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Master of Business Administration (MBA)



The Impact of Digital Transformation on Operational Performance in Saudi Airports Evidence from Jeddah

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1. Introduction

Digital transformation is fundamentally changing the *modus operandi* of organizations within diverse disciplines, including the aviation industry. Innovative technologies are positively impacting operational efficiency and the overall experience of air travelers. AI, the Internet of Things (IoT), biometric systems, and big data are some of the technologies that modern airports are implementing to enhance operational automation and decision-making (Zaharia and Pietreanu, 2018).

Recent years have witnessed the birth of the so-called “smart airports” that signify the first operational airports with digitally transformed infrastructures. These innovations have promoted efficiency, security, and overall service improvements. In this regard, the operational performance of airports is a core focus for governments and authorities worldwide (Masood and Tan, 2021).

International aviation is a central player in economic development, international commerce, and the promotion of tourism—making it imperative for governments and authorities to prioritize improving the operational performance of airports. Enhanced operational efficiency, minimized delays, and increased passenger satisfaction are some of the high-value outcomes of digital transformation (Tsui et al., 2014).

Digital isolation in Saudi Arabia has transformed into the rapid development of the nation's international bridging infrastructure adding heightened prestige to Saudi Arabia as a constituent of the global logistics and transportation systems. Currently, the digital development of the aviation industry is a high-priority modernization target across the various strategic sectors of International Air Transport Association (2022) member countries.

Operational efficacy, security, and passenger service experience improvements at airports in the Airports Council International (2023) database, are a product of the

increasingly prevalent application of passenger processing and biometric systems, security smart bags, and digital management systems at airports.

As Saudi Arabia's primary entry point for millions of pilgrims to performing Hajj and Umrah, King Abdulaziz International Airport (KAIA) in Jeddah has a disproportionately high volume of passengers. In response, subsequent to the introduction of state-of-the-art digital systems at the airport, improvements of operational efficacy, and the uninterrupted flow of passengers, digital systems have continued to be incorporated (Thums et al, 2023).

Research examining the impact of digital transformation on operational performance in the Saudi aviation industry is lacking even though digital technologies are being implemented more frequently at Saudi airports. Therefore, this study looks at the impact of digital transformation on operational performance in Saudi airports focusing on King Abdulaziz International Airport in Jeddah.

As part of the Kingdom's plan to develop its transportation systems, Saudi Arabia's aviation industry has experienced significant growth over the last ten years. The Kingdom's General Authority of Civil Aviation (GACA), has instituted several of its own measures that center on the development of new airport infrastructures, increases in the volume of people that can flow through an airport, and on the operational efficiency of airports in the Kingdom.

Technological innovation is instrumental to development. Airports have begun to apply new technologies in their operational processes, which streamlines the collaboration between all stakeholders at the airport and enhances the services offered to airport users. Airport digital management systems provide the ability to monitor operational activities in real-time, which helps managers quickly respond to operational disruptions and the effective utilization of the airport's resources (Remencová & Sedláčková, 2021).

Saudi airports have rolled out numerous new digital systems for better passenger processing. Automatic electronic gates faster immigration by using biometric systems to capture and process IDs. This system conquers long lines leaving more room to process other travelers (ACI 2023).

Moreover, biometrics have arrived in the form of face recognition and other systems at security checkpoints. This form of technology allows faster identity verification at security controls which in turn enhances safety and reduces the volume of travelers at security checkpoints (Poulaki and Papadopoulos 2021).

Investing in all of the technologies mentioned is part of the process of upgrading to 'smart airports' systems and technology to provide operational efficiency and improve the traveling experience of the passengers.

2. Research Problem

The past few years have seen remarkable advancements within the aviation sector due to altering technologies. Given the several operational and passenger service technologies emerging from the rapid digitization of the aviation sector (Zaharia & Pietreanu, 2018; Masood & Tan, 2021) and the use of AI, IoT, and Biometrics, Digital Operational Automation, airports have been able to streamline their operational productive use of data to enhance the passenger experience (ACI, 2023) and in the process, develop Smart Airports that operate in a multi-layered operational paradigm.

Aligned with the National Development Strategy under Vision 2030, Saudi Arabia has invested significantly in modernizing its aviation sector. Additionally, some Saudi airports have begun digitizing operational initiatives, tailored biometrics, automated passenger processing, smart digital baggage, and management systems to enhance the operational capacity and quality of the passenger experience of airports (IATA, 2022).

Given the technological advancements, the degree of impact digital transformation initiatives have on the operational performance of airports in Saudi Arabia is still under-researched. The majority of studies available have looked at digital transformation in the aviation industry, either on a global level or in a regional context and have failed to address the operational performance of airports in Saudi Arabia (Thums et al., 2023).

Also, there is not much evidence to support the claim that operational improvements in passenger processing, baggage handling, and overall operational coordination of Saudi Airports have been a result of digital technologies. Though some studies have pointed out the role of digital technologies in improving the operational efficiencies of airports, little has been done in the Saudi aviation sector (Tsui et al., 2014).

For this reason, this study aims to address this, in order to establish the relationship that exists between digital transformation and operational performance in Saudi airports, focusing on King Abdulaziz International Airport in Jeddah. It seeks to answer the question of how digital technologies have improved operational processes in airports in order to identify the level of effect digital transformation has on the operational efficiency and quality of services at airports.

3. Research Objectives

The broadest intention of this research is to establish the relationship between digital transformation and operational performance of Saudi airports.

Specific Objectives

- 1- To compile a list of technologies that have been implemented digital transformation on Saudi airports.
- 2- To determine the correlation between digital technologies and operational efficiency of airports.
- 3- To determine the effect of digital technology on processing passengers at the airports.

4- To analyze how operational performance of King Abdulaziz International Airport has been transformed digitally.

4. Research Questions

- 1- What is the impact of digital transformation technologies on operational performance of airports?
- 2- What impact do digital technologies have on improving the processing of passengers?
- 3- What are the operational improvements of digital transformation at King Abdu Aziz Airport?

5. Research Significance

The importance of this study can be viewed from both practical and academic points of view. From the academic standpoint, the study elucidates associations between digital technology and operational performance in the aviation industry, specifically in the airports, which has scarcely been covered in the literature, particularly, the Saudi Arabia aviation industry (Zaharia & Pietreanu, 2018; Masood & Tan, 2021).

From a practical perspective, the results of this study will help decision-makers, airport and service providers, and policymakers in Saudi Arabia understand the role of digital technologies on the operational efficiency of airports, and the quality of services of passenger processing systems (ACI, 2023).

The findings of the study can also assist in smart airports construction planning and investment in Saudi Arabia. Identifying the operational advantages of digital transformation can help airport management direct resources to technologies that create elevated levels of operational efficiency in the airport and an improved passenger travel experience.

In the end, this research will further the goals of Saudi Vision 2030 by showing how digital tools can provide socio-economic value for the construction of new, modern, smart airports.

6. Literature Review

Digital transformation has brought positive changes to operational management of all industries, notably transportation and aviation. Worldwide, airports have started to adopt digital technologies to help them streamline the operations, enhance the passenger experience and maximize the use of the available real estate. As noted by Zaharia and Pietreanu (2018), airports are undergoing digital transformation by applying various automation, data analytics, and smart technologies to solve operational challenges. The authors have noted that there are operational challenges posed by modern airports.

Likewise, Masood and Tan (2021) studied implementation of Industry 4.0 technologies at airports and noted that AI, big data, and the Internet of Things (IoT) data analytics, radically change operational systems. These technologies help airports automate everyday functions and enhance operational decision making and data analytics in real time

Another example, Tsui et al. (2014) studied operational efficiency of airports in the Asia-Pacific region. The result showed that success at airports is largely dependent on the effectiveness of passenger processing, aircraft turnaround time and performance, and baggage handling. The authors stated that digital technology can be used to enhance the above operational factors.

In addition, Remencová and Sedláčková (2021) studied the impact of digital technologies on improving operational processes at airports. This study affirmed that the application of digital operating systems and automated operational processes increases the interaction of airport staff and the efficiency of processes.

Poulaki and Papadopoulos (2021) stated that improvement of digital technologies, including (1) biometric identification systems, and (2) automated passenger processing systems) has positively contributed to the improvement of the services offered to customers, but also to the reduction of waiting time in the airport.

Thums et al. (2023) predicts future digital transformations occurring in air travel; however, they note the increasing digital complexities within an individual's travel experience. Most digital complexities come from the growing need for travel management, which creates an obstacle for the traveler. The growing complexities lead to the need for management, which can be controlled by the traveler. The growing need for the travelers to use their own devices increases the need for digitally controlled devices. Most digital devices used by the traveler are devices that the traveler can administrate themselves.

AI in the travel management industry has been mentioned in most of the discussions. According to Choi (2026), AI in travel management strengthens the ability of travel management systems to have the ability to predict the future based on prior data, which enables systems to combine the available operational resources to strengthen the abilities of travel management systems to control the capacity of an airport.

According to Nazir, et al. (2022) predictive analytics used in the travel management systems, coupled with digital analytics, has the ability to control the management of traveler movement to decrease redundancy in traveler movement and assisting with the movement of travelers. Predictive analytics and digital analytics combine to control the movement of congestion to decrease the redundancy of the movement of travelers.

One of the most important transformations that have been occurring is the increase in the use of the Internet from travel management systems to the travel management systems. Travel management systems within the travel management systems have been able to

increase their own control of systems, have been able to increase their own operational systems, and to increase their ability to perform their own maintenance.

The effect that digital space has on travel management systems cannot be understated. According to the travel management systems, the use of digital space is crucial. Digital travel management systems are crucial to the operation of travel management systems. According to ACI (2023) and IATA (2022), digital travel management systems are essential to the growth of travel management systems.

There is a pronounced potential in improving operational performance at airports through extensive digital transformation. Literature suggests that operational performance has the potential to increase through digital transformation by automation, data management and operational coordination.

7. Research methodology

7.1. Research Approach

To identify the relationship of operational performance and digital transformation in airports in Saudi Arabia, a quantitative research methodology has been adopted.

For this study, quantitative techniques are the most suitable as they provide a basis for statistical analysis of the relationships among the variables.

7.2. Research Methodology

The study employs a cross-sectional survey methodology to obtain data from operational employees at the King Abdulaziz International Airport in Jeddah.

7.3. Population

The study has focused on the employees of the operational areas of the airports, and these include:

- Personnel in the airport operations
- Information technology staff

- Employee in passenger services
- Staff in the airport management

7.4.Sample

The participants will be selected based on a simple random sampling technique.

The anticipated sample size is between 200 and 300 respondents.

7.5.Data Collection Method

To collect primary data, a structured questionnaire will be administered to the employees of King Abdulaziz International Airport.

7.6.Data Analysis

The collected data will be analyzed by the SPSS statistical software by Descriptive Statistics, Correlation, Regression, Reliability Analysis

7.7.Research Timeline

The study intends to determine a significant positive correlation between digital transformation and operational performance in Saudi airports.

Activity	Duration
Drafting the proposal	Month 1
Completion of the literature review	Month 2
Designing the questionnaire	Month 3
Collection of data	Month 4
Analysis of data using SPSS	Month 5
Interpretation of the results	Month 6
Writing the final thesis	Month 7

8. Study outcomes

The study is expected to find that:

The impact of digital transformation on operational performance is expansive. It is expected that digital resources will drive improvements across multiple layers of airport management and service delivery. For example, Digital technologies will enhance the passenger processing experience including automated identity verification and security. In addition, Artificial Intelligence will enable the performance of data analysis to create operational allocation plans and predict passenger flow. In addition, the Internet of Things (IoT) will enable predictive control of management systems and assist in optimizing the maintenance activities planning.

Furthermore, smart airport systems will assist in the improvement of passenger experience and service quality. Therefore, it is anticipated that digital transformation will aid in improving service delivery within airports, operational performance and control of airport management systems. It is anticipated that findings from this research will assist in providing evidence to support improved digital transformation. In addition, advanced digital resources should be used to enhance the operational functionality of airports to airport managers and policymakers in the region of Saudi Arabia.

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10. Appendix

10.1. Questionnaire

Demographic Information

Question	Options
Gender	Male / Female
Age	Less than 30 / 30–40 / 41–50 / Above 50
Educational Qualification	Bachelor's / Master's / Doctorate
Years of Experience	Less than 5 / 5–10 / 11–15 / More than 15
Department	Operations / IT / Customer Service / Management

Artificial Intelligence (AI)

Statement	1	2	3	4	5
Artificial intelligence improves operational decision-making in airports	☐	☐	☐	☐	☐
AI technologies improve airport resource allocation	☐	☐	☐	☐	☐
AI systems help predict passenger demand	☐	☐	☐	☐	☐
AI technologies enhance airport security monitoring	☐	☐	☐	☐	☐
AI improves airport operational planning	☐	☐	☐	☐	☐

Internet of Things (IoT)

Statement	1	2	3	4	5
IoT technologies improve monitoring of airport infrastructure	☐	☐	☐	☐	☐
IoT sensors help monitor baggage handling systems	☐	☐	☐	☐	☐
IoT technologies improve maintenance planning	☐	☐	☐	☐	☐
IoT technologies enhance operational coordination between departments	☐	☐	☐	☐	☐
IoT improves monitoring of passenger flow within airports	☐	☐	☐	☐	☐

Smart Airport Technologies

Statement	1	2	3	4	5
Smart technologies improve airport operational efficiency	☐	☐	☐	☐	☐
Automated systems improve passenger processing efficiency	☐	☐	☐	☐	☐
Biometric technologies improve passenger identification	☐	☐	☐	☐	☐
Smart airport systems improve passenger experience	☐	☐	☐	☐	☐
Digital airport systems improve service quality	☐	☐	☐	☐	☐

Operational Performance

Statement	1	2	3	4	5
Digital technologies reduce passenger waiting times	☐	☐	☐	☐	☐
Digital transformation improves baggage handling efficiency	☐	☐	☐	☐	☐
Airport operations become faster after digital transformation	☐	☐	☐	☐	☐
Digital systems reduce operational errors	☐	☐	☐	☐	☐
Digital monitoring improves airport operational coordination	☐	☐	☐	☐	☐
Digital technologies improve overall airport productivity	☐	☐	☐	☐	☐
Digital transformation reduces congestion in airports	☐	☐	☐	☐	☐
Digital technologies improve airport service quality	☐	☐	☐	☐	☐
Digital transformation improves airport operational performance	☐	☐	☐	☐	☐
Digital transformation improves passenger satisfaction	☐	☐	☐	☐	☐