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A Systematic Literature Review on AI, Innovation, and Digitalisation in Airport Management: Enhancing Passenger Experience and Operational Efficiency.

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Abstract

Purpose: This systematic literature review synthesises a decade of research on the impact of Artificial Intelligence (AI), innovation, and digitalisation in airport management. It examines their combined role in enhancing operational efficiency and passenger experience.

Methodology: The review was conducted according to the PRISMA 2020 framework, analysing 50 peer-reviewed studies from Scopus published between 2013 and 2024. A thematic analysis was used to identify and interpret the findings.

Findings: The analysis reveals six core themes: AI in airport management; digitalisation and smart airport paradigm; innovation and organisational transformation; data governance and ethics; human factors and organisational readiness; and sustainability and resilience. These themes illustrate a paradigm shift from infrastructure-focused management to integrated, data-driven service ecosystems. The findings demonstrate that technological advancement alone is insufficient; its success in improving efficiency and passenger experience is contingent upon parallel progress in organisational adaptability, ethical governance, and human capital.

Research limitations/implications: This review is limited by its scope to English-language, Scopus-indexed publications. Future research should incorporate a wider range of sources and employ longitudinal methods to track the evolution of digital maturity.

Originality/Value: This study's primary contribution is a novel, integrative framework that conceptualises airport digital transformation through the complementary lenses of four theories: Technology Acceptance Model (TAM), Technology-Organization-Environment (TOE), Service-

Dominant Logic (SDL), and Dynamic Capabilities. This framework provides a cohesive model for scholars and a strategic, evidence-based guide for practitioners, emphasising that sustainable transformation requires the alignment of technology, organisation, and ethics.

Keywords: Artificial Intelligence, Digitalisation, Innovation, Airport Management, Passenger Experience, Operational Efficiency, Systematic Literature Review.

Paper Type: Systematic Literature Review

1. Introduction

Airports occupy a pivotal position in the global transport system, functioning not only as nodes of mobility but as complex, multi-stakeholder ecosystems where technology, people, and infrastructure converge. In the past decade, rapid advancements in Artificial Intelligence (AI), digitalisation, and innovation have begun to transform the traditional logic of airport management. These developments are reshaping both operational efficiency and the passenger experience, turning airports into living laboratories of technological experimentation and organisational adaptation. The integration of digital technologies has redefined how airports plan, coordinate, and deliver services, linking operational processes, safety systems, and customer interfaces in ways that were unimaginable a generation ago (Halpern et al., 2021; Büyüközkan, et al., 2021). This transformation is unfolding amid profound structural and societal shifts. The digital economy, characterised by data-driven decision-making and pervasive connectivity, is changing how value is created and captured across sectors (Malik, 2023). Airports are no longer judged solely by their capacity or punctuality but by their digital maturity: their ability to leverage technology for adaptability, resilience, and personalised passenger engagement (Becker & Boettcher, 2024). The evolution toward smart airports, underpinned by AI, automation, and the Internet of Things (IoT), signifies a paradigm shift from infrastructure management to information management. Within this paradigm, the airport becomes a digitally mediated ecosystem where sensors, algorithms, and human actors co-produce efficiency, safety, and experience (Lunacek et al., 2021). The implications of this shift are far-reaching. On the operational side, AI and predictive analytics are transforming traditional functions such as resource allocation, baggage handling, and airfield maintenance. Digital twins and integrated command centres enable real-time coordination across departments, reducing delays and improving safety (Büyüközkan et al., 2021). On the customer-facing side, biometric identification, mobile applications, and self-service systems are redefining the Passenger Experience, blending convenience with autonomy and personalisation (Lien et al., 2019). However, these innovations also generate new managerial challenges concerning data governance, cybersecurity, ethics, and workforce adaptation. As AI systems become more embedded in decision-making processes, questions arise about accountability, transparency, and the future role of human expertise (Becker & Boettcher 2024). Despite these transformative dynamics, academic research on airport digitalisation remains fragmented, uneven, and discipline bound. Technical studies in engineering and computer science have examined the development of AI-based tools for optimisation and automation (Kovynyov & Mikut, 2019; Lunacek et al., 2021). In contrast, management and policy-oriented studies have explored innovation governance, sustainability, and the socio-economic implications of digital transformation (Colak et al., 2023; Halpern et al., 2021). Yet, few attempts have been made to synthesise these perspectives into a unified understanding of how technology, organisation, and human factors interact in shaping airport transformation. The absence of such integration limits the ability of both scholars and practitioners to grasp the systemic nature of digitalisation and to identify the conditions under which it enhances, not merely automates, airport performance. The COVID-19 pandemic further intensified the need for such understanding. The crisis revealed both the vulnerabilities and the latent potential of digital systems in maintaining operations under extreme disruption (Halpern et al., 2021). Many airports accelerated digital investments in response to social distancing requirements, remote monitoring, and passenger safety concerns. Contactless technologies, AI-based health screening, and digital communication platforms became critical tools for resilience. However, the accelerated pace of innovation also exposed gaps in organisational

readiness, regulatory flexibility, and ethical oversight (Sanders & Mattson, 2021). The pandemic thus acted as a catalyst for digitalisation while simultaneously magnifying the complexity of its management. In this context, Artificial Intelligence, innovation, and digitalisation emerge as interconnected dimensions of a single transformative process, what can be described as the digital reinvention of airport management. AI provides the analytical intelligence that powers predictive and autonomous systems; innovation represents the organisational capability to experiment, adapt, and institutionalise change; and digitalisation provides the technological and infrastructural foundation for integration. Together, these dimensions redefine how airports create value, interact with stakeholders, and pursue sustainability. The challenge, however, lies in understanding how these dimensions align, reinforce, or contradict one another across different organisational levels and institutional contexts. Addressing this challenge requires a systematic and integrative review of existing research. Over the past decade, a growing body of literature has emerged on AI applications, digital transformation, and innovation management within the airport domain. Yet, this literature remains dispersed across journals, disciplines, and methodologies. To date, there has been no comprehensive synthesis that connects empirical findings, theoretical perspectives, and managerial insights into a coherent framework. Without such synthesis, it is difficult to evaluate the maturity of knowledge in this field, identify theoretical gaps, or formulate actionable implications for industry and policy. The present study responds to this gap by conducting a Systematic Literature Review (SLR) of academic research published between 2013 and 2024. The review adheres to the *PRISMA 2020* protocol (Page et al., 2021), ensuring methodological transparency and replicability. It analyses fifty peer-reviewed articles retrieved from Scopus, encompassing a decade of research characterised by both technological advancement and post-pandemic reorientation. Through a process of thematic synthesis, the review identifies a set of six interrelated themes, spanning technological, organisational, and human dimensions, that structure the discourse on digital transformation in airports. These clusters reveal that digitalisation in airports extends beyond technical improvement. It represents a strategic, organisational, and cultural transformation in which technological, human, and institutional subsystems must evolve together. To interpret these dynamics, this review integrates four theoretical frameworks: Technology Acceptance Model (TAM) (Davis, 1989), Technology Organization Environment (TOE) (Tornatzky & Fleischer, 1990), Service-Dominant Logic (SDL) (Vargo & Lusch, 2004), and Dynamic Capabilities Theory (DC) (Teece, 2007). Collectively, these frameworks provide a multi-level analytical lens:

- TAM explains user perceptions and adoption at the micro level;
- TOE captures organisational and contextual enablers at the meso level;
- SDL frames value co-creation among stakeholders at the network level; and
- DC conceptualises digitalisation as an adaptive and strategic capability at the macro level.

The integration of these frameworks enables a holistic interpretation of how airports sense, seize, and transform opportunities arising from digital innovation. It also bridges the divide between individual behavioural adoption studies and system-level strategic analyses, contributing a unifying conceptual model for future research.

This study thus pursues three main objectives:

1. To map and categorise the academic literature on AI, innovation, and digitalisation in airport management;
2. To identify and synthesise the theoretical and methodological approaches that structure this field of research; and
3. To develop an integrative conceptual framework linking technological advancement, organisational transformation, and passenger experience.

By addressing these objectives, the paper makes several contributions. Conceptually, it provides a structured synthesis of a fragmented field and advances theoretical integration between technology management, organisational studies, and service science. Empirically, it consolidates evidence from fifty peer-reviewed studies, identifying emerging themes and research frontiers. Practically, it offers managers and policymakers insights into how digital transformation can be leveraged to improve operational performance, sustainability, and passenger satisfaction. The remainder of the paper is organised as follows. Section 2 outlines the methodological approach, detailing the search strategy, inclusion criteria, and thematic synthesis process. Section 3 presents the results of the review, describing the six thematic clusters that define current research on digital transformation in airports. Section 4 discusses the findings through the lens of four theoretical frameworks, highlighting their implications for understanding digitalisation as a systemic process and the managerial and policy implications, and Section 5 concludes by summarising the key contributions and proposing directions for future research.

2. Methodology

This study employs a Systematic Literature Review (SLR) approach to synthesise the existing academic knowledge on Artificial Intelligence (AI), innovation, and digitalisation in airport management. The systematic approach was selected to ensure methodological transparency, reproducibility, and comprehensive coverage, consistent with the *PRISMA 2020* framework (Page et al., 2021). A systematic review provides an effective means to structure fragmented bodies of research, allowing for the integration of technical, managerial, and policy-oriented perspectives that have traditionally evolved in isolation. In this study, the SLR was used not only to map the state of knowledge but also to uncover theoretical and conceptual linkages between technology adoption, organisational transformation, and passenger experience. The Scopus database served as the primary and sole data source for the review. Scopus was selected for its extensive multidisciplinary scope, indexing of leading journals in both engineering and management, and its comprehensive metadata for citation and keyword searches. The search strategy was developed iteratively, combining key terms relating to AI, innovation, and digitalisation with terms referring to airports and management. After pilot testing several combinations, the final search string applied was:

(“Innovation” OR “Artificial intelligence” OR “AI” or “Digital*”) AND (“Aviation” OR “Air Transport” OR “Air Transportation” OR “Airport” OR “Airport operation*” OR “Airport marketing”) AND (“Passenger Experience" OR "Customer Satisfaction" OR "Service Quality" OR "Safety" OR "Security" OR "Operational Efficiency" OR "Touchpoint" OR “Customer experience” OR “Customer”).

The search was conducted in December 2024 across titles, abstracts, and keywords, without restrictions on year, language, or document type at the retrieval stage. The review period was defined as January 2013 to June 2024 to capture the most recent decade of developments in digital transformation and AI applications in aviation. Following the initial retrieval, the search yielded 327 records. These were screened systematically in line with PRISMA’s four-phase process. After duplicate removal and initial relevance checks, 185 papers remained for title and abstract screening. At this stage, studies were excluded if they did not deal directly with airports or if their focus was exclusively technical, such as algorithmic development, without managerial or operational context. This screening led to the exclusion of 108 records, leaving 77 for full-text assessment. Each full-text article was then read carefully to evaluate its relevance, methodological soundness, and contribution to understanding digitalisation, innovation, or AI in airport management. After this stage, 50 studies met the inclusion criteria and were retained for analysis. The selection process is summarised in Figure 1, which follows the PRISMA 2020 flow structure.

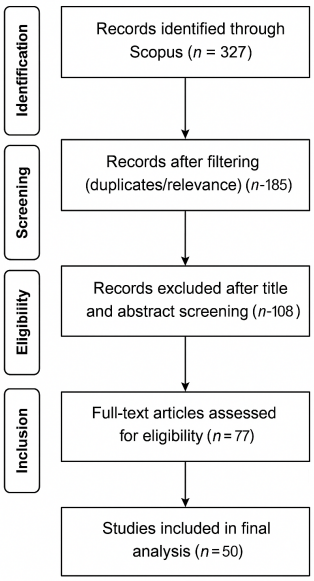

Figure 1. Prisma 2020 applied to the research.

Each of the 50 studies was examined manually, and key information was extracted into a structured table including author(s), year, research objectives, methodological approach, theoretical framework, and principal findings. This manual extraction process provided the foundation for qualitative interpretation and ensured that no relevant conceptual detail was lost through automation. The analysis was conducted inductively and interpretively rather than computationally. Each paper was read multiple times to identify recurring ideas, concepts, and relationships. Studies that addressed similar issues or shared conceptual ground were grouped together, and the analysis was an iterative process of comparison and refinement, through which the structure of the field emerged into six thematics clusters:

1. AI in Airport Management;
2. Digitalisation and the Smart Airport Paradigm;
3. Innovation and Organisational change;
4. Data governance and Ethics;
5. Human factors and Organisational Readiness;
6. Sustainability and Resilience.

The formation of these clusters was a gradual and reflective process. Rather than counting word frequencies or applying rigid coding frameworks, the focus was on identifying conceptual convergence and divergence. The goal was to capture how different authors approached similar challenges, such as the integration of AI into passenger services, the role of leadership in fostering innovation, or the ethical implications of data-driven systems, and to organise this diversity of perspectives into an interpretable structure. Thematic synthesis of this kind is particularly suitable for reviews that cross disciplinary boundaries, as it allows for analytical integration without reducing complex ideas to simplistic categories.

During the synthesis process, several theoretical perspectives repeatedly appeared across the analysed studies. Among them, four frameworks proved particularly salient and provided the basis for the conceptual interpretation of findings in later sections: the Technology Acceptance Model (TAM) (Davis, 1989), which explains user perceptions and adoption behaviour; the Technology Organization Environment (TOE) framework (Tornatzky & Fleischer, 1990), which accounts for organisational and contextual determinants of innovation; Service-Dominant Logic (SDL) (Vargo & Lusch, 2004), which conceptualises value creation as a co-creative process among multiple stakeholders; and the Dynamic Capabilities (DC) framework (Teece, 2007), which interprets digitalisation as a strategic capability enabling adaptation and resilience. These frameworks were not imposed before but identified inductively as they emerged across the reviewed literature. They collectively provide a multi-level analytical structure linking individual adoption, organisational transformation, and systemic innovation, and they serve as the theoretical foundation for the discussion of findings in this paper. While this review aimed for methodological rigour, it is important to acknowledge its limitations. Relying solely on Scopus, although methodologically justified, may have excluded relevant studies indexed elsewhere, such as specialised industry reports or regional journals. The decision to focus exclusively on English-language publications also introduces potential language bias. Moreover, the thematic synthesis was interpretive, relying on researcher judgment in grouping and interpreting themes. However, transparency in reporting and consistency in decision-making were maintained throughout the process to mitigate subjectivity. The results should therefore be seen as a faithful synthesis of the academic literature up to end-2024, representing the current state of knowledge on digital transformation in airport management.

3. Results and Thematic Findings

The systematic analysis of 50 studies revealed six major thematic clusters that collectively define how Artificial Intelligence (AI), innovation, and digitalisation are shaping contemporary airport management. These clusters reflect different yet interrelated dimensions of transformation, spanning technological applications, organisational change, governance, human factors, and sustainability. Each cluster represents a domain of scholarly attention within which specific technologies, practices, and conceptual frameworks have evolved. While the clusters are presented separately for analytical clarity, their interdependence is evident: AI and digitalisation act as enablers of innovation, while human, ethical, and sustainability considerations moderate and frame their impacts on operational and strategic outcomes.

3.1 AI in Airport Operations and Management

AI has emerged as one of the most significant technological drivers of change in airport operations. The reviewed literature indicates a growing range of applications, including predictive maintenance, resource allocation, passenger flow management, and automated security screening. Recent reviews highlight the growing use of AI algorithms can optimise operational efficiency by analysing real time data from sensors, surveillance systems, and passenger tracking technologies (Kovynyov & Mikut, 2019; Lunek et al., 2021). These systems enhance situational awareness, allowing managers to make proactive decisions regarding congestion, equipment failures, and scheduling. Beyond operational efficiency, AI also supports decision intelligence, the integration of analytics into strategic and tactical management processes. Several authors highlight the potential of AI-based systems for demand forecasting, dynamic pricing, and performance monitoring (Halpern et al., 2021; Becker & Boettcher, 2024). Recent evidence highlights that decision model innovation also plays a vital role in optimising airport operations.
Rengarajan et al. (2021) illustrate how predictive analytics and AI-enabled decision frameworks can improve scheduling, forecasting, and productivity, supporting the shift toward data driven airport management. However, while technological potential is widely acknowledged, empirical studies reveal significant barriers to adoption, particularly regarding data integration, cost, and staff resistance. These findings suggest that AI implementation in airports is not merely a technical upgrade but a process of organisational adaptation that requires new skills and governance mechanisms. AI is therefore not only an operational tool but a strategic enabler of digital transformation, with implications for how airports plan, coordinate, and evaluate their performance. This sets the stage for understanding how broader digitalisation efforts complement AI-driven innovation.

3.2 Digitalisation and the Smart Airport Paradigm

The concept of the smart airport represents a central theme in the literature, describing a transition from traditional infrastructure management to data-driven, interconnected, and user-centric systems. Digitalisation encompasses a range of technologies, such as the Internet of Things (IoT), cloud computing, big data analytics, and digital twins, that collectively enable the automation and integration of airport functions (Dini et al., 2023; Yildiz et al., 2024). Studies emphasise that smart airport development is not merely about technology deployment, but rather involves establishing digital ecosystems that facilitate seamless information flows across stakeholders, including airlines,

security agencies, and service providers. A key outcome of this shift is the enhancement of the passenger experience, which is increasingly recognised as a strategic differentiator (Miyamoto, 2023). Technologies such as AI-enabled check-in kiosks, biometric boarding, and mobile wayfinding apps contribute to personalised and frictionless journeys. Empirical research shows that passengers are generally receptive to biometric technologies when they perceive clear benefits in efficiency and privacy (Negri et al., 2019), a finding consistent with earlier work by Morosan (2012) on the role of perceived privacy and control. Collectively, these digital technologies reshape the passenger experience (Gould, 2019) and create opportunities for data-driven service innovation (Weisser, 2024). Similarly, Straker and Wrigley (2018) highlight how airports leverage digital channels to enhance passenger engagement and service innovation across touchpoints. However, this transition demands robust cybersecurity and privacy frameworks, as increased digital integration also heightens vulnerability to data breaches. Research by Becker & Boettcher (2024) and Berz (2022) stresses that the "smart" aspect of digitalisation must be accompanied by digital responsibility, ensuring that efficiency gains do not compromise ethical and legal standards. Indeed, the smart airport paradigm links technology adoption with a broader redefinition of airport identity, from transport infrastructure to digitally enabled service platforms. This shift aligns with the Service-Dominant Logic perspective, where value is co-created between airports, passengers, and partners through data-driven interactions. Thus, digitalisation provides the infrastructural backbone for innovation and organisational change, much as earlier transformations, such as airport privatisations, redefined governance structures and stakeholders, paving the way for subsequent business model innovation (Bowyer & Chapman, 2014).

3.3 Innovation and Organisational Transformation

Innovation within airport management is increasingly viewed as a dynamic capability rather than a series of discrete technological projects. Across the reviewed studies, innovation is conceptualised as a multi-level process encompassing technological, organisational, and service dimensions. Scholars such as Halpern et al. (2021) argue that airports operate in complex ecosystems where innovation depends on collaboration among multiple actors, including technology firms, regulators, and service providers. A recurring theme is that organisational readiness, including leadership commitment, culture, and learning orientation, is a decisive factor in successful innovation (Chen et al., 2015). Research indicates that innovation initiatives often fail not due to technological immaturity but because of resistance to change and a lack of internal alignment (Sanders & Mattson, 2021). Leadership plays a pivotal role in articulating a shared digital vision, mobilising resources, and fostering a culture that encourages experimentation and continuous improvement. At the same time, the literature reflects growing interest in open and collaborative innovation models, where airports partner with startups, research institutions, and other stakeholders to develop and test emerging solutions. Such initiatives reflect a shift from linear innovation processes to networked ones, characterised by shared data and co-created knowledge. This evolution supports the view that innovation in airports is both a driver and an outcome of digital transformation, linking technical capability with organisational agility.

3.4 Data Governance and Ethics

The rise of data-driven operations has brought issues of data governance, privacy, and ethics to the forefront of airport management research. The reviewed studies consistently emphasise that the

effectiveness of digital and AI applications depends on the availability of accurate, interoperable, and ethically managed data (Becker & Boettcher, 2024). Data governance frameworks determine how data are collected, shared, and used across systems and actors, influencing both operational performance and public trust. A central tension identified in the literature concerns the balance between innovation and accountability. While data integration enables predictive analytics and operational optimisation, it also raises ethical questions regarding surveillance, consent, and algorithmic bias. Research in this domain highlights the need for transparent governance structures that define ownership, access rights, and decision accountability. The absence of clear regulatory frameworks often leads to inconsistent practices across jurisdictions, creating uncertainty for managers and policymakers alike. Scholars also stress that data ethics extends beyond compliance. It involves cultivating an organisational culture of responsibility, where staff at all levels understand the implications of data use. In this sense, ethical governance becomes a component of digital maturity and a prerequisite for sustained innovation. As airports evolve into data-centric organisations, governance quality becomes a critical determinant of legitimacy and trust among passengers and stakeholders.

3.5 Human Factors and Organisational Readiness

Technological advancement alone does not guarantee successful digital transformation. Across the literature, the human dimension consistently emerges as both a facilitator and a constraint. Studies reveal that employee attitudes, digital literacy, and perceived usefulness strongly influence technology adoption (Gössling & Humpe, 2023). The Technology Acceptance Model (TAM) is frequently applied to explain these dynamics, underscoring that perceived ease of use and perceived benefit shape behavioural intentions toward new systems. The reviewed studies emphasise that airports, as complex socio-technical systems, require deliberate strategies to prepare and empower their workforce for digital change. Training, participatory design, and transparent communication are identified as effective practices to mitigate resistance and build trust. Conversely, lack of engagement or unclear change management processes can hinder adoption and erode the potential benefits of technology investment. Importantly, several papers highlight the emotional and cultural dimensions of digitalisation. Employees' sense of professional identity and job security often shapes their response to automation and AI integration. Leadership therefore plays a key role in aligning technological and human change, ensuring that innovation is perceived as an opportunity rather than a threat. This perspective positions human readiness as a strategic capability essential to achieving long-term transformation.

3.6 Sustainability and Resilience

The final cluster links digital transformation to sustainability and resilience, illustrating how AI and innovation contribute to environmental efficiency, crisis management, and long-term operational continuity. Digital technologies are increasingly leveraged to optimise energy consumption, manage waste, and reduce carbon emissions through smart monitoring systems (Berz 2022). The integration of data analytics enables more informed decision-making regarding resource allocation and environmental impact, aligning airport operations with broader sustainability goals. Resilience, meanwhile, has become a central concern in the post-pandemic context. The COVID-19 crisis exposed vulnerabilities in airport systems and accelerated the adoption of digital tools for contactless

processing, real-time information sharing, and scenario modelling (Chand et al., 2023). Studies show that airports with pre-existing digital capabilities were better able to adapt to operational disruptions, confirming that digital maturity enhances institutional resilience. The literature also notes that sustainability and resilience are increasingly intertwined with governance and ethics. Digital transformation offers the tools for sustainability monitoring, but it also requires ethical stewardship to ensure that technological progress supports social and environmental objectives. As airports move toward integrated digital ecosystems, balancing economic performance with sustainability imperatives emerges as a defining challenge for the next generation of airport management.

3.7 Cross-Cutting Insights

Taken together, the six clusters reveal that digital transformation in airport management is a multidimensional process. AI and digitalisation provide the technological infrastructure; innovation and organisational change supply the managerial and strategic mechanisms; while governance, ethics, human factors, and sustainability ensure that transformation remains legitimate and future oriented. The literature underscores that progress in one domain often depends on maturity in others. For example, technological innovation requires strong data governance and employee readiness; ethical practices support public trust, which in turn enables broader adoption; and sustainability objectives align digital transformation with societal expectations. The interplay among these dimensions suggests that digitalisation in airports is best understood as an ecosystemic process, a continuous alignment of technology, people, and governance aimed at operational efficiency and enhanced passenger experience.

4 Theoretical Integration

The literature analysed in this review shows that research on airport digitalisation and artificial intelligence relies on a variety of theoretical frameworks that originate from different disciplines. Rather than proposing new models, this study highlights how existing theories can be connected to explain the complexity of technological transformation in airport contexts. The most frequently used frameworks include the Technology Acceptance Model (TAM), the Technology Organization Environment (TOE) framework, Service-Dominant Logic (SDL), and the Dynamic Capabilities (DC) approach. Each of these perspectives provides insights into a specific dimension of digital transformation, but the literature rarely combines them into an integrated explanation. The TAM is typically applied to understand how airport employees or passengers perceive and adopt new digital tools. Studies focusing on biometric systems, mobile check-in technologies, or AI-assisted customer interfaces (Dini et al., 2023; Malik, 2023) show that perceived ease of use and usefulness are key drivers of adoption (Mwesiumo et al., 2023). The TOE framework complements this perspective by including organisational and environmental factors that shape technological readiness and adoption. The Service-Dominant Logic perspective, discussed by authors such as Vargo and Lusch (2004), provides a useful lens to interpret how value is co-created through digital interactions among passengers, airport operators, and partner organisations. In airport ecosystems, service delivery increasingly depends on shared data and continuous collaboration, reflecting SDL's emphasis on co-creation and relational exchange. Finally, the Dynamic Capabilities framework (Teece, 2007) helps explain how airports develop long-term strategic capacity to sense opportunities, seize digital innovations, and reconfigure resources. Studies analysing airport innovation strategies (Halpern et al., 2021; Gössling & Humpe, 2023) confirm that digital transformation is as much about learning and adaptation as it is about technology itself. Integrating these frameworks allows researchers to connect micro-level adoption behaviour with macro-level strategic and institutional processes. Future studies could build on this synthesis to explore not only why technologies are adopted but how digital capabilities evolve within airport ecosystems.

4.1 Managerial Integration

A recurring theme in the literature is that digital transformation in airport management requires not only technological investments but also deep organisational change. Most studies emphasise that innovation in this context depends on leadership commitment, cross-departmental collaboration, and the ability to integrate digital tools into existing operational routines (Negri et al., 2019). Managers play a central role in translating digital strategies into practical improvements in both efficiency and passenger experience. Several papers in the dataset show that the managerial dimension of digitalisation involves balancing strategic goals with operational constraints. For instance, research on AI-based forecasting systems and resource allocation platforms (Zaoui et al., 2024) highlights that the successful adoption of technology depends on how well digital initiatives align with organisational priorities such as safety, punctuality, and customer satisfaction. In airports where managers frame digitalisation as an enabler of broader organisational learning—rather than a one-time investment—transformation tends to be more sustainable. Another important insight from the literature concerns change management. Many airports still face cultural resistance and skill gaps when implementing AI and data-driven systems. Studies focusing on innovation management (Gössling & Humpe, 2023) note that digital transformation succeeds when employees are actively

involved in the process, training programs are continuous, and innovation is embedded into daily routines. This echoes findings from broader public-sector digitalisation research, which stresses that organisational culture and leadership style often determine the real impact of technology. At the same time, digitalisation requires new forms of coordination across airport stakeholders. The integration of airlines, security providers, ground handlers, and retailers demands shared platforms and clear data governance frameworks. Authors such as Halpern et al. (2021) and describe airports as complex ecosystems, where digital platforms function as boundary-spanning tools that link operations, commercial management, and passenger services. In such environments, managers must navigate tensions between data openness and privacy, innovation speed and regulatory compliance. From a managerial perspective, the literature suggests that airports that invest in building internal digital capabilities, such as analytics teams, agile project structures, and collaborative decision-making processes—gain greater flexibility and resilience in the face of disruption. This was particularly visible during and after the COVID-19 crisis, when airports with mature digital systems were able to reconfigure operations more effectively (Dini et al., 2023). The evidence reviewed shows that managerial integration depends less on technology adoption itself and more on the development of internal capabilities that enable airports to learn, collaborate, and adapt in rapidly changing environments.

4.2 Technological Integration

The technological dimension of airport digitalisation concerns the integration of artificial intelligence, data analytics, and automation into both operational and strategic processes. The literature consistently shows that technology adoption in airports is not only about acquiring new tools but about embedding them in a coherent digital ecosystem that connects airside, landside, and passenger-facing systems (Halpern et al., 2021). A central topic in the reviewed studies is the use of AI and predictive analytics to enhance efficiency and resilience. Applications such as passenger flow prediction, baggage handling optimisation, and air traffic coordination have demonstrated measurable improvements in throughput and resource allocation (Negri et al., 2019). However, these advances often depend on data integration across heterogeneous systems. Many airports still struggle with legacy infrastructures and fragmented IT architectures, which limit the scalability of AI-based solutions. Another recurring issue concerns interoperability. The reviewed papers highlight that successful digitalisation depends on the ability to share data between multiple actors, airlines, air traffic control, ground handling, and border agencies, without compromising data privacy or operational security. The literature also underscores the role of emerging technologies, such as Internet of Things (IoT), blockchain, and digital twins, in shaping the next phase of airport digitalisation (Gössling & Humpe, 2023). IoT sensors enable real-time monitoring of passenger movements, assets, and environmental conditions; blockchain offers secure transaction and identity management; and digital twins simulate airport operations for scenario planning and predictive maintenance. Yet, many studies caution that the introduction of these technologies requires not just technical capacity but also institutional readiness, especially regarding cybersecurity and data governance. Several papers point out that technology adoption follows an incremental pattern: digitalisation evolves through pilot projects, iterative learning, and feedback loops. Successful cases, such as those documented in large hub airports, show that progress is achieved through experimentation and collaboration with technology partners, start-ups, and research institutions

(Halpern et al., 2021) Therefore, technological integration is best understood as a continuous process of learning and adaptation, where technical, organisational, and human factors are interdependent.

4.3 Passenger Experience and Human Factors

The relationship between digitalisation and passenger experience has become a central concern in recent airport research. The reviewed studies agree that technology now mediates nearly every interaction between passengers and airport services, from self-check-in kiosks to biometric boarding gates and AI-based information systems (Halpern et al., 2021). Yet, while these innovations are often designed to improve convenience and efficiency, their impact on passenger perception depends heavily on usability, trust, and inclusiveness. Several papers highlight that the human factor remains decisive in the perceived success of technological innovations. Passengers' acceptance of AI technologies is strongly influenced by perceived control, privacy protection, and data transparency (Morosan, 2012; Heracleous & Wirtz, 2006). When passengers feel that digital systems are intrusive or difficult to use, satisfaction declines even if the technology itself performs well. The findings echo broader trends in digital service research, which suggest that emotional comfort and perceived fairness play an increasingly important role in technology adoption. The post-COVID-19 period further amplified the importance of contactless technologies and real-time information systems. Studies focusing on smart and safe travel (Halpern et al. 2021) report that airports accelerated the deployment of biometrics, digital health credentials, and mobile services to restore passenger confidence. However, the literature also points to persistent digital divides: some travellers, particularly older passengers or those with limited digital literacy, experience greater stress or exclusion when airport processes become highly automated. Managing this diversity requires a balance between efficiency-driven automation and human-centred service design. Research also notes the growing role of AI-driven personalisation in shaping passenger experience. Through predictive analytics and data mining, airports can anticipate passenger needs—such as queue management, retail offers, or assistance for passengers with reduced mobility. While these capabilities can enhance satisfaction, they also raise questions about surveillance and the ethics of data use. Authors such as Halpern et al. (2021) and Gössling & Humpe (2023) stress that transparency and informed consent are essential for maintaining public trust in AI-based systems. Digitalisation in airports should thus be understood as a human–technology partnership: a way of enhancing passenger experience through the thoughtful coordination of automation and human service, not as a replacement of one by the other.

4.4 Conceptual Contributions

This review contributes to the literature by clarifying how airport digitalisation should be understood as an organisational capability that extends beyond the introduction of new technologies. The findings suggest that digital transformation in airports is better described as a long-term learning process that changes how information, decision-making, and collaboration occur across the airport ecosystem. Rather than viewing technology as an isolated driver of efficiency, the reviewed studies emphasise its role in shaping how airports adapt, coordinate, and innovate in response to new challenges. One of the main conceptual insights emerging from this review is that airport digitalisation represents a

move from infrastructure-based management to information-based coordination. In this context, technologies such as AI, data analytics, and digital platforms act as enablers of new organisational routines, linking previously separate functions, operations, security, passenger services, and commercial management—into more integrated systems. This perspective helps to explain why digital transformation outcomes depend on organisational readiness and the capacity to align strategy, governance, and technology implementation (Malik, 2023). The review also contributes to theory by connecting frameworks that are often used separately. The Technology Acceptance Model (TAM) and the Technology Organization Environment (TOE) framework are useful for analysing how individuals and organisations adopt innovations. Meanwhile, Service-Dominant Logic (SDL) and the Dynamic Capabilities (DC) approach explain how organisations create and sustain value through innovation and resource reconfiguration. When considered together, these frameworks offer a more comprehensive understanding of how technological adoption relates to long-term strategic evolution in airport contexts. Integrating them allows scholars to bridge micro-level adoption behaviour with macro-level organisational and institutional change (Teece, 2007; Vargo & Lusch, 2004). Indeed, the findings position airports as relevant sites for studying digital governance and innovation policy. Airports occupy a hybrid space: they are public infrastructures, commercial enterprises, and regulatory environments at the same time. Because of this dual nature, they provide a living laboratory for understanding how technology, ethics, and regulation interact in practice. Lessons drawn from airport digitalisation therefore extend beyond aviation, contributing to broader debates about smart mobility, data governance, and sustainable innovation. This conceptual framing strengthens the theoretical basis for future research on how complex organisations manage digital change while maintaining accountability and public trust.

4.5 Policy and Future Research Implications

The findings of this review have several implications for policy and airport management practice. Digitalisation and AI adoption in airports cannot be pursued in isolation from institutional and regulatory frameworks. Policymakers should recognise that airports operate as complex ecosystems where public and private actors share responsibilities for safety, efficiency, and passenger welfare. The literature highlights that successful digital transformation depends on policies that enable experimentation, interoperability, and data sharing while maintaining accountability and privacy (Halpern et al., 2021). Regulatory agencies can support this process by promoting standards for digital platforms, incentivising open data initiatives, and encouraging collaboration between airports, airlines, and technology providers. Another key implication concerns skills development and organisational learning. Governments and airport authorities need to invest not only in infrastructure but also in human capital. Studies reviewed here emphasise that the long-term value of digital transformation arises from employees' ability to use and adapt new technologies. Policy frameworks that support training programs, knowledge-sharing networks, and partnerships with universities can enhance workforce readiness for continuous technological change. Furthermore, ethical and legal dimensions—such as data protection, algorithmic transparency, and accessibility, should be explicitly integrated into digitalisation policies to maintain passenger trust and social legitimacy. From a strategic perspective, the review suggests that digitalisation should be embedded in national and regional transport strategies rather than treated as an isolated operational goal (Raimundo et al., 2023). Airports represent critical nodes in the mobility network and can act as testbeds for smart infrastructure, low-carbon operations, and multimodal connectivity. Integrating airport digitalisation

policies with broader innovation and sustainability agendas can multiply benefits across sectors, including energy efficiency, logistics, and tourism. The review also identifies several gaps and priorities for future research. Although existing studies describe numerous applications of AI and digital tools, few provide longitudinal evidence of how these technologies influence airport performance over time. More empirical research is needed to measure outcomes such as efficiency gains, environmental impact, and changes in passenger satisfaction. Comparative studies across regions and airport sizes could clarify how institutional context affects the pace and depth of digital transformation. Another promising direction involves examining the governance of data ecosystems, how data ownership, interoperability, and cybersecurity are managed across public and private boundaries. Finally, future research should explore the social dimension of airport digitalisation, including digital inclusion, accessibility for diverse passenger groups, and the role of human–machine collaboration in service quality. By addressing these areas, future work can move beyond technical assessments and contribute to a richer understanding of how digitalisation reshapes the organisational and societal roles of airports. Such knowledge will help policymakers, managers, and researchers to design digital strategies that enhance efficiency and sustainability while ensuring that technological progress remains aligned with public interest and human values.

5. Conclusion

This systematic literature review has undertaken a comprehensive synthesis of a decade of research (2013–2024) to explore the transformative impact of Artificial Intelligence (AI), innovation, and digitalisation on airport management. The analysis of 50 peer-reviewed studies reveals that airports are undergoing a fundamental paradigm shift, moving from their traditional role as asset-intensive infrastructure operators to becoming adaptive, data-driven, and service-oriented ecosystems. This transition is captured through six core, interrelated thematic clusters: AI in airport management, digitalisation and the smart airport paradigm, innovation and organisational change, data governance and ethics, human factors and organisational readiness, and sustainability and resilience. These clusters demonstrate that technological capability is a necessary but insufficient condition for transformation; its success is deeply contingent on organisational, human, and ethical dimensions. A central theoretical contribution of this review lies in the integration of four complementary frameworks: Technology Acceptance Model (TAM), Technology-Organization-Environment (TOE), Service-Dominant Logic (SDL), and Dynamic Capabilities, to conceptualise digital transformation as a multi-level phenomenon. This integrated lens clarifies that while TAM explains micro-level adoption behaviours and TOE outlines meso-level organisational enablers, it is the macro-level perspective of Dynamic Capabilities, interwoven with the value co-creation principles of SDL, that explains how airports build the strategic capacity to sense, seize, and reconfigure opportunities in a volatile environment. The evidence consistently shows that airports treating digitalisation as a strategic, learning-oriented process, embedded in a long-term vision and supported by leadership, achieve higher levels of operational efficiency and passenger satisfaction. Conversely, initiatives focused solely on technology procurement often encounter resistance, fragmentation, and a failure to realise sustained benefits. The implications for practice are significant. For airport managers, this review underscores the role of leadership as an orchestrator of complex ecosystems, requiring a balance between technological investment, human capital development, and ethical data stewardship. For policymakers, the findings highlight the urgency of developing harmonised regulatory frameworks that encourage innovation and interoperability while safeguarding privacy, security, and

digital inclusion. Future research should move beyond the cross-sectional and technical assessments that dominate the current landscape. Longitudinal studies tracking digital maturity over time, comparative analyses across different airport sizes and governance models, and deeper inquiry into the governance of multi-stakeholder data ecosystems are critical next steps. The evidence synthesized in this review confirms that the digital transformation of airports is not a destination but a continuous, holistic journey of alignment. The future of airport management thus depends on this ongoing process, one where operational efficiency, enhanced passenger experience, and robust ethics must evolve in concert. By framing digitalisation through this integrated lens, this study provides a foundational framework for understanding and shaping the next generation of smart, sustainable, and human-centred airports.

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