

# **DIGITAL TECHNOLOGIES AND INNOVATION IN AIRPORT SERVICES: A BENEFIT MODEL APPROACH**

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## **ABSTRACT**

Significant changes have taken place at airports due to market liberalization, airport privatization and growing competition. The growing demand and evolving expectations of passengers, require new ways of using technologies, to enhance operational processes and the whole travel experience. The digital era is transforming the aviation industry and has a significant impact on its future. The aim of this study is to assess the benefits of applying digital technologies to airports and airlines and their inseparable connection with innovative services provision to passengers, while it describes how to create a seamless end to end experience at the airport, maintaining a high level of security. Moreover, the study underlines the contribution of digital technologies to aviation industry, focusing on the organizational integration and passenger experience optimization. Reference is made to the pandemic, of COVID-19 and its impact on air travel. Primary research methodology is qualitative, with structured personal interviews, while the main findings indicated that through digital technologies and innovative services, the benefits for airports, airlines and passengers are

increasing. Finally, this paper discusses a benefit model approach, based on the literature review and the research findings, with theoretical and practical implications.

**KEYWORDS:** innovation, digital technologies, airports, airlines, passenger experience, benefit model

## 1. INTRODUCTION

Passenger satisfaction is mainly influenced by the environment and services at the airport, both on arrival and departure, as well as during the transfer to and from the airport. Passenger experience at the airport is significantly influenced by the technologies used to process their data. The overall process that passengers go through to plan and schedule their journey, check-in, baggage handling and security procedures often have a big impact on their experience and reduce their level of satisfaction. Little research has been done, with aggregated information, as to which airports are implementing strategic use of digital technologies in the aviation industry and their impact on airport economic growth and overall passenger experience. The literature related to the determinants affecting service quality at airports and the evolution of digital practices at airports has created the need to understand the interdependence of these concepts. Rhoades, Wagnespach and Young (2000), developed a list of key indicators of airport service quality and identified the factors that mainly influence customer perception, however their study focused, only on the passenger perspective. Konstantinova (2019) studies the digital transformation of tourism and focuses on artificial intelligence and robotics but does not expand on other advanced technologies and makes little reference to airports. Patel (2018) extensively describes how advanced technologies and biometrics can facilitate passenger handling and security processes at airports rather than airlines.

However, the references to improving the passenger experience through new technologies focus more on the technical part of the services. Florido-Benitez et al. (2016), concentrated only on analyzing the impact of mobile marketing on passenger experience and satisfaction at the airport. Little (2015) conducted research to examine the potential of digital technology to reduce the overall cost of airport operations. However, in that case, the airline and passenger sides are not considered. Furthermore, Kilic et al. (2021) postulate that “despite the increasing focus of industry and academia on innovation in general, there is no research specifically focusing on the question of how innovation can be achieved at airports”. Based on

the above, although the digital strategy of airports seems to lead to an improvement in passengers' perception of the quality of airport services, there is a gap in the current literature concerning the employment of this strategy both in airports and airlines. Therefore, in a context of aviation excellence spearheaded by digital technologies and innovation, this paper aims to better understand the implementation of digital technologies in the aviation industry and highlight both their technical and commercial importance for all stakeholders, i.e., airports, airlines and passengers by developing of a benefits model.

## **2. LITERATURE REVIEW**

Due to the global growth of air transport, the demand for airport services and more efficient passenger, baggage and aircraft handling processes have increased in parallel (Pabedinskaite and Akstinaite, 2014). The intensification in competition among airlines has resulted in air carriers seeking to operate at airports that offer efficient operations in order to increase the quality of service to their passengers and reduce their operating costs (Oum, Yu & Fu, 2003). The period when airports were a place only for departures and arrivals has passed. Nowadays, airports, are multifunctional travel nodes, with a plethora of services offered. This evolution has been driven by the ever-increasing number of passengers travelling by air, due to the improved living and economic standards. At the same time, the new experiences that passengers have gained in their travels, force them to increase their demands and expectations of the services provided. Consequently, airports are aiming for continuous modernization and quality services in order to be able to meet these needs and desires on an ongoing basis.

Airport managers, acknowledging the need to assess their customers' perceptions of the quality of their services (ACI, 2013), regularly conduct passenger satisfaction surveys in order to immediately identify opportunities to improve these services and reduce unsatisfied passengers (Fodness & Murray, 2007). However, it is worth mentioning that there are several airports worldwide that have exceeded passenger expectations and provide a unique passenger experience (ACI, 2015). For example, they use social robots, artificial intelligence and the Internet of Things to provide enhanced passenger experience. Regarding the passenger-airline interaction, there is an increasing trend in terms of passengers' use of technology, according to IATA's (2019) survey results. Since the IATA's very first survey in 2012, in a seven-years period, passengers have shown a clear preference for self-service and connectivity. Besides, passengers wish to constantly interact with airlines throughout their journey through apps on smartphones for timely and accurate information about their flight.

Service speed and airport waiting times are of concern to passengers, who are more willing than ever to share sensitive personal data, with governments and airlines to drive a smoother and better travel experience. It is noted that, travelers want to be in control of their travel and have choices and they are willing to pay extra for services if they are very important, as long as the overall product is improved and lives up to their high expectations. We should not ignore an increasing segment of passengers comprised of elderly and disabled people. The above surveys included travelers belonging to these groups and their responses showed that, compared to the others, they need the assistance of an airport agent for check-in and the delivery of their luggage, but the monitoring of luggage and connectivity concerns them just as much as the others. Overall, today's passengers are looking for:

- efficiency,
- comfort,
- less waiting and
- control over their journey.

## **2.1 COVID-19 and Airports**

Airports are global hubs that connect the world and facilitate economic development. The COVID-19 pandemic brought global traffic to a standstill in 2020 (Nhamo et al., 2020) and caused huge damage to the once growing aviation sector. Before the pandemic broke out, many airports around the world were congested due to the rapid increase in air traffic volumes, which put additional pressure on the existing infrastructure. However, in 2020, due to the pandemic, a huge drop in travel was caused and created new demands on health and hygiene protocols.

Research by the Airports Council International on the impact of COVID-19 on airports (ACI, 2020) showed that a reduction in passenger numbers of over 6 million passengers was expected by the end of 2020 in the global aviation industry. According to the same study, while the airline industry was expected to generate approximately \$172 billion in 2020, with the onset of the crisis, airport revenues resulted in a decrease of \$111.8 billion, 65% lower than the pre-COVID-19 forecast. Also, in April 2020, commercial flights, globally, dropped by 75%, compared to the same period in 2019 (Petchenik, 2020). Some countries saw an even larger drop, of up to 90% (OAG, 2020). Contactless travel is the key to restoring passenger confidence and will fuel a rapid revival in air travel (Collins Aerospace, 2020). Airports were never designed for social distances, instead, they have been designed to promote social interaction. Therefore, it is urgent to adopt a model that drastically reduces costs and

increases the operational efficiency of airports and the speed of passenger processing, while enhancing the quality of services provided, to reduce the likelihood of spreading the disease (Dube et al., 2021). Airports have high fixed costs and try to reduce variable costs where possible (closing infrastructure departments, laying off employees, cutting salaries). Therefore, automation of several processes is unavoidable.

Similarly, for airlines, restructuring and resizing will be unavoidable in order to support their liquidity and mitigate the risks that threaten their viability. Measures were taken such as employees' layoffs and retirement of old and large aircraft, to increase their operational efficiency in a more cost-effective way (Dube et al., 2021). Most airlines, expect that air travel will not return to normal levels for the next 2-3 years (Atkinson, 2020). However, there is also a prediction of strong aircraft demand over the next 20 years (Seymour, 2021). In any case, technology innovations propelled by COVID-19, such as inflight social distancing and utilizing touchless technologies at airports are useful strategies to offset disruption caused by the pandemic (Amankwah-Amoah, 2021).

Technology is an important force to create flexibility in the tourism industry (Hall et al., 2020). Robots, automation technologies and artificial intelligence, have the potential to reduce costs, improve liquidity and enhance flexibility. The digital transformation of airports can lead to sustainable long-term growth by meeting travelers' needs. The transformation and automation of operations are a necessity in the industry now. Through technology, pandemic-specific problems at airports can be easily managed, including (Sharma et al., 2021):

- The flow of passengers through the airport
- The control of travelers
- The detection of COVID-19 cases with temperature sensors, etc.

Furthermore, during the pandemic period, it was observed that the public increased their trust in technology (Sharma et al., 2021). In the short term, airports, will have to decide when to reopen sectors that were closed due to the massive drop in traffic. With the opening of infrastructure, increased operational costs will have to be offset against maintaining social distance and satisfactory performance (Serrano and Kazda, 2020). Experts in the aviation sector, however, state that, the pandemic, is likely to have also a positive impact on the industry, because it will force airports to immediately adopt better features in terms of design and technology, which otherwise may have taken years to implement. Once this crisis is over, airports and airlines will have to be more proactive and capable of enhancing their digital transformation, both on the organizational and commercial side, in order to reposition themselves in the global aviation industry (Poulaki and Papatheodorou, 2021).

During this pandemic, it is important to maintain the standard air travel experience and operational procedures. However, in the wake of the pandemic, there is also an opportunity to explore the potential of advanced technologies that will make passenger contact points intact and flexible, ready to receive passengers at all stages of air travel, effectively addressing any health and safety concerns arising. For example, the adoption of new technologies can significantly reduce staff interaction with passengers at the airport, ensuring social distance. The application of artificial intelligence (AI) technology can help the seamless flow of passengers because passengers can be screened faster and more accurately. The need for contactless security checks in the context of the pandemic may accelerate the development of AI technologies (ICAO, 2021). The development of biometric technologies at airports will allow airport operators to efficiently and accurately analyze large amounts of data, such as passenger ID verification, etc. (Amankwah-Amoah, 2021). COVID-19 had an immediate, dramatic impact on airport traffic and revenue. As people stop flying, non-aviation revenues from parking facilities, restaurants or tax-free, are equally reduced (IFC, 2020). However, with the use of technology, especially in security screening, passengers will waste less time in these processes and will have more time to spend in restaurants and shops, which improves their overall airport experience and increases non-aeronautical revenue for airports (Zaharia & Pietreanu, 2018).

## **2.2 Airport Innovative Services using Digital Technologies**

*Artificial Intelligence.* AI is a technology that enhances both existing and new business opportunities for airlines and airports, as well as other aviation organizations. In the field of artificial intelligence, several new technologies used by airports to provide a new experience for air travelers include:

- Facial recognition technologies
- Virtual reality applications
- Chatbots
- Robots
- Interactive maps
- Language translators
- Ease of shopping, etc.

In the general aviation sector, the adoption of AI applications can facilitate (IATA, 2018c):

- Services available 24/7
- 100% up-to-date system
- Security and real-time monitoring

- Baggage delivery
- Commercial decision making

However, it should be mentioned that, while all the above applications are already technically possible, some of them may have regulatory hurdles or are not commercially viable yet. Furthermore, despite the significant benefits that AI has to offer, some limitations also arise. As Mercier-Laurent et al. (2015) mention, to date, AI cannot surpass human intelligence. There are additional areas where AI could be used and make improvements (IATA, 2018c), such as:

- Airport security
- Transparency in payments

*Biometric Identification.* International organizations and individual states cooperate with IATA, to formulate policies and regulations that will facilitate safe and sustainable industry. IATA has already created standards for messaging and exchanging passengers' data between airlines and governments, including API (advanced passenger information) and PNR (passenger name records). IATA has also developed the "ONE ID" initiative, aiming at replacing the electronic passport and improving processes and passenger experience from the beginning to the end of their journey. Biometric identification is at the core of this service (IATA, 2020). To facilitate passenger flow, facial, fingerprint or iris recognition will be performed at airport gates. The consolidation of biometric identification brings multiple benefits for passengers, airports, airlines and governments alike (Patel, 2018). Passengers will benefit from a seamless experience with a single identity (IATA, 2020) since:

- They will not have to worry about the numerous documents they currently have to carry
- They will have easy identification
- They will not need to go through repetitive procedures
- There will be no need for unnecessary paperwork; they will not have to worry about having to go through a lot of hassle
- They will avoid long queues, allowing passengers to arrive at the airport and be ready to fly,

while airlines and airports:

- Will increase their efficiency and performance, relative to their operating costs.
- Their staff will not spend time at ID checks, thus improving their productivity.
- Will have the ability to know, in real time, where passengers are at the airport, potentially directing them to the appropriate procedure.

*Mobile Applications.* Smartphones have become a key accessory for travelers who rely on them to get instant information and connect to their social network. Airlines are not stopping at introducing features for mobile devices to improve passenger processing and information flow. The use of these technologies as communication tools has been recognized by airlines seeking to improve their efficiency towards their passengers. Mobile applications enhance airlines' innovation since they increase communication speed, frequency and availability, while they can transform the travelers' experience boosting customer loyalty and increasing airlines' revenues (Katsoni and Poulaki, 2021). Large airports, following the commercial guidelines of their operators, are implementing a business model focused on developing a more creative environment in line with new technologies, leaving behind the image of a simple intermodal hub (Benitez, 2016).

Mobile applications are increasingly being used to access entertainment, games, news, weather and many other information sources. Major airports are taking advantage of mobile devices to create apps for advertising reasons. These apps have led to the creation of a new type of marketing, mobile marketing, which, due to its multiple functions, has been evolved in recent years into a product, rather than a simple communication medium. Mobile marketing contributes to the exploitation of the content of the services offered and increases the level of passenger satisfaction within the airport. The availability of new mobile applications, is one of the many products offered by their business portfolio, helps to manage passengers' time in an efficient way, for as long as they are at the airport, providing real-time information. At the same time, it favors the efficiency of the processes that passengers carry out at the airport, confirming the multifunctionality of this marketing tool is. More and more airports are resorting to mobile marketing in order to improve passenger satisfaction and experience at their facilities. The main benefits of mobile applications are (Benitez, 2016):

- Convenience provision,
- Address customized needs
- Quicker information dissemination

Passengers want to have the details of their journey available at their fingertips without having to call or wait for a travel agent to respond or send an email. As airlines strive to innovate, their approach must be practical and realistic. Consequently, in order to bring real innovation, airlines must provide information customized to the location of the passengers and their personal preferences. Globally, mobile technology can differentiate the airline product, however, fulfilling this goal is to some extent difficult. Certainly, every new opportunity that arises for airlines to beat the competition has its difficulties. The mobile device technology is

a unique opportunity, given the speed at which these devices are evolving and the efforts that airlines are making in terms of using ancillary services and market segmentation techniques to differentiate their products.

### **2.3 Benefits for airports, airlines and passengers**

*Airports.* By digitalizing airports, the objectives of operational efficiency and improved passenger experience are being achieved in terms of:

- Airport Operations
- Passenger Journey
- Ancillary revenues

An effective digital transformation does not come from implementing the latest technologies, but from transforming organizations to realize the potential offered by digital solutions (ACI, 2017). Digitalization brings many benefits to airports, business partners and customers, at different levels. Through digitalization, airports are positioning themselves in the wider ecosystem, joining forces with other partners and stakeholders. In doing so, they ensure that, they benefit from market innovation and create greater value for all their customers (ACI, 2017). The benefit of enhanced interaction through digital technology with passengers is twofold (Amadeus, 2019) passengers have access to tailored, detailed information, efficiently and in return, airports gain valuable insight into customer behavior and needs.

Particularly for the airports, some of the benefits are summarized below are (ACI, 2014; Gardy, 2016):

- Efficiency of operations
- Automation activities
- Real-time monitoring processes
- Provision of real-time self-service, guidance and travel information to passengers
- Process optimization
- Improving employee productivity
- Cost reduction
- Innovative business model
- Development of new revenue streams (other than aviation)
- Segmentation of airline passengers (in order to offer new services to the right people, at the right time, at the right price)
- Improving customer experience
- Processing of undocumented passengers
- Improving brand value (creating a strong brand)

The digital offerings of any airport define its digital strategy and allow it to differentiate from competitors. Through a digital strategy, airports are improving areas of quality, interaction and service diversion and they are overcoming operational and capacity shortcomings. Operational efficiency can be improved through new innovative systems, advanced technology, such as biometrics, which identifies and processes passengers faster. Capacity issues become more apparent in cases of flight delays, disruption, mistaken passengers and disappointing experiences. With the use of artificial intelligence, there is the potential for accurate flight forecasting, allowing airports to do better planning (Little, 2015).

*Airlines.* In recent years, an impressive wave of digital innovation has emerged across the airline industry. The digital transformation of airlines is revolutionizing the way airlines use their technology and human sources and adapt their processes to radically change their business performance (Boulton, 2017). This is a new look at how airlines are integrating new technologies into their processes:

- To better serve their customers
- To become more efficient
- To increase their commercial value

The main benefits resulting from the digital transformation of airlines are summarized below (Dubos, 2017):

- Better passenger experience thanks to personalization and customization
- Digital transformation helps boost ancillary sales
- Strengthen customer loyalty
- Improve customer support
- Crisis management
- Strategic integration of distribution/partner channels
- Insightful business analysis
- Protecting brand value
- Creating a virtuous cycle of innovation
- Protection against market disruption

*Passengers.* Passengers today expect a fully digital experience from airports and airlines, that need to develop a strong digital identity. New technologies, give passengers control over their journey and minimize the time required to process their data at every step at the airport until boarding the aircraft. Therefore, they have a comfortable travel experience (Raina, 2020). A good travel ecosystem is well shaped by new technologies and digital transformation, which represent the means to simplify the life of passengers (Baust, 2017). They offer the passenger the convenience of booking their entire journey through a platform that has it all (e.g., ticket,

staging area, car rental, etc.). Furthermore, through innovative technologies, passengers are benefited from personalized services that meet their needs and preferences, in summary, the main benefits that passengers gain from the adoption of innovative services at airports are:

- Convenience
- Ease of access
- Simplification of procedures (e.g., personalization)
- Safety
- Reduced waiting time at the airport
- Minimize stress
- Control of the journey at all stages

From all the above, we conclude that through the innovative digital products and services that airports and airlines provide to passengers, their level of service is enhanced in all dimensions of their journey, and they have the flexibility to manage it at all stages.

### **3. RESEARCH METHODOLOGY**

In this paper, qualitative research has been conducted through structured personal interviews. Qualitative research aims to explore and deepen understanding of a case study or social phenomenon. It is a flexible method, in terms of the research process, which explores trends, motivations, perceptions and experiences that interviewees have gained from their experience of the topic being researched. The analysis of responses and the small sample of participants are characteristics of qualitative research. With the interview method, the researcher, groups and compares the views of the respondents. The method of data collection used is structured face-to-face interview and the sample was selected using the judgment sampling method, in which the researcher selects a representative sample according to their opinion (Kent, 2003). Through the questionnaires used for the interviews, the selected sample is asked to answer the same set of questions in a specific order. Specifically, the interview was based on an 11-question inquiry. To formulate questions for the questionnaire, the objective of the research was first identified, the method of data collection was selected, and the characteristics of the respondents were understood.

The questions of the interview (appendix), aim to capture the experiences and opinions of the participants regarding digital transformation and innovative service delivery at airports, as well as the resulting benefits for all stakeholders. In addition to these, there are questions, referring to the COVID-19 pandemic crisis, such as whether the pandemic crisis can promote industry change and whether it represents an opportunity for the digital transformation of

airports and airlines. In summary, while drafting the questionnaire, an effort was made to include questions that would ensure variety and breadth in order to draw safe conclusions. Each question constituted a separate topic, corresponding to a separate digital transformation area. The validity and reliability of the questions, are based on the fact that they were derived from a) two IATA conferences, the first one on technology and its advancement in the evolution of passenger experience and infrastructure at airports (IATA, 2019), and the second one, the Global Airport and Passenger Symposium, held in 2018 (IATA, 2018a); b) an IATA study exploring the forces shaping the future of aviation and the potential implications for the aviation industry (IATA, 2018b); c) the World Customs Organization's study on new airport technologies (WCO, 2019); and d) the Amadeus report on the digital transformation of airports (Amadeus, 2019). The characteristics of the interviewees are summarized in Table 1.

Table 1. The interview sample

<i>Professional Status</i>	<i>Organization</i>	<i>Experience</i>
Flight Operations Manager and Deputy Accountable Manager	Airline	many years of experience in the aviation industry in the fields of flight safety and crisis communication management
Product and Services Manager	Airline	many years of experience in airport terminal operations
Airport Services Manager	Airline	overseeing all airport terminals in Greece
Head of Customer Care Center	Airline	many years of experience in passenger service at both airport and airline
Chief Commercial Officer	Airline	many years of experience in commercial directorates, most of them in managerial positions
Information Technology and Telecommunication (IT&T) Business Unit Director	Airport	22 years of experience in the aviation sector and actively involved in airport technology issues
Customer Relationship Management (CRM) Team Leader	Airline	experienced in customer oriented big data analytics

Seven interviews were conducted with persons actively involved in the Greek aviation industry (dominant airline and Athens International Airport - AIA). The passenger volumes served in 2019 exceeded fifteen million for the airline and twenty-five million for the airport. Thus, it is considered as a significant market to investigate. Their representatives were initially approached by telephone and the interviews took place in their offices or via videoconference, during the first two waves of the COVID-19 pandemic in 2020. In order to draw useful and correct conclusions, all the opinions on the various issues were analyzed. First, the common responses to the different themes were coded and then, the differences and similarities of the expressed opinions were listed. Based on the recordings of the interviews, the following section is an evaluation of the findings, along with two axes: similarities and differences.

### *3.1 Research Limitations*

A limitation of the current study is the small number of people interviewed. The more views covered, the more secure the conclusions. The chosen sample, however, was selected according to the professional status and their direct relationship with the airports. Additional limitations arise because the interviewees could not provide further information due to data confidentiality.

## **4. FINDINGS**

### **4.1 Similarities**

From the interviews conducted, it was apparent that the interviewees agree on most issues, while they have different opinions only on a few issues. All the respondents believe that technology can be a competitive advantage for an airport or airline, and they stressed the importance of technology which is now an integral part of the travel experience. Also, all the responses indicated that technology may improve the overall passenger experience through its potential and benefits all stakeholders. In terms of the level of digitalization at AIA, there was a general agreement that it is at a good level, unlike other Greek airports, and all respondents cited several examples to demonstrate their estimation. Furthermore, a commonality in the respondents' answers is the view that the COVID-19 pandemic will bring about changes in the aviation industry and enhance the role of technology in line with the differentiated needs of airlines and passengers. In addition, they unanimously argue that air travel is being driven towards full digitalization, and the consequent abolition of travel documents cannot negatively affect passengers' personal security. Another common factor is the increase in passenger confidence resulting from the real-time information on their journey,

which is now available through advanced technology. Passengers' loyalty to the brand is enhanced by innovative services, as interviewees jointly argue, because technology brings efficiency. Furthermore, there was a similarity in the responses on the improvement of the passenger experience using technology by the airport and airlines, indicating the value of investments in this area and the benefits for all participants. All also agreed that their future business plans were dramatically affected by new technologies and indicated that further digitalization of products and services was in their first priorities. Finally, all respondents felt that the role of technology would be enhanced following the COVID-19 pandemic, which would facilitate tourism recovery.

## **4.2 Differences**

On the other hand, it was observed that the respondents have different views on one of the interview questions. In particular, there are disagreements on the issue of personalizing the passenger experience and whether this is still a vision or a tangible goal, using the data available today. Half believe that it is a tangible goal that can be achieved with the right cooperation between stakeholders and the appropriate organizational structure, while the rest believe that it is a goal that has already been materialized and is happening now.

The COVID-19 pandemic caused a global crisis and the international quarantine measures, had a negative impact on tourism. Travel postponement or cancellation due to COVID-19 is estimated by the Global Business Travel Association to cause losses to industry operators that could reach \$820 million worldwide, by the end of the year 2020 (Rutynskyi and Kushniruk, 2020). A recent IATA survey showed that people are concerned about COVID-19 when they travel (IATA, 2020). IATA argues that the measures introduced to protect passengers, are leading to the restoration of confidence in travel, but this will take some time. According to Sigala (2020), COVID-19, may be an opportunity to transform the tourism industry. He argues that it will significantly influence travel attitudes, intentions and future behaviors, claiming that crises accelerate technological innovation and change.

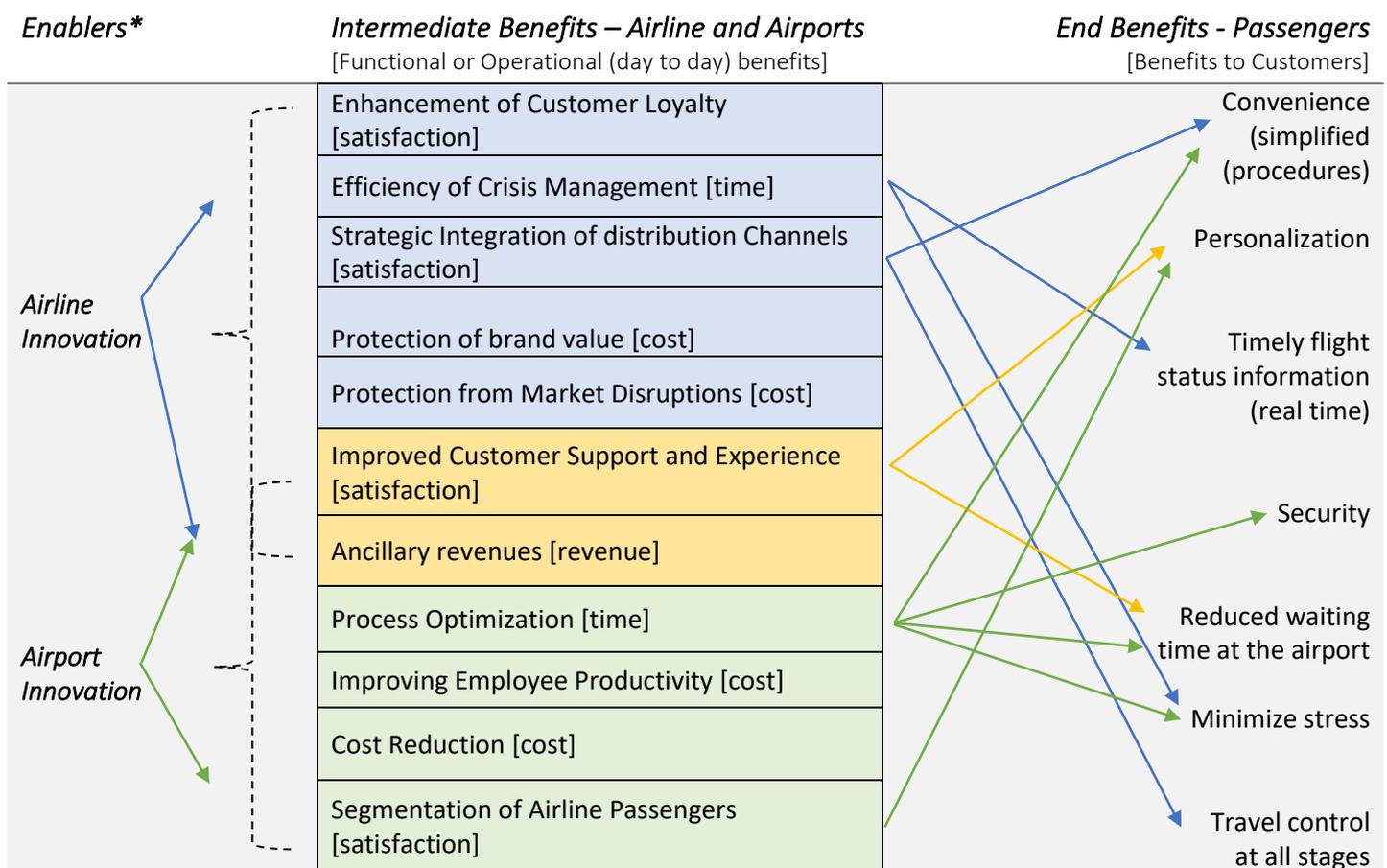
## **5. DISCUSSION**

Research findings confirm previous relevant studies, while both literature review and research findings indicate a triangular relational system involving airports, airlines and passengers, in which the use of digital technologies results in innovation and brings benefits to all stakeholders. The authors, based on the benefit modelling approach of the Northern Ireland Department of Finance (DoF), developed the benefit model for innovative air travel. After the

benefit identification, the relationship between the different levels of benefits is clarified, while the benefit model is developed in a graphical representation with three main sections (from left to right). These sections include:

- Enablers, that concern new capabilities, directly attributable to the investment in digital technologies connected to the innovative services provision.
- Intermediate Benefits, that concern the actual operational and services provision improvement, driven by the use of digital technologies, when it comes to the internal processes and integration.
- End Benefits, that concern the strategic benefits to the customers resulting from the middle-level intermediate benefits to the organizations.

According to this benefit model approach of DoF, intermediate benefits should have a unique identifier that may include cost/revenue, time and satisfaction.



\* [New tangible capabilities directly attributable to the investment in digital technologies]

Figure 1. The Benefit Model for Innovative Air Travel

## **6. CONCLUSIONS AND THE WAY FORWARD**

This paper explored the interaction between airports, airlines and passengers in the light of innovative technologies used in airport services. Its objective was to capture the implementation of innovative technologies in airports and to highlight both their technical and commercial importance from the perspective of the main stakeholders: airports, airlines and passengers. For the purpose of the study, a review of the development of services at airports was carried out, a reference was made to the basic services of airports and the necessity of adapting services to modern trends was presented. Subsequently, a literature review was conducted in the field of new technological innovations adopted globally by airports, in recent years. The issue of technological development of airports and airlines has been studied more in the international literature, while Greek references on this issue are scarce. In addition, online sources and the studies of international organizations, such as IATA and ACI, contributed greatly to the completion of the literature review. The benefits of digital transformation for airlines, airports and passengers were then investigated. Primary research was conducted to document the study through interviews and the findings were presented. The COVID-19 pandemic has greatly reduced tourist traffic and has particularly affected air travel, but the findings of the study suggest that the use of technology is one of the important factors that will help passengers to regain their confidence in air travel. New technologies can make a decisive contribution to the development of a country's aviation sector and tourism product, improving quality and making it more competitive in terms of pricing. Passenger volumes continue to grow, and their needs and expectations are diversifying. Airports and airlines cannot meet these expectations with traditional approaches. Digital technologies can help airports to ensure that their facilities utilize maximum capacity, enhancing passenger flows and time efficiency, which is very important both for airlines and passengers. The need for aviation industry digitalization is growing significantly, mainly for two reasons: the pursuit of revenue growth and increased competition. The importance of commercial revenue is crucial for airports that saw their aeronautical revenues hit hard by the pandemic. Airports, therefore, need to take advantage of technology to communicate their marketing strategies, increasing passenger satisfaction levels and non-aeronautical revenues. Digital technology can offer many opportunities in this direction. For several years now, the aviation industry has been exploring, installing and using technologies designed to accelerate the flow of passengers through airports. Biometrics, artificial intelligence, mobile apps, self-service capabilities and other technology solutions are rapidly transforming the airline industry as an ecosystem. These technologies are providing passengers with a much more enjoyable travel experience. At the same time, they are bringing significant improvements in airport capacity

and greater border control and security. However, it must be made clear that to reap the full benefits of new technologies in the future, airports must continue to evolve every day. Sustaining the benefits is influenced by developing a culture and the ability to anticipate future digital technologies, innovating on those technologies, applying them to every airport and investing in partnerships that will make digital transformation sustainable.

The aviation industry gains a competitive advantage using new technologies, but the sales of airlines are particularly affected. Because of the specificity of their activities, airlines have more room than airports to build and maintain relationships with passengers at every stage of their journey. However, airports are not remaining passive and are increasingly responding to the needs of the market. Around the world, technology is transforming the future of air travel. Not only must airlines keep pace with passenger expectations, but they must also maximize the unique opportunity to use new technologies to differentiate their products, increase sales and enhance customer brand loyalty. The study highlighted a strong future development in ancillary revenues, from the use of new technologies in mobile devices. These services can entice passengers to maximize their spending. Easy access to ancillary services offers flexibility and convenience to passengers while benefiting airlines and airports with additional profits. Through mobile marketing, airports are effectively enhancing passenger experience and satisfaction. Airlines, through mobile apps, are reducing the cost of passenger services and gaining the opportunity to establish real-time, interactive contact with passengers. The use of these applications is a source of numerous benefits for the travelers themselves eventually. Designing products and systems that meet passenger expectations, making their journey easier, can create long-term value for airports and airlines through customer perception and ultimately loyalty. The results of the primary research showed that technology and the new services resulting from it have a positive impact on passengers' overall perception, meeting their expectations in terms of security efficiency, the control they gain over their travel and the ability to be informed in real-time. In addition, it was found that the use of technology contributes to an increase in passengers' trust and loyalty to airports and airlines. Ultimately, the use of technology benefits all major aviation stakeholders and finally reaches to satisfy the final recipient: the passenger.

Efficiency, personalization, self-service, and the infinite possibilities offered by advanced technologies are more necessary today than ever before. The usefulness and benefits resulting from the digital transformation of airports and airlines are confirmed by industry professionals. The findings of the primary research are fully in line with the findings of the international literature. It is also concluded that airports and airlines should make more efforts to improve

the services they provide to passengers by developing a quality strategy based on modern practices and advanced technology to gain a competitive advantage. Following the proposed benefit model for innovative air travel, airports and airlines should invest more in technology introducing it into the processes they already have in order to ensure passenger experience optimization. It is necessary to continuously evaluate the quality of procedures and services offered by airlines and airports altogether, in accordance with the needs and requirements of passengers, intending to increase their satisfaction and improve the tourism and economic development of the whole country. To further explore the individual points of this study, the following are proposed: Although hub airports have the financial capacity to implement their digital transformation, it would be useful and interesting to examine, which technologies should be prioritized, in those airports that do not have the luxury of resources. The markets offered, for additional services, through mobile applications, by airlines, before or even during the journey, may affect airports. It would therefore be useful to investigate the commercial impact, which airlines have developed in recent years, on the commercial activity of airports. Finally, it would be interesting to study passenger satisfaction in relation to the technological development of airports and airlines they use for their travel.

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## APPENDIX

Research Questionnaire (Interviews)	
1.	Can technology be a competitive advantage for an airport/airline? At what points of contact with the passenger can it improve the passenger experience?
2.	What stage of digitalization is Athens International Airport at, and what digitalization projects has it already carried out to ensure a seamless travel experience?
3.	What kind of long-term structural changes do you think the COVID-19 pandemic will bring about in tourism?
4.	Can the COVID-19 crisis promote industry change? Is it an opportunity for digital transformation?
5.	A "smart" airport, which has adopted advanced technologies such as artificial intelligence, robotics and other digital developments, is leading to paperless (documentless) air travel processes. Do you think this may shake the passenger's confidence in the airport/airline as to their personal safety?
6.	With the adoption of innovative services, for example, real-time information on mobile devices from the airline about the status of the flight, does this increase passenger loyalty to the brand of the company?

7. Do you consider that the investment you have made so far in the digitalization of the passenger experience has contributed first to the financial growth of the company and then to the improvement of the customer experience? Which parts of the company have benefited most from the above investment?
8. Can you think of an example where the digital transformation has improved an airport process?
9. Is personalizing the passenger experience, with the availability and accuracy of data that exists nowadays, a tangible goal, or is it still a vision?
10. To what extent have your plans, development-wise, been affected by the COVID-19 pandemic? What were your plans before the pandemic outbreak?
11. What is your vision for the digital future of the air travel experience as it relates to the passenger, post-pandemic containment? Do you believe that the role of technologies in the recovery and redefinition of tourism will be enhanced?

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