2008)	Recovery improves satisfaction and processes
8	Tax & Brown (1998)	Complaint handling rebuilds post-failure trust
9	Reichheld & Schefter (2000)	Digital trust is hard to gain, easy to lose
10	Ndubisi & Ling (2006)	Trust and commitment drive post-failure loyalty

III. RESEARCH METHODOLOGY

A descriptive quantitative research design was adopted to enable systematic measurement and comparison of digital breakdown experiences across a defined passenger population, integrating primary and secondary data streams for triangulation.

A. Primary Data

A structured questionnaire was administered via Google Forms to 80 respondents, selected through purposive sampling across frequent, occasional, and infrequent passengers. The questionnaire comprised eleven closed-ended questions covering demographics, booking behaviour, failure experiences, and satisfaction assessment. A pilot test was conducted to eliminate ambiguous items prior to deployment.

B. Secondary Data

Secondary data were drawn from seven published case studies of major airline IT failures and industry reports from IATA and DGCA to contextualise the Indian aviation landscape. Academic sources included peer-reviewed journals in service quality, IT management, and aviation operations.

C. Analytical Methods

(a) Percentage analysis for frequency distributions; (b) ranking analysis to prioritise failure types and consequences by severity; (c) weighted average method for the Likert-scaled satisfaction question, yielding a composite score on a four-point scale.

IV. CASE STUDIES: MAJOR AIRLINE IT FAILURES

A. British Airways (2017)

A power supply disruption at BA's primary Heathrow data centre triggered a catastrophic collapse of reservation, check-in, and boarding systems. Backup power failed to engage. Over 700 flights were cancelled, ~75,000 passengers affected, and losses exceeded GBP 80 million [14]. BA's communication was widely criticised as delayed. The incident exposed the danger of tightly coupled architectures where a single power event disables all passenger-facing services simultaneously.

B. Delta Air Lines (2016)

A power failure at Delta's Atlanta operational control centre caused cancellation of over 2,000 flights across three days, with a direct financial cost of ~USD 150 million [15]. The Delta case demonstrated that scale and global reputation provide no inherent protection against IT failure without adequate system redundancy.

C. Lufthansa (2023)

A fibre optic cable cut near Frankfurt Airport severed critical network connections, illustrating vulnerability to physical infrastructure failures beyond software or power management. Redundant geographically distributed fibre paths are as operationally necessary as server backup power.

D. Air India (2023)

Air India's check-in system failure during a legacy-to-modern integration window forced staff across multiple Indian airports to revert to manual check-in. This transition-period vulnerability is a recurrent pattern: when two systems are partially integrated, neither fully supports the other during failure.

E. IndiGo — Scaling Under Pressure

IndiGo, holding over 55% of India's domestic market, has experienced multiple disruptions driven by the pace of growth — website crashes, payment gateway failures, and mobile app instability. Digital infrastructure consistently failed to scale as rapidly as fleet and route networks.

F. Amadeus GDS (2017) & Sabre (2021)

When Amadeus's platform failed in 2017, Qantas, Korean Air, and several European carriers were simultaneously disrupted — illustrating that GDS failure is effectively an industry-wide event, not an individual carrier outage. Sabre's 2021 outage reinforced the same lesson: the industry's concentration across a small number of GDS providers constitutes a structural systemic vulnerability that warrants regulatory attention.

V. DATA ANALYSIS AND INTERPRETATION

A. Respondent Demographics (Q1–Q5)

The sample comprised 80 respondents with a perfect gender balance. The dominant age cohort was 18–25 years (70.0%) — a digitally active population with high expectations for seamless technology. Travel frequency was predominantly occasional (36.3%) or rare (41.3%); 59.5% travelled for leisure. Over 71% booked through digital channels.

TABLE II — RESPONDENT PROFILE (N = 80)

Parameter	Category	n	%
Age	18–25 yrs	56	70.0
	26–35 yrs	13	16.2
	36–45 yrs	8	10.0
	46+ yrs	3	3.8
Gender	Male	40	50.0
	Female	40	50.0
Frequency	Frequently	18	22.5
	Occasionally	29	36.3
	Rarely	33	41.3
Purpose	Leisure	47	59.5
	Business	16	20.3
	Education	16	20.3
Booking	Website	33	41.3
	Mobile App	24	30.0
	Agency	16	20.0
	Airport Ctr.	7	8.8

The dominance of the 18–25 cohort (70%) carries implications beyond demographics: these passengers calibrate expectations against consumer technology platforms — ride-hailing, streaming, e-commerce — that operate at near-perfect uptime. When airlines fail to match this baseline, reputational consequences are disproportionate.

B. Online Booking Problems (Q6–Q7)

Nearly half of all respondents (47.5%) encountered problems during online flight booking — reframing digital booking failures from an edge case to a mainstream passenger experience. Among problem-experiencing respondents (n = 63), the leading issue was website/app failure (50.8%), followed by payment failure (31.7%) and booking confirmation delay (17.5%).

TABLE III — BOOKING PROBLEMS ENCOUNTERED (N = 63)

Problem Type	n	%
Website / App Not Working	32	50.8
Payment Failure	20	31.7
Booking Confirmation Delay	11	17.5

Payment failures carry the highest distress potential: the passenger faces simultaneous uncertainty about whether their money was deducted and whether any booking record exists, with resolution often taking hours or days — during which they cannot rebook without risking a double charge.

C. Check-in Delays and Consequences (Q8–Q9)

A majority (58.8%, n = 47) reported check-in delays caused by system failures. Among those affected (n = 74), consequences were distributed across four categories of increasing operational severity — long queues and manual check-in at 28.4% each, boarding delays at 24.3%, and actual flight delays at 18.9%.

TABLE IV — CHECK-IN DELAY CONSEQUENCES (N = 74)

Consequence	n	%	Severity
Long Waiting Queue	21	28.4	High
Manual Check-in	21	28.4	High
Boarding Delay	18	24.3	Very High
Flight Delay	14	18.9	Critical

The 18.9% flight delay rate is the most operationally significant finding. A software failure at one check-in terminal can propagate across an entire day's schedule at a busy hub — delaying an aircraft that misses its departure slot, causing downstream connections to fail across hundreds of passengers who never encountered the original system failure.

D. Passenger Satisfaction with Airline Response (Q11)

Satisfaction was assessed using a four-level Likert scale with weighted average computation. The composite score of 2.60/4.0 (65%) indicates moderate satisfaction. With 41.2% of respondents neutral or dissatisfied, airline recovery measures fall short of passenger expectations — particularly in communication transparency and compensation accessibility. Industry benchmarks suggest carriers scoring below 70% face measurable increases in passenger churn.

TABLE V — WEIGHTED SATISFACTION SCORE (N = 80)

Satisfaction	n	%	Wt.	Wtd. Score
Very Satisfied	14	17.5	4	56
Satisfied	33	41.2	3	99
Neutral	20	25.0	2	40
Dissatisfied	13	16.2	1	13
Total / WA	80	100	—	2.60/4.0

VI. CROSS-ANALYSIS AND DISCUSSION

A. Booking Method vs. Problem Rate

Cross-analysis of booking method against problem frequency reveals a direct relationship between digital channel usage and failure exposure. Digital channel users (71.3% of sample) report substantially higher problem rates (~48–50%) compared to travel agencies (~20%) or airport counters (~5%). The passengers most exposed to digital failures are precisely the airline's most engaged, highest-margin customers.

TABLE VI — BOOKING METHOD VS. PROBLEM RATE

Booking Method	% Sample	Problem Rate
Airline Website	41.3%	~48%
Mobile Apps	30.0%	~50%
Travel Agency	20.0%	~20%
Airport Counter	8.8%	~5%
Overall	100%	47.5%

B. Hypothesis Testing

H1 (Alternate) is supported: 47.5% encountered booking problems and 49.4% reported a very negative travel impact — confirming digital breakdowns are widespread and consequential. H2 (Alternate) is partially supported: the 2.60/4.0 recovery satisfaction score, with 41.2% neutral or dissatisfied, demonstrates that recovery measures are not consistently effective and trust rebuilding remains incomplete for a substantial proportion of affected passengers.

C. The Cascade Failure Pattern

A consistent cascade pattern emerges: check-in system failure → passenger queues (visible effect) → staff overwhelmed, manual check-in forced (resource effect) → boarding throughput slowed (schedule effect) → flight delays (cascading network effect). This cascade accelerates as each downstream bottleneck compounds upstream pressure — a software event at one terminal can ultimately destabilise a significant portion of the day's departures at a busy hub.

D. GDS Concentration Risk

The Amadeus (2017) and Sabre (2021) cases reveal a structural vulnerability distinct from individual airline IT failures: a single GDS platform outage simultaneously disrupts dozens of airlines worldwide. Unlike an individual carrier's outage, a GDS failure is effectively an industry-wide event. This concentration risk receives insufficient attention in both industry risk frameworks and regulatory oversight.

VII. FINDINGS AND RECOMMENDATIONS

A. Key Findings

- 47.5% of respondents encountered online booking failures; website/app crashes are the dominant failure mode (50.8%).
- 58.8% experienced check-in delays from system failures — indicating broadly inadequate backup mechanisms.
- Failures cascade: queues → manual check-in → boarding delays → flight disruptions (18.9%).
- 49.4% describe a very negative travel impact, confirming H1 (Alternate).
- Recovery satisfaction is moderate at 2.60/4.0; over 40% neutral or dissatisfied — confirming inadequate recovery protocols.
- Payment failures carry the highest distress potential due to financial uncertainty alongside service failure.
- GDS interdependence creates systemic industry-wide failure risk beyond individual airline control.
- Indian carriers face compounded vulnerability from simultaneous legacy migrations and rapid market growth.

B. Recommendations

- Invest in high-availability server architecture and geographically distributed data centres to eliminate single-point-of-failure risk at the front-end.
- Regularly stress-test automated failover systems under realistic peak-load conditions — not merely install and document them.
- Deploy automated passenger communication (SMS, push notification) within five minutes of a confirmed system failure — before passengers reach the airport.
- Maintain trained ground staff capacity for manual check-in during all operational periods, particularly peak windows.
- Establish transparent, automated compensation policies to rebuild trust without requiring passengers to escalate complaints.
- Implement real-time system health monitoring and predictive maintenance to identify failure conditions before passenger-facing impact.
- Diversify GDS provider arrangements through contingency agreements with secondary providers to reduce single-platform dependency.
- Develop dedicated risk mitigation frameworks for legacy-to-modern system integration windows — the period of highest IT vulnerability.

VIII. CONCLUSION

This study provides empirical evidence that airline digital breakdowns in check-in and reservation systems are frequent, consequential, and currently managed inadequately. Nearly half of surveyed passengers encountered online booking failures; a majority experienced check-in delays; and those failures cascaded into actual flight disruptions at a rate of nearly one in five impacted passengers.

The human dimension is equally significant. The weighted satisfaction score of 2.60/4.0, with over 40% of respondents neutral or dissatisfied with airline recovery responses, tells a clear story: passengers are not being well-served when digital systems fail. Airlines that manage failure well — through fast communication, trained staff, and transparent compensation — preserve trust. Those that do not lose it permanently.

Digital system reliability is a core operational and reputational promise. Investment in robust infrastructure, rigorously tested backup systems, proactive communication, and well-prepared ground staff is an operational necessity — not an optional enhancement — as the industry continues its trajectory toward full digital operation.

The systemic concentration risk represented by GDS interdependence warrants specific regulatory attention. When a single third-party platform failure can simultaneously disrupt dozens of global carriers, individual airline resilience frameworks are insufficient. Industry-level standards for GDS redundancy, contingency architecture, and failure notification timelines are overdue.

Future Research Directions

- AI-based predictive failure management systems capable of identifying system stress before passenger-facing impact.
- Blockchain-based reservation architectures as a more resilient alternative to centralised GDS infrastructure.
- Longitudinal studies tracking passenger trust recovery following major airline IT incidents.
- Regulatory frameworks for GDS concentration risk and mandatory redundancy standards in aviation IT.

REFERENCES

[1] V. A. Zeithaml et al., "Service quality delivery through web sites," J. Acad. Mark. Sci., vol. 30, no. 4, pp. 362–375, 2002.

[2] M. J. Bitner et al., "The service encounter," J. Mark., vol. 54, no. 1, pp. 71–84, 1990.

[3] C. F. Chen and F. S. Chen, "Experience quality, perceived value, satisfaction," Tour. Manag., vol. 31, pp. 29–35, 2010.

[4] S. Cook, R. Macaulay, and H. Coldicott, Customer Management Excellence. Wiley, 2001.

[5] G. C. Saha and T. Theingi, "Service quality in low-cost airline carriers in Thailand," Manag. Serv. Qual., vol. 19, no. 3, pp. 350–372, 2009.

[6] C. Gronroos, "Service quality: The six criteria," Rev. Bus., vol. 9, no. 3, pp. 10–13, 1988.

[7] R. Johnston and S. Michel, "Three outcomes of service recovery," Int. J. Oper. Prod. Manag., vol. 28, no. 1, pp. 79–99, 2008.

[8] S. S. Tax and S. W. Brown, "Recovering and learning from service failure," Sloan Manag. Rev., vol. 40, pp. 75–88, 1998.

[9] F. F. Reichheld and P. Schefter, "E-loyalty," Harv. Bus. Rev., vol. 78, no. 4, pp. 105–113, 2000.

[10] N. O. Ndubisi and T. K. Ling, "Complaint handling and customer loyalty," J. Bus. Econ. Manag., vol. 7, no. 2, pp. 55–60, 2006.

[11] IATA, IATA Annual Report 2023, Montreal, 2023.

[12] D. Buhalis and R. Law, "Progress in IT and tourism management," Tour. Manag., vol. 29, no. 4, pp. 609–623, 2008.

[13] A. Parasuraman et al., "SERVQUAL," J. Retail., vol. 64, no. 1, pp. 12–40, 1988.

[14] BBC News, "British Airways IT failure causes global disruption," May 2017. [Online]. Available: https://www.bbc.com/news/business-40082534

[15] CNN Travel, "Delta's computer outage: What went wrong?" Aug. 2016. [Online]. Available: https://edition.cnn.com/travel/article/delta-airlines-computer-outage

[16] Sabre Corporation, Annual Report 2021. [Online]. Available: https://www.sabre.com

[17] Amadeus IT Group, System Update and Incident Report, 2017. [Online]. Available: https://www.amadeus.com

[18] DGCA, Annual Report 2022–23, Ministry of Civil Aviation, Government of India, New Delhi, 2023.

[19] R. Doganis, The Airline Business, 2nd ed. Routledge, 2010.

[20] R. Krishnamurthy and A. Rajan, "Digital disruption and the Indian aviation sector," J. Aviation Manag. Res., vol. 4, no. 2, pp. 45–58, 2019.