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The effect of digitalisation on sustainability and smart airport

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Abstract: Players in the aviation industry have had to engage in a digital transformation with the spread of the concept of digitalisation because of rapid technological development. The concepts of sustainability, already present in aviation, and digitalisation, have become even more important in the industry. As digitisation and sustainability are two processes that need to be done together and are interdependent, and the results of which will have an impact on all stakeholders, whether positive or negative, they need to be completed successfully. Smart airports are airports where networked technologies such as IoT devices are widely used to support operations and operational planning and management. In this way, airports can become paperless and reduce environmental waste and pollutants. In this study, the concepts of sustainability and digitalisation are first discussed separately and then together, as well as the difficulties that digitalisation will bring and the contribution of digitalisation to aviation sustainability.

Keywords: digitalisation; sustainability; aviation sustainability; smart airport.

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1 Introduction

Digitalisation is causing the transformation of existing services and products and the creation of many new products and services in a way that affects all industries on a global scale. In this regard, the aviation industry is one of the sectors most affected by this change. While digitalisation enables people to access the information and services they want more easily, it also creates a platform where they can raise their issues, concerns and ideas. In all sectors impacted by digitisation, new and hard-to-solve problems are emerging alongside many benefits. Environmental sustainability studies, which have greatly affected the aviation industry in recent years, sometimes receive help from digitisation and sometimes reach a dead end due to digitisation. Thanks to well-developed digitisation, the information exchanged will influence and guide sustainability efforts in the future. As the concept of sustainability becomes more prominent in aviation, as it is everywhere in the world, environmental sustainability practices have become remarkable in this sector. Today’s aviation industry is influenced by many factors. One of the most important of these is digitalisation. If you properly manage the interplay between the concepts of sustainability and digitalisation, which are influencing the industry at the same time, you can easily manage digitalisation as well as win at sustainability. The concept of the smart airport is an application that also sets the course for the future of airports when it comes to digitalisation. It means that the aviation industry is adapting to modern technology. It includes applications such as passenger and baggage flow in the terminal building and air traffic control technologies. The environmental impact of the energy savings achieved by these processes should also be assessed and the gains in terms of sustainability identified.

As the world faces more and more the problem of global climate change, environmental performance is being questioned and actions are being taken in this direction all over the world. Environmental sustainability has therefore been added to the many challenges facing the complex environment of aviation. Although the contribution of aviation to global pollution is relatively small, aviation is one of the sectors that can reduce pollution through various measures. The steps being taken in this direction affect all stakeholders. Efforts are being made to reduce carbon dioxide emissions and greenhouse gas emissions through various applications, especially by airlines and airport operators. As major facilities in airline operations, airports have therefore come into focus. Efforts are being made to reduce pollution and improve environmental performance through digitisation and similar techniques. One of the digitisation techniques that will create environmental awareness among both employees and customers is the concept of smart airports. The services provided by smart airports have a positive impact on airports as a business and improve customer satisfaction among passengers as customers.

2 Digitalisation and sustainability relationship

Sustainability generally means the balance of the relationship between the growth rate of societies and the consumption of resources. It examines the negative consequences that will lead to unsustainable development in the future if the world's resources are consumed faster than they are renewed. The most important dimension of sustainability, especially after climate change, is environmental sustainability (Akanke et al., 2019). Environmental sustainability does not only include the problem of resource scarcity. In addition to this problem, there is also the pollution of the environment by harmful wastes and gases produced during production and consumption. Greenhouse gases cause the climate crisis by heating up the atmosphere. The resulting situation is called climate change or global warming (IPCC, 2018). The impact of digitalisation, which is another concept that seriously affects the aviation industry, on sustainability will be the subject of our study. It refers to the set of methods applied to the technological transformation of information-based companies based on digitalisation and acceleration of their activities by making them more efficient (Klymenko et al., 2019).

As a global threat, climate change will negatively impact the future lives and operations of airlines. Sustainability efforts become essential for continuity of production and social well-being. At this point, it is clear that rapidly evolving technology will play a key role in environmental sustainability. In research and analysis, it is believed that digitalisation has a positive impact on sustainability. Moreover, sustainability can be easily tracked through digital technologies (Gouvea et al., 2017; Wu and Raghupathi, 2018). Digitisation activities provide benefits in managing resources in many sectors. In addition, through digitisation steps, states are seeking to transform their state policies that encompass all sectors. This is an important factor for environmental sustainability (Mickoleit, 2010). The United Nations encourages countries and companies with the sustainable development goals (SDGs). The SDGs are closely linked to digitalisation (UN, 2016). The importance of digitisation is expected to continue in line with the United Nations goals in the future.

Techniques such as the efficient use of resources, equipping business facilities with smart systems, and realising production capacities with new technologies increase the sustainability of industries. Digital transformation is also an integral part of corporate sustainability. Thanks to digital technologies, companies can manage sustainably, achieve balanced growth, create awareness of their capacities, and achieve this with less use of resources thanks to smart systems (Castro et al., 2021; Klymenko et al., 2019). Today, the concepts of digital management and digital transformation have gained importance in transport policy. It turns out that the air transport industry, which is an important pillar of the economy at the global level, is one of the sectors most easily adapted to the said digital transformation. In technology-intensive sectors such as aviation, sustainability practices are more strenuous and costly than digital transformation practices.

Sustainability has become a sensitive issue for aviation in recent years, and industry stakeholders have focused on this issue. Carbon emissions from the aviation sector account for 3.5% of climate change. Moreover, carbon emissions from aviation accumulate in the atmosphere. For this reason, it is defined as one of the major problems in ensuring environmental sustainability. To ensure environmental sustainability, serious measures should be taken to ensure the participation of all stakeholders in the aviation industry. Global forums on climate change and agreements reached following these forums impose obligations on the aviation industry. Annualised targets and the roadmap

established to achieve them provide guidance to companies (ICAO, 2019). Even though technologies that offer fuel economy benefits are used mainly because they are related to corporate sustainability, their impact on environmental sustainability is also quite large.

The concept of environmental sustainability is “the set of actions that require sensitive management of natural resources in order to lead healthy and stable lives” (Johnston et al., 2007; Goodland, 1995). In other words, environmental sustainability refers to the relationship between people’s lives and the life of the world. Since it is now believed that this relationship is not working very well, steps are being taken to create a balanced system. In order to achieve and maintain this balance in the future, all stakeholders in the sector should be involved in sustainability studies. This is the main reason why this effort is being carried out at the United Nations level. Some studies mention that the United Nations environmental goals and its economic goals are in conflict, while other studies argue that the sustainability goals are not realistic due to the increase in consumption and population growth (Kopnina, 2020; Scherer et al., 2018; Barbier and Burgess, 2019; Castro et al., 2021).

Applications of digitisation include technologies such as cloud-based management, deep learning, artificial intelligence, virtual reality, robotic coding, additive manufacturing, internet of things (IoT), Big Data processing, and digital decision making. Although these concepts were considered far removed from daily life in the past, they are now part of everyone’s daily routine (The World in 2050, 2019). Although it is preferred by companies, especially to facilitate information-based business based on digitalisation, it is beneficial in processing the data of all companies. It provides marginal benefits by making the use of resources more efficient in production and services (Lange et al., 2020). Thanks to these technologies, the data transferred to the digital environment ensures that operations are faster and more effective, and a more efficient production process is created through greater interconnection of operations.

Digitisation means changing the evolutionary way of doing business in the field, rather than being accepted as a tool for sustainability. In the aviation industry, digitalisation is already widely used in management, operations and maintenance. There are studies that say that digitalisation also has a negative impact on the environment. For this reason, it is necessary to study the impact of digitalisation in detail (Chen et al., 2020). If the implementation of the digital transformation process in the aviation industry is closely monitored through change management, the process can be successfully completed and the negative aspects of environmental sustainability in this process can be eliminated (WEF, 2017). While it is generally accepted that digitalisation is the most important method to reduce environmental impact, digitalisation is now used based on business development and business strategy (Sparviero and Ragnedda, 2021).

3 Digitalisation practices in aviation

Progress in the aviation industry is happening very fast, mainly thanks to the development of technology. In parallel with the developments in technology and communications, the aviation industry was initially affected, but when this situation was overcome industrially, the aviation sector surpassed other sectors. The first use of digital technologies in the aviation industry began with the collection of passenger data by airlines, which was then processed and shared with industry stakeholders. In this way,

attempts were made to achieve passenger satisfaction by personalising services for passengers (WEF, 2017). At the same time, flights have become smoother and safer thanks to data technologies. Digitisation increases efficiency, reduces costs, and improves operations in the highly competitive aviation industry (Kuisma, 2017). In aviation, augmented reality, artificial intelligence, blockchain, and IoT are the most commonly used technologies (George et al., 2021).

Digitisation processes carried out by airlines and airports, the main players in the aviation industry, receive more attention than the efforts of other players. Although digitisation has occupied an important place in aircraft production since the early days of aviation, recent digital transformation efforts have also seen digitisation enter the management function of all aviation companies. Digitalisation in aviation has found its first resonance in maintenance activities. Airline operators and aviation maintenance companies have digitised their entire maintenance activities (Mattig, 2017). The digitisation efforts of national and international aviation regulators are being studied along with all other stakeholders.

Digital applications deployed at airports provide airlines and airport operators with additional uptime by preventing flight delays at airports. In this way, the environmental impact is reduced in several ways. One such application is the Airport IQ, a European Union project. This project provides real-time data by combining various mobile devices with existing airport infrastructure. By bringing together all the operations carried out by staff on the apron, incorporating real-time data, the time spent by aircraft waiting in the queue, especially in the check-in process, is reduced and the emission of exhaust gases from the aircraft engine is reduced. Digital transformation projects deployed at airports are generally related to security systems, border control processes, the air traffic control system, and maintenance activities (Guraly, 2018).

Digitalisation in aviation has many benefits. Many of them were more clearly recognised during the COVID-19 pandemic. Many unmanned operations, especially at airports, which are quite complex areas, were sanitised under pandemic conditions. The proliferation of online shopping among people has increased the need for airlines to deliver services through online platforms and has put pressure on airline management to transform digitally. Airlines have begun to reap cost benefits from the digital transformation they are required to undertake. In addition, environmental awareness has emerged that these practices should be preferred in terms of environmental impact (Drljaca et al., 2020).

The aviation industry is one of the sectors where performance has been a high priority for many years. The high risk, high cost and complexity of management are areas where performance is pursued. In addition, environmental performance and digital performance have recently become notable performance indicators. The collection and storage of big data has become one of the most important tools in enterprise performance monitoring. Big data helps predict risk factors within the system and succeed in risk control applications. The contribution of big data is important to witness important developments in this sector. It is used in aircraft design and performance monitoring, maintenance, air traffic control, flight operations monitoring, route planning, flight environment definition and safety, flight and airport management, and product development (Dou, 2020).

3.1 Airlines and digitalisation

Airlines require intensive processes to transfer and share information as they continue their operations. The management of this data is provided by digital technologies, storage areas and data transmission networks. Today, almost all airlines offer their ticketing and reservation activities through digital channels to maximise the passenger experience while reducing many costs. While these applications are the best-known examples of digitalisation, they have also led to advances in environmental sustainability. In addition to airlines that have advanced on the path of digitisation, there are also airlines that have not embraced digitisation in the industry. It is not wrong to say that these companies are lagging behind their competitors for this reason (Mattig, 2017). There are authors who claim that the reason for lagging behind in digitalisation is corporate governance. According to some authors, those who cannot adapt to digitalisation are employees who cannot keep up with change (Abolado et al., 2017; Lamb, 2018).

The International Air Transport Association's (IATA) steps toward sustainability coincide with those toward digitisation. Digitisation steps bring benefits in terms of environmental sustainability. Leading the digitisation efforts are FRED+, Trajectory Sharing Platform (TSP), e-Freight (Meré et al., 2020). The FRED+ platform provides airlines with information on fuel, emission rates, and operational efficiency with benchmark reports and analytical tables (IATA, 2019). This platform is a digital-based website. Access to it is open and free of charge for all countries associated in CORSIA and for IATA member airlines. TSP, on the other hand, can be defined as a platform that communicates the flight routes generally used by airlines and aims to minimise harm to the environment by ensuring fuel efficiency. Moreover, the e-freight platform is a digital platform that promotes paperless operations on the air cargo side and is mandatory as of today (Meré et al., 2020).

3.2 Airports and digitalisation

Digitisation measures, which are used at airports as well as airlines primarily to increase efficiency and the customer experience, have been used extensively in the past in the area of flight and aviation security. In particular, airports known as pioneers in the field of sustainability (Schiphol, Heathrow, Munich, Frankfurt, Copenhagen, Zurich, Stockholm Arlanda) are taking major digital steps in the area of operational efficiency, security, and passenger experience (Zaharia and Pietreanu, 2018). The use of cloud-based, big data flow, and IoT technologies is mostly focused on instant monitoring of existing processes and improving the human-machine interface. Such technologies are suitable for use at airports that want to automate their processes more (Little, 2018).

The main purpose of digitisation of airports is to increase efficiency in production, as in airlines. It seems possible to fulfil the tasks of airports in the field of sustainability through digitisation activities. Basically, an airport is expected to focus on sustainability: Reduction of emissions, efficient use of resources, reduction of environmental, noise, light and visual pollution, waste management and selection of energy used from renewable sources. There are already airports that meet these expectations. There are some digital database applications to measure the data needed for environmental sustainability activities at airports and for future forecasting. These applications are provided by EUROCONTROL. These; they are called OPEN ALAQS, AMP, IMPACT, V-PATH (SESAR, 2020). As explained earlier, the digitisation applications provide

information to users by measuring the emissions of fuel consumption at airports during take-off, taxiways, and aprons. One such application developed specifically for airport monitoring is, of course, OPEN ALAQS. This application is integrated with the AUSTAL2000 tool developed by Germany, which is also used to analyse carbon levels.

3.2.1 Smart airport concept

With the advent of Industry 4.0, the concept of the smart airport has evolved all over the world. Instead of just responding to passenger needs, it uses Big Data and open data to develop new airport systems. The concept of the smart airport is related to the idea of the smart city. Through the Internet of Things, different smart devices can interact with each other. A smart airport is different from a traditional airport. Instead of just responding to passenger needs, Big Data and mobile networks are used to develop new airport solutions. Smart technology helps reduce energy consumption by controlling lighting and air conditioning based on a demand at a specific time. Examples of technologies used in the smart airport concept include: Self-boarding, smart check-in, biometric services, indoor navigation, smart wearables, self-adhesive baggage tags, RFID baggage tags, border control, lost baggage kiosks and airport apps for mobile devices (Rajapaksha and Jayasuriya, 2020).

Although today's airports are designed for travel, they have evolved into multifunctional centres that provide digital information, integrate with the digital world, make great use of communication systems, and promise digital data to all stakeholders. In addition, they are 'smart' operating areas that offer users many new services linked to the latest technology and have changed the way they do business through automation systems. These innovations also provide convenience, creativity and safety for customers. Smart airports should also be seen as a key investment for a sustainable future. Thanks to smart airports, energy consumption is reduced and environmental benefits such as reduced paper consumption are achieved through redesigned services implemented by operators (Kapila et al., 2020).

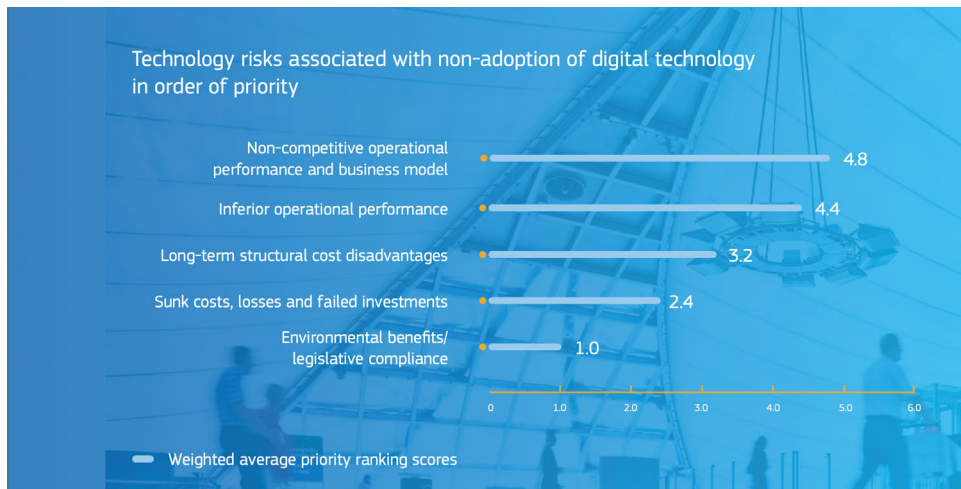
Smart airport applications enable all stakeholders to make technological use of the airport environment. Not only do they serve to expedite and track passenger and cargo flow within the airport, but they also enable real-time location of passengers, baggage, and cargo within the airport at various prescribed times. To this end, tracking passengers at check-in, expediting transactions at security points and border checkpoints through digitisation, and tracking aircraft transactions in the air can be realised thanks to the IoT. Complex airport management systems include various levels of technical equipment. For this reason, the aviation industry has been fundamentally digitised for many years. This process has not developed as desired due to problems with information exchange (Mrna et al., 2021).

Airports are considered complex ecosystems. To track digitisation in airports, the digital twin of airports is created. Digital twin technology is one of the most effective technologies for developing baseline data that will help airport management in predicting and simulating the future and moreover in developing future applications. In airports, security services, passport control, passenger flow management, and airline sorting services are basically equipped with the digital twin technology. Smart grid technologies have a positive impact on the environmental impact of airports by incorporating various conventional energy sources that do not emit carbon and the efficient use of energy sources. They help reduce air pollution through reduced use of ground vehicles,

personnel, and aircraft by supporting effective planning by airport operators. Because it also helps reduce airline fuel consumption, it can also reduce operating costs (Weichenhain et al., 2019).

Aviation companies are trying to achieve digital transformation by acting within the framework of different objectives. Although the impact of digital transformation is mentioned in terms of sustainability, environmental impact is not one of the primary objectives of the companies. Considering the studies conducted in this direction, it is not surprising that companies see the least environmental benefits among technology risks. Nevertheless, the mention of environmental impact among the listed benefits is promising. It is shown that in Figure 1.

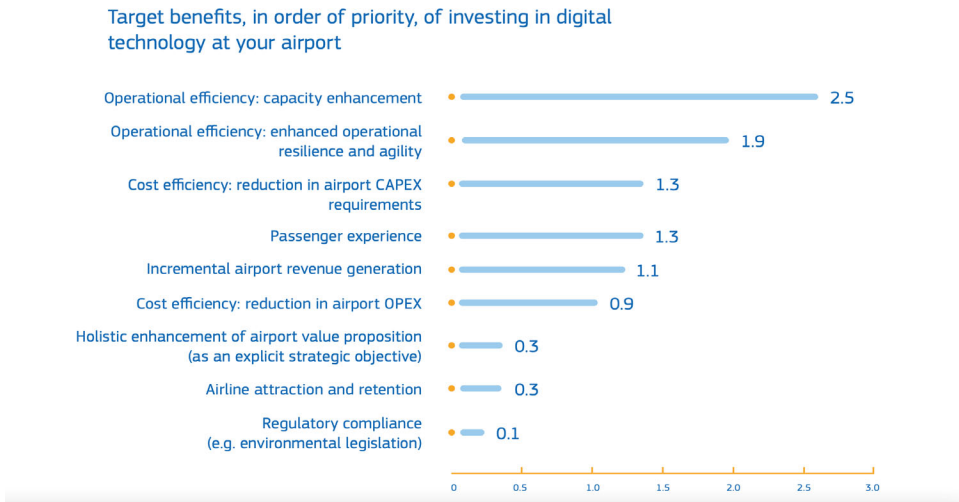
Figure 1 Prioritised digital technology risks (see online version for colours)



Source: Pell and Blondel (2020)

When airport management invests in the digitisation of airports, it pursues various goals. These goals are mostly related to operational efficiency and cost, as shown in Figure 2. However, environmental goals can be achieved if all broad goals are considered. The environmental waste of airports that achieve operational efficiency will decrease. Airports that achieve cost efficiency will be able to invest more in environmental sustainability. Airports that target customer experiences will be able to pursue green marketing. Airports will become more competitive in terms of environmental performance. Finally, through digitalisation, airports will be able to adapt to environmental laws and standards more easily.

The worldwide growth in the air transport and tourism sector in recent years is attributed to the development of the smart airport concept and the growth of the smart airport market. The growth of air transport and tourism even after the 2008 economic crisis has been one of the most prominent socio-economic phenomena. About 4.5 billion passengers are carried by scheduled international airlines, and this figure is expected to double by the end of 2029. Moreover, the tourism sector in many countries of the world has been deeply shaped by the continuous development of air transport services. Advances in information and communication technology (ICT) have doubled the number of tourists in the world (Astute Analytica, 2022).

Figure 2 Top priority digital transformation benefits (see online version for colours)

Source: Pell and Blondel (2020)

According to the United Nations World Tourism Organization (UNWTO), in 2019, the Middle East region grew in international tourism almost twice the world average. Asia-Pacific expansion has slowed, but still has seen an average of 5% growth in international tourism. North America has the largest share of the global smart airport market in 2021, with a share of approximately 35.3%. Data in airport operations has the feasibility of improving visibility and optimising the business process. In addition, the increasing preference to develop personalised experience and higher concentration of market players are expected to drive market growth in the region. In addition, Asia-Pacific is projected to grow at the fastest CAGR of 14% during the forecast period, with a 25% market share in the global smart airport market in 2021 (Astute Analytica, 2022).

3.3 Stakeholders and sustainability

If we look at the players in the sector outside the airline and the airport, we find that the steps of digitalisation have begun in a big way in every sector. Kovynyov and Mikut (2019) conducted a study on the areas of application of digital technologies for ground operations at airports in the aviation industry and divided these technologies into groups. In the passenger group, there are applications such as check-in with kiosk devices, automatic boarding devices, terminal navigation, smart wheelchairs, fingerprint and facial recognition. In the baggage group, there are applications such as RFID, a type of barcode system, automatic baggage claim, lost baggage kiosks. In the team planning and programming group, there are applications such as intelligent crew allocation method, congestion reduction method, and shift change method. In the human resources and training group, there are applications such as the digital processing of personnel data, web-based training, mobile applications and enterprise communication, personnel cycle management. In the management group, the application of accessing reports on key performance indicators is important for digitalisation by completing the aviation process outside airports and airlines (Kovynyov and Mikut, 2019).

Another problem with ground handling services is the intensive use of printed documents. In fact, most documents used between the time passengers enter the airport and the time they leave have been digitised. But the labels that must necessarily be attached to luggage and bags are still used in printed form. In this context, it is expected that in the future, baggage tags with reusable IoT technology will be used thanks to digitisation (Wong and Wong, 2016). In aircraft maintenance, digitisation is widely used for monitoring, planning, and reporting on the life cycle of components. The use of three-dimensional printers in aircraft production meets the requirements of the digital age. Most of the digital technologies used in aircraft production are corporate know-how and are not shared by manufacturers (Mattig, 2017). It is known that maintenance and production companies are also sensitive to issues such as efficiency in resource management, waste management, and renewable energy consumption for the sustainability of their own production processes. Digital technologies are used in the implementation of these activities.

4 Results and discussion

In particular, the sources used and investigated in this study are sustainability, digitalisation, sustainability in aviation, digitalisation in aviation, sustainable digitalisation, the impact of digitalisation on sustainability, and finally, the impact of digitalisation on sustainability activities in aviation and smart airport which were achieved using the deductive method. As can be seen from the literature and the aviation companies investigated in the study, the environmental dimension of sustainability in aviation has not yet been integrated into the digital era. Outside of aviation, the importance of digitalisation for environmental sustainability or the environmental impact of digital technologies is frequently researched and analysed.

It is claimed that investment in digital airports will increase by 40% (from 2018) by 2020. Basically, the aim is that digital investments will increase the commercial and technical efficiency of airports. The environmental benefits that will accrue if these goals are achieved have not been considered. Adequate digitalisation efforts allow airport operators to go beyond the mere adoption of the latest technology and achieve environmental sustainability through the appropriation of a digital culture. For example, thanks to the automated boarding system that can be deployed at airports, boarding time can be halved, which benefits the environment by saving fuel and aircraft operating time on the ground (Zaharia and Pietreanu, 2018). According to a study conducted by ACI in 2020, it was determined that 5.46% of airport revenues were allocated to Information Technologies in 2020. It has been determined that this rate corresponds to 3.5 billion dollars. Again, it has been determined that 55% of the airports participating in this study have increased their 2021 IT budgets and will remain the same or increase thereafter (ACI, 2021).

The growth and development in the aviation industry have brought with it regulatory studies on environmental protection. It is seen that recycling technologies develop similarly to the digitalisation process (Mehta, 2015). With the intensification of regulations regarding the disposal of electronic waste, recycling organisations that offer environmentally friendly disposal options have been established. Many businesses use lifecycle management (LCM) methods in tracking electronic waste. Especially harmful

substances in computers (mercury, lead, cadmium, chromium VI, PBB, PBDE, PVC) pose a serious threat to environmental pollution (Dunn et al., 2007). For this reason, national and international regulations should examine the issue of electronic waste in detail within the digitalisation regulations.

With digitalisation, the need for qualified personnel in aviation enterprises has also begun to differ. According to ACI, the need to attract and recruit qualified, talented professionals in the digital age is a key issue affecting all airports. For this reason, due to digitalisation affecting all processes, it is necessary to measure the digital compliance of the people to be recruited for organisational success by using the next-generation recruitment tools and platforms of airports (Webster, 2019).

If we look at the mass of passengers/customers at airports where digitalisation is lived with the concept of smart airport, it has been found through research that the general perceptions of these passengers about digitalisation are generally positive. At the same time, this group's general views of environmental sustainability are positive. This shows that the relationship between digitalisation and environmental sustainability has a connection beyond other sectors in aviation (Miskolczi et al., 2021).

It is expected that any new technologies that IATA and ICAO bring to aviation will teach the industry as a whole the methods of delivering environmental services related to digitalisation through intra- and inter-company learning. In this context, smart airport projects, one of the most used applications at airports and the preferred one for the future, are very important from a sustainability perspective (Meré et al., 2020).

Digitisation is changing and improving the aviation industry in many respects, as it does in all sectors. All stakeholders in the aviation industry (in line with their budgets) are trying to manage their digitalisation processes. When examined in terms of environmental sustainability, it is possible to encounter many different digitalisation applications. After the pandemic (COVID-19), the steps taken regarding the digitalisation application have increased, and new environmental sustainability studies have begun to be conducted in this direction. In this context, it will be possible to encounter new applications related to environmental protection day by day.

5 Conclusions

The concepts of sustainability and digitalisation are processes that affect companies in both the aviation industry and the global marketplace and should be done together at a fundamental level. The reason why these concepts are trending together is the concern for the liveable environment due to the growing environmental awareness and the immutability of technological developments. In addition to the positive effects of digitalisation, its negative consequences also have an impact on the aviation industry and environmental sustainability. In particular, the problem of digital waste can reach alarming proportions (Arushanyan et al., 2014). There are also challenges that airlines and airports face in managing their digitalisation processes. Inadequate infrastructure, the cost of technology, the constraints that may arise in adapting employees, the increase in the consumption of energy resources, and the social impact are among the problems that digitised companies will experience (Pohl, 2017). Looking at the aviation industry, the data of digitisation processes are not shared due to competition, trust issues, and data security. For this reason, sectoral problems occur during digital transformation. The lack of information sharing between airlines can be solved by national and international

institutions reaching agreements on this issue. With the digitalisation of companies, the issue of cybersecurity has also become more important. Companies have become more vulnerable to the theft of their data. Another obstacle to digitisation is the human factor. Employees in companies may feel that their jobs are at risk. The use of new technologies may cause resistance among employees. It is normal to encounter problems on the road to digitisation. Industry players are looking for common solutions to these problems. The sectoral benefits of digitisation are many. Lower fuel consumption, energy savings, reduction of operating resources thanks to paperless processes are the best known of these benefits.

In addition to the fact that digital transformation will bring great innovation to the sector, the problems that arise in digital transformation also pose a challenge to the sector. One of these problems is the lack of financial resources. In addition, the issue of cybersecurity is also important. Problems with data sharing and data quality can arise from the fact that not all players in the sector can digitise to the same extent. Digitisation, which is beneficial for meeting customer needs, is not a positive process for every customer. The income level and demographic structure of passengers have a major impact on their perceptions of digitisation. The demographic structure of employees also affects the formation of a digitisation culture in the company and the adoption of digital applications. It becomes necessary to inform and train employees in this direction. The management structure of companies should also be flexible to keep pace with digitisation. There are regional and international imbalances in digitalisation across the industry and the world. It can be seen that these imbalances are reflected in the aviation industry and are forcing companies. One of the problems that will arise with the digitalisation of aviation is electronic waste and recycling of electronic devices. For the solution of this problem, it is very important to establish national and international regulations as soon as possible.

It turns out that smart airports offer a systematic approach to digitalisation through a wide range of technologies and automation tools. This approach enables digital transformation and delivers benefits across the board, from customer satisfaction to improved environmental performance. Smart airports are likely to offer more sustainable air transport in this direction. Smart technologies will have an impact on creating a cleaner environment of the future for all stakeholders and customers involved in air transport. Smart airports systematically bring together the aviation operational environment and technology. Multiple independent technologies around the complex airport are connected via the internet of things (IoT) to facilitate business operations. This will also help provide the data source and make it easy to analyse in sustainability studies. Real-time data can be used to determine 'where' the airport stands in terms of environmental sustainability and develop future goals.

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