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Improving Operational Resilience with AIRQUAL: Managing Flight Delays and Cancellations in Airport IT Disruptions

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Abstract

This study investigates the application of the AIRQUAL model in assessing and enhancing airport service quality during technology network disruptions that often lead to flight delays and cancellations. By integrating AIRQUAL dimensions (Airline/Airport Service Quality Model) with operational resilience strategies, the research aims to identify key factors influencing passenger satisfaction, operational continuity, and airport collaborative decision-making (A-CDM). Findings are expected to provide recommendations for airport authorities, airlines, and stakeholders in developing proactive mitigation frameworks to minimize operational disruptions caused by technology network failures.

Keywords: AIRQUAL, Airport Technology Network Disruptions, Flight Delays, Flight Cancellations, Service Quality

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Introduction

In recent years, airport operations have become increasingly dependent on complex technology networks that integrate flight information systems, air traffic management, passenger processing platforms, baggage handling systems, and security operations. While these digital infrastructures are designed to enhance operational efficiency, their growing complexity also creates vulnerabilities. Technology network disruptions, including system outages, cyberattacks, and failures in software or hardware components, have emerged as critical factors contributing to widespread flight delays and cancellations across global airports.

System outages often occur due to technical malfunctions, power failures, or software errors within critical airport systems. For instance, disruptions in airline reservation platforms, check-in systems, or flight information displays can create cascading effects, delaying boarding processes and ground operations. Similarly, failures in baggage handling or aircraft dispatch systems may extend turnaround times, leading to further schedule disruptions.

Cybersecurity threats represent an even greater challenge, as airports have become high-value targets for cyberattacks. Cyber incidents such as ransomware attacks or distributed denial-of-service (DDoS) attacks can paralyze essential airport functions, jeopardize both operational continuity and passenger data security. Recent global events highlight that even a short-lived cyber incident can ground hundreds of flights, creating massive financial losses for airlines and inconvenience for thousands of passengers.

Hardware and software failures also remain a persistent cause of disruptions. Legacy systems, outdated servers, or insufficient redundancy mechanisms increase the risk of breakdowns. In cases where backup systems are inadequate, even minor failures can escalate into major operational crises. The interconnected nature of airport technology networks further amplifies these risks, as a disruption in one subsystem often spreads across multiple functions, magnifying its impact.

The consequences of such disruptions are significant. Flight delays and cancellations not only undermine passenger satisfaction but also impose substantial costs on airlines, airports, and associated stakeholders. According to aviation industry reports, unplanned IT disruptions can cost millions of dollars in operational losses and compensation claims. Moreover, recurrent disruptions

erode passenger trust in both airlines and airport management, potentially affecting long-term competitiveness.

Given the increasing reliance on digital systems in the aviation sector, airport technology network disruptions pose a critical challenge to operational resilience. There is an urgent need for airports and airlines to strengthen their technological infrastructure, enhance cybersecurity frameworks, and implement proactive contingency planning. Understanding the link between technology disruptions and service quality degradation is therefore essential for developing strategies that minimize delays and cancellations while safeguarding passenger experience.

Objective

1) To evaluate how AIRQUAL dimensions affect passenger perception during airport technology disruptions.

2) To identify strategies to reduce flight delays and cancellations using AIRQUAL framework.

3) To propose an integrated service quality and resilience model for airports.

The objectives of this study are threefold:

1) This objective seeks to assess the relationship between service quality dimensions, as defined by the AIRQUAL framework (tangibles, reliability, responsiveness, assurance, and empathy), and passenger experiences during technology-related disruptions at airports. By analyzing how these dimensions influence passenger trust, satisfaction, and tolerance toward service interruptions, the study aims to uncover the critical factors shaping passenger perception in disruption scenarios.

2) This objective focuses on developing evidence-based strategies that leverage service quality dimensions to mitigate the operational and customer service impacts of airport technology failures. By applying the AIRQUAL model to disruption management, the study will identify actionable measures that airports and airlines can adopt to minimize delays and cancellations while maintaining operational efficiency and passenger confidence.

3) This objective aims to synthesize findings into a comprehensive model that integrates AIRQUAL dimensions with airport resilience and operational continuity frameworks. The proposed model will provide practical guidelines for airports to enhance service reliability, strengthen technological resilience, and improve crisis response mechanisms. Ultimately, the model aspires to contribute to both academic literature and practical applications in the field of aviation management and airport collaborative decision making (A-CDM).

How Enhancing Communication, Reliability, and Responsiveness Can Reduce Negative Impacts of Delays/Cancellations

Flight delays and cancellations caused by airport technology network disruptions often lead to dissatisfaction, frustration, and loss of trust among passengers. Previous research has demonstrated that the way airports and airlines manage service quality during such events plays a crucial role in shaping passenger perceptions and mitigating negative outcomes (Chen & Chang, 2005; Park, Robertson, & Wu, 2006). In this context, three dimensions of the AIRQUAL model—communication, reliability, and responsiveness—are particularly critical.

1. Communication

Effective and transparent communication significantly reduces passenger anxiety during operational disruptions. Studies indicate that timely updates, accurate information, and clear explanations regarding delays or cancellations enhance passenger trust and reduce perceived uncertainty (SITA, 2019; IATA, 2022). According to Jeeradist, Thawesaengskulthai, and Fujita (2016), communication is a decisive factor in managing passenger perceptions during irregular operations, as it provides reassurance and a sense of control even when service interruptions cannot be avoided.

2. Reliability

Reliability refers to the ability of airport systems and staff to deliver accurate, consistent, and dependable services. When technology failures occur, reliability is tested through the effectiveness of contingency measures, backup systems, and operational recovery strategies. Research by Tsafarakis et al. (2018) highlights that maintaining reliable flight information and ensuring operational continuity through redundancy mechanisms substantially reduces the

spread of network delays. Similarly, ICAO (2020) emphasizes that operational resilience, supported by reliable IT infrastructure, is key to minimizing cancellations during system disruptions.

3. Responsiveness

Responsiveness reflects how quickly and effectively airport personnel and airline staff react to disruptions. Prompt assistance, rebooking support, and alternative travel arrangements are shown to reduce passenger dissatisfaction during delays (Fodness & Murray, 2007; Bezerra & Gomes, 2016). Empirical evidence suggests that responsiveness in service recovery—such as offering compensation, providing amenities, or arranging alternative connections—can mitigate the negative impacts of cancellations and improve perceptions of fairness (SITA, 2021). This aligns with findings from Park and Cho (2020), who note that responsiveness in crisis situations strengthens overall service evaluations and fosters passenger loyalty.

Integrated Perspective

By combining effective communication, reliable operations, and responsive service delivery, airports and airlines can reduce the adverse impacts of technology network disruptions. These dimensions not only address the immediate needs of passengers but also contribute to long-term trust and resilience within the aviation ecosystem. Thus, enhancing communication, reliability, and responsiveness should be seen as strategic pillars of airport service quality management in the context of disruption recovery.

Discussion

The findings of this study highlight the significant role of communication, reliability, and responsiveness in mitigating the negative impacts of flight delays and cancellations caused by airport technology network disruptions. Consistent with the AIRQUAL framework, these three service quality dimensions directly influence passengers' perceptions, satisfaction, and trust in airport and airline services during irregular operations.

Communication was found to be a critical determinant in reducing passenger anxiety during disruptions. Transparent and timely updates about flight status, the causes of delays, and

estimated recovery times reduce uncertainty and help passengers feel more informed and respected (Fodness & Murray, 2007; SITA, 2019). Prior studies confirm that passengers are more likely to tolerate delays if they perceive that information is accurate and consistently delivered (Park & Cho, 2020).

Reliability emerged as another essential dimension. In disruption contexts, passengers value the dependability of systems and recovery mechanisms. Research indicates that airports with robust IT infrastructure and redundancy strategies are better able to minimize the spread of network-related delays (Tsafarakis et al., 2018). Similarly, ICAO (2020) emphasizes that building operational resilience through reliable systems is fundamental to protecting both flight schedules and passenger confidence during technology failures.

Responsiveness was equally critical in shaping passenger experiences during delays and cancellations. The ability of airport staff and airlines to quickly rebook flights, offer compensation, and provide assistance significantly reduces frustration and restores a sense of fairness (Bezerra & Gomes, 2016). Park and Cho (2020) further argue that responsiveness in crisis situations positively affects long-term loyalty, as passengers tend to remember how disruptions were handled rather than the disruption itself.

Taken together, these findings reinforce the notion that effective management of communication, reliability, and responsiveness is not merely a reactive measure but a strategic approach to disruption management. Integrating these service quality dimensions into airport resilience planning can strengthen collaborative decision-making processes, minimize operational inefficiencies, and enhance passenger trust during inevitable disruptions.

Conclusion

In conclusion, enhancing communication, reliability, and responsiveness offers a practical pathway for airports and airlines to reduce the adverse impacts of delays and cancellations resulting from technology network disruptions. While disruptions are often unavoidable due to the increasing reliance on complex IT systems, their consequences can be substantially mitigated through effective service quality management.

Airports and airlines should prioritize:

- Investments in real-time communication systems to ensure passengers receive timely and accurate updates.
- Strengthening system reliability by implementing redundancy and robust IT infrastructures.
- Enhancing responsiveness through well-trained staff and proactive service recovery protocols.

By adopting these strategies, airports can not only reduce operational and financial losses but also safeguard passenger satisfaction and long-term loyalty. Future research should expand this framework by exploring cross-cultural passenger expectations and integrating advanced digital technologies, such as artificial intelligence and predictive analytics, to further enhance resilience in airport operations.

Theoretical Implications

This study contributes to the academic literature on airport service quality and operational resilience by extending the application of the AIRQUAL model to contexts of technology-driven disruptions. While prior studies have primarily focused on service quality under normal operating conditions (Fodness & Murray, 2007; Bezerra & Gomes, 2016), this research emphasizes how communication, reliability, and responsiveness serve as critical determinants of passenger perception during irregular operations. Furthermore, by linking AIRQUAL with disruption management, the study provides a conceptual foundation for integrating service quality frameworks with resilience theory (ICAO, 2020). This advances scholarly understanding of how service dimensions interact with technological vulnerabilities to shape passenger satisfaction and trust.

Practical Implications

From a managerial perspective, the findings underscore the importance of embedding communication, reliability, and responsiveness into airport and airline crisis management strategies. First, airport authorities and airlines should invest in robust communication platforms

that provide real-time, transparent, and consistent updates to passengers, thereby reducing uncertainty and frustration during disruptions. Second, enhancing system reliability through redundancy mechanisms and IT resilience strategies is essential to minimize operational breakdowns and prevent cascading delays (Tsafarakis et al., 2018). Finally, training staff to respond effectively and empathetically during service interruptions is critical for service recovery and long-term passenger loyalty (Park & Cho, 2020).

For policymakers and regulatory bodies, the study suggests the necessity of integrating service quality frameworks into airport collaborative decision-making (A-CDM) initiatives. By aligning service quality principles with resilience planning, stakeholders can develop more holistic strategies to safeguard passenger experiences and reduce financial and reputational risks associated with delays and cancellations.

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