Creating a Safer Journey: Exploring Emerging Innovations in the Aviation Sector

Gui Lohmann, Bruno Pereira, and Luke Houghton

Abstract The COVID-19 pandemic has affected the global aviation sector in an unprecedented way. It has brought changes to air passenger travel behaviour, with demand being reduced significantly due to border closures and concerns over the spread of the virus. As a result, the aviation industry has been required to adopt new technologies and procedures to offer a safer journey in terms of bio-safety and security. This unique scenario has presented an opportunity to redesign safety practices and create solutions to restore trust and reduce risks both in-flight as well as within airports. Examples include touchless/gesture-based self-service devices, airport-based passenger tracking technologies, contactless biometrics, autonomous handling services using robotics, and automated cleaning and sanitising innovations. This chapter describes some of these innovations and practices that are being adopted by major airports and airlines around the world, offering a value proposition for a bio-secure, safer environment, to enhance the wellbeing of air transport passengers.

Keywords Aviation · Innovation · Safety · Travel · COVID-19

Introduction

Historically, aviation has operated as a highly regulated sector, under competitive pressure and strict safety levels. Its global presence and ongoing growth have facilitated the potential for the rapid spread of infectious diseases worldwide (Ikonen et al., 2018; Webster, 2009).

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In the context of the travel and tourism industry, COVID-19 brought the sector to an unprecedented crisis. In 2020, forecasts showed that airline passenger revenues could fall by US$314 billion; in some cases airlines have reduced original capacity by to up to 90%, operating a skeleton network (IATA, 2020). Changes in consumer behaviour are emerging, primarily due to the fear of contracting the virus while travelling, leading to the avoidance of crowded environments, and concerns in relation to flying and visiting other places. Scientists have argued that the odds of catching COVID-19 on an airplane are slim (Hardingham-Gill, 2020). One explanation for the apparently low-risk level is that the air in modern aircraft cabins is replaced with new fresh air every 2–3 min, and most planes are fitted with air filters designed to trap 99.99% of particles (Hardingham-Gill, 2020). In addition, the perceived heightened risk of boarding could be reduced with innovations enabling greater passenger confidence, including new sanitising solutions, biometrics, screening procedures, and personal protective equipment. The belief of a *new normal* indicates a singular opportunity to engage the sector into an innovation paradigm, where turbulent times encourage new advances in safety technologies.

Although the barriers to restoring air passenger growth seem numerous, a window of opportunity for technological advancement is apparent. Emerging technologies are presenting as viable solutions for a safer environment, improving the traveller journey. These circumstances suggest the need for a new aviation security mindset that brings together key safety factors such as technology, intelligence, and procedures in a new complex environment (McLay et al., 2010). Examples include the introduction of cashless payment self-service shopping experiences, thermal scanning integrated into the security processes, and the use of predictive analytics to identify those at risk and to concentrate containment efforts (Future Travel Experience, 2020a).

Innovation has become a major focus for airports and airlines due to the biosecurity requirements imposed to create COVID-19 safety plans. In some cases, key players are fostering an open innovation approach by aggregating external collaborations to solve contingencies and challenges during the pandemic. For example, Emirates Airlines, through its Aviation X Lab, has created the Traveler Well-being challenge to accelerate and scale market-ready solutions and products from other companies to enhance health and safety for travellers (Arabian Aerospace, 2020). The Swiss start-up Xovis has begun tracking crowd movements through a passenger contagion map, as well as identifying contagious groups at an early stage, helping airports to foster procedures to keep physical distancing (Cision PR Newswire, 2020a). The Copenhagen Optimisation company, with its Better Airport platform, provides a cloud-based planning solution for airport operations, forecasting and managing baggage and passenger flow in real-time at Heathrow Airport, London (Silicon Canals, 2020).

The aviation sector's growth is equally important to maintain passenger safety and safe experiences for travellers. Innovative technological solutions need to emerge to restore a distressed value chain from collapsing and help the sector to rebuild. In addition, new policies, anticipatory planning, and comprehensive screening procedures will need to be enacted. Stronger network coordination, fast response

Fig. 1 The mandatory use of face masks in airports and aboard many flights is now widespread throughout the world. (Image courtesy of Professor Donna Pendergast)

to flight cancellation and ongoing and effective coordination of disease control will also be required (Webster, 2009).

This chapter presents an overview of safety and security innovation within air transport, from September 2015 to September 2020, as the sector/industry moves towards the fourth industrial revolution. This revolution is based on the paradigm of Aviation 4.0, where a new cycle emerges and demands innovation adoption to ensure survival and adaptation within the new normal context. The overview includes current cases and a discussion of the emerging technologies, highlighting the practices and policies that aggregate industry value (see Fig. 1). The chapter concludes with a discussion comprising of practical insights to create a safer journey from the perspective of bio-safety and security.

Innovation and Safety in the Aviation Sector: Context and Evolution

The aviation sector supports the tourism and travel chain and, more widely, other businesses, contributing to global productivity as a catalyst for world trade (Chapman, 2007; Chen et al., 2015). The sector is technology-driven, where innovation plays a key role driving advances for the entire aviation sector and a thriving

supply chain (Halder, 2013; Lee & Mo, 2011; Mrazova, 2013). The development and expansion of this sector have important effects on society and economies, demanding greater efforts related to capacity and safety during a travel journey (Gao et al., 2009; Rissman et al., 2013).

Since 1944, the Chicago Convention on International Civil Aviation, promoted by the International Civil Aviation Organization (ICAO), set out minimum standards for civil aviation safety and environmental protection. These standards include control measures to prevent the spread of disease as a result of air travel (Groenleer et al., 2010; ICAO, 1944; Lohmann & Pereira, 2019). In a globalised environment, safety and security remain a constant challenge to the aviation sector, where policies, practices and technologies should be implemented for effective and rapid remediation to minimise contingencies and potential economic impact (Fox, 2014; Watson et al., 2011).

Innovation has become a driver of progress providing solutions for diverse operations within the aviation sector (Franke, 2007; Nicolau & Santa-María, 2012). Recent technologies have facilitated access to international and domestic markets, supporting wellbeing benefits, and impacting on the relationship between customer satisfaction and value (Chen et al., 2015; OECD, 2018). The safety and security dimension of air travel is indispensable to the value proposition compared to other factors such as convenience, comfort, and meals (Chen et al., 2015; Hofer & Wetter, 2012).

While the aviation sector has experienced several significant advances over the years, challenges such as the COVID-19 pandemic have forced breakthroughs with the adoption of technological innovations. The pandemic has required that biosecurity strategies focus on risk analysis and prevention, and emphasise the importance of circulation, contingency, and connectivity (Brueckner & Pai, 2009; Martin, 2010).

The COVID-19 pandemic is an ongoing concern for airlines and airports (see Fig. 2) as it comprises of novel problems in relation to environmental, health, and security concerns that cannot be effectively addressed by existing solutions (Fox, 2014; Groenleer et al., 2010). Innovation in safety and security may help to prevent and minimise these problems and ensure the health and wellbeing of passengers (Fox, 2014). Emerging innovations such as touchless/gesture-based devices, tracking technologies, biometrics, autonomous services, and robotics may address these concerns. The enabling of technological adoption into airports and airlines will improve the travel experience and help to adapt to the *new normal* COVID-19 context.

However, emerging innovations need to be initiated, managed, and materialised in a target-oriented manner to achieve value creation and tangible results, assuring travellers a feeling of safety during their journey (Franke, 2007; World Travel & Tourism Council [WTTC], 2020). The innovation adoption is a complex process which requires certain procedures to allow for further development and change. The innovation process and subsequent adoption involve varying stages including the identification of opportunities, the selection of strategic options, appropriate resourcing, and implementation measures (Halder, 2013; Matthews, 2000). In

Fig. 2 As air travel resumes social distancing and face masks are essential safety measures. (Photo by Pexels, used with permission)

addition, when facing new demands, these stages form a paradigm for technology adoption in the relationship between markets, passenger, and practices (Perl, 1998).

In this context, the use of adequate technologies, procedures, and operations should be encouraged to manage emerging issues, particularly potential safety risks, and provide opportunities to foster innovation (ICAO, n.d.). To explore the emerging innovations within the aviation sector, it may be relevant to reflect on the recent history of the evolution of safety and security technologies.

To provide this overview, an online search was carried out using the Griffith University library database to collect technical and practice material. Only resources fully available online, in English, were selected, covering a publication period from September 2015 to September 2020.

Terms related to aviation, safety, and innovation were searched in the title field, by using the following combination of keywords and Boolean operators (*aviation* OR *airline* OR *airport* OR *air transport* OR *air transportation*) AND (*safety* OR *safe* OR *security* OR *secure* OR *health* OR *well-being* OR *disease* OR *contamination* OR *pandemic* OR *outbreak* OR *virus*) AND (*innovation* OR *innovative* OR *technology* OR *solution* OR *advance* OR *novelty*).

The search resulted in 500 results. The Mendeley Web Importer plugin was used to collect and organise the material. Next, a .xml document was exported to an Excel spreadsheet to remove redundancies. Material that did not fit the study criteria was also removed. The removed items included academic papers, event announcements, tender and contract notices, or paid reports. In addition, material that was not

directly associated with the aviationcontext were also removed, such as news related to airport-tech style measures implemented in prisons security (Williams, 2019).

A total of 135 items were selected for analysis. The results comprised of newspaper articles, trade publication articles, magazine articles, web resources, and reports. Figure 3 synthesises the recent evolution of safety and security innovations in the context of the aviation sector (2015–2020).

When analysing this data, it was noticeable that a new technology paradigm supported the new normal context. Prior to 2020, most innovations aimed to address safety and security issues related to terrorism attacks, accidents, and warning situations at airports and in flight. These technologies were developed in response to concerns following the 9/11 terrorism attack in the United States of America in 2001. Since the beginning of 2020, with the COVID-19 pandemic, most results comprise of innovations addressing issues related to bio-safety, security, and health and wellbeing during the passenger journey.

By examining this new context, it is possible to note that the aviation sector has not reduced its attention to terrorism and security threats. In fact, the sector is fostering the emerging innovations to address an additional, critical issue. Response to both the 9/11 terrorism attack and the COVID-19 pandemic suggest that the sector has been reactive rather than proactive to potential future threats. For example, just after the Pan-Am Lockerbie bombing in 1988, involving a Boeing 747 heading from London's Heathrow Airport bound for New York City, more robust explosive detection technology was implemented for checked baggage (ABC News Australia,

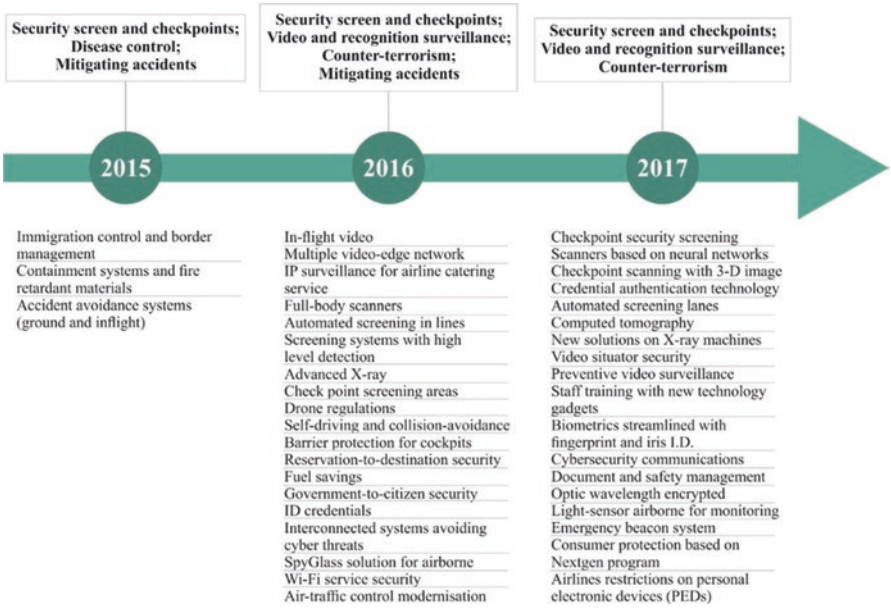

Fig. 3 The recent evolution of safety and security in the aviation sector: main themes and innovations (2015–2020)

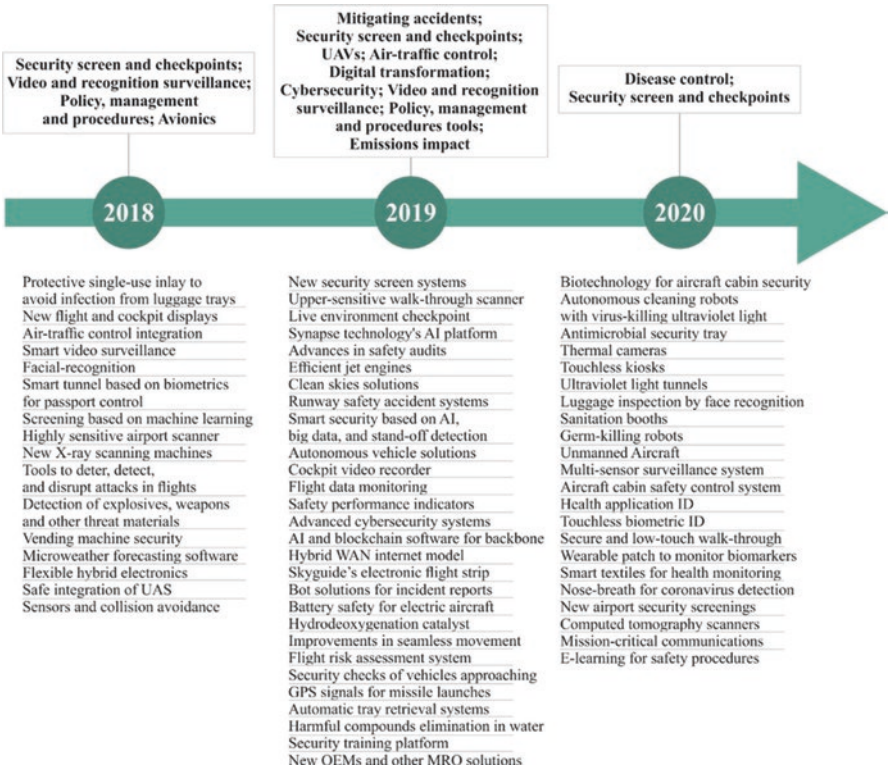

Fig. 3 (continued)

2020; Cox et al., 2011). More recently, just after the 9/11 terrorism attack in the US, the Transportation Security Administration was established to retrain the workforce and accelerate the implementation of more advanced security technologies (Cox et al., 2011). One explanation for this reactive behaviour is that there is no start or endpoint to the diffusion of innovations or digital change. It involves a continuous process of improvements that can increase costs within airlines and airports (Halpern et al., 2021).

The COVID-19 crisis has become a serious concern for all business sectors, especially the aviation sector within the scope of global operations (Serrano & Kazda, 2020). This crisis has created the necessity to adopt a continuous technology paradigm, requiring an innovative mindset to return the sector to sustainable growth. The continuous technology paradigm also requires policies, practices, and new business models to be adopted by airports and airlines to accelerate and enhance the diffusion of innovations within the sector.

The New Normal and Emerging Innovations: Technologies for a Safer Journey

Within the evolution overview of safety and security in the aviation sector, it was noticeable that there have been emerging innovations relating to health since the COVID-19 pandemic. The following discussion presents a comprehensive description of these solutions, adopted by major airlines and airports globally, into five innovation groups. These groups include:

1. Sanitising and cleaning technologies
2. New anticontamination material and barriers
3. Touchless, biometrics, and automated passenger processing
4. Real-time monitoring, screening, and thermal detection technologies, and
5. Apps and devices for a digital new normal.

Sanitising and Cleaning Technologies

After the emergence of COVID-19, airlines and airports introduced new rules and measures to minimise the chances of infection by expanding the cleaning of public spaces to reduce the presence of the virus and by deploying sanitising technologies. Germ and virus-killing robots, autonomous cleaning, and new products for sanitising are prominent innovations in this context. For example, Gatwick became the first airport in the United Kingdom to treat security trays with ultraviolet (UV) light energy. The aim is to protect passengers and staff and reduce the spread of COVID-19 and other infections on these high-touch surface areas (Future Travel Experience [FTE], 2020b).

Los Angeles, San Francisco, and New York's JFK airports adopted a germ and virus-killing robot that sanitises airplanes (Legacy MedSearch, 2020; NS Medical Devices, 2020). This technology is equipped with a ground-breaking system that utilises ultraviolet-C (UVC) light that is capable of killing disease-causing pathogens (Dimer, n.d.). It has been proven safe and highly effective in eliminating germs that cause infectious diseases, including coronaviruses, influenza, and Ebola (Businesswire, 2020a). Similarly, Hong Kong airport has deployed autonomous cleaning machines equipped with virus-killing ultraviolet light, applied antimicrobial coatings to frequently touched surfaces, and used air sterilisers to disinfect toilets and other passenger areas (Martín, 2020). Clean tech machines were adopted here as part of a full-body disinfection facility, incorporating ultraviolet light and nano needles to pierce the cell membrane of bacteria and viruses to disinfect humans and clothing (Jamil, 2020; Pitrelli, 2020). The Hong Kong airport has also adopted photocatalyst technologies and sanitising sprays, all meant to protect travellers and airport staff from potential viral infections (Snow, 2020).

New Anticontamination Material and Barriers

Person-to-surface contact became a critical concern with the COVID-19 pandemic, requiring new materials and surfaces to reduce contamination. For example, Edinburgh Airport has upgraded the airport's security tray return systems with antimicrobial tray technology to minimise the spread of bio-contamination from person-to-surface contact (Airport Technology, 2020). The antimicrobial technology is built into the security tray during the manufacturing process and minimises the presence of microbes throughout the security tray lifecycle (Cision PR Newswire, 2020b; Leidos, 2020). The trays prevent the reproduction of a broad spectrum of bacteria, including staphylococcus aureus (staph), E. coli, and antibiotic-resistant bacteria like MRSA (Methicillin-resistant Staphylococcus aureus) and VRE (Vancomycin-resistant Enterococcus), by 99.99% (Caswell, 2020).

Inside the aircraft, technologies such as air curtains around passengers are easily adapted to prevent the spread of viruses (Morris, 2020). The personal protection window is an example of a cheap technology that utilises barriers designed to protect passengers from the risk of droplet transmission and is made from transparent polycarbonate. These can be installed without the need to reconfigure aircraft interiors (Newton, 2020; Street, 2020).

The wearing of a Personal Protective Equipment (PPE) travel kit, including a protective jacket with hood, gloves, mask, and face shields (see Fig. 4) has been called on to be mandatory for all passengers on any mode of transport (Chandra, 2020). Airlines such as Qatar Airways, AirAsia, Thai Airways, and Philippine Airlines have commenced offering PPE to cabin crews to protect themselves and the passengers (Snow, 2020). Most airlines are adopting soft inner cotton or linen linings to make the PPE more comfortable. However, with the advent of new technologies and materials, it may be possible to design these materials differently. For example, adopting sustainable materials such as PPE with bio-filters composed of bamboo fibres, silk, silver, or carbon. In addition, sensors can be integrated into aircraft to continuously measure crew and passenger temperatures (Chandra, 2020; Thomasy, 2020).

Touchless, Biometrics Technologies and Automated Passenger Processing

Technology is the primary driver to achieve passenger touchless travel (Serrano & Kazda, 2020). Innovations can further unlock the potential of seamless next-generation processing solutions, making mobile-enabled and touchless airport processes a reality (Express Computer, 2020).

Low-touch and automated passenger processing can comply with new hygiene requirements and be in line with recommendations from the Airports Council International (ACI) and International Air Transport Association (IATA) (Global

Fig. 4 Passenger on repatriation flight from Europe to Australia in full protective Perspex face shield as well as personal mask. (Image courtesy of Andrew Purchase)

Travel Media, 2020; Kastelein, 2020). These innovations allow passengers to use their digital identity on their mobile phone whenever they travel, at each step of the journey. Collaborations such as those between SITA Company and NEC Corporation are providing a combination of technology for common use platforms and artificial intelligence (AI) solutions in which key touchpoints will automatically recognise a passenger (Business Daily Media, 2020). This integrates a biometric identity to check-in, payments, bag drops, pass through security, immigration, and boarding by simply scanning (Express Computer, 2020; NEC, 2020).

The touchless option has new appeal in light of the COVID-19 precautions and may help travellers to feel safer traversing the airport (Best Travel Tale, 2020). For example, the Nashville International Airport fostered clear biometric identity scanners, providing passengers with an expedited, touchless security screening option (Mazza, 2020). The kiosks utilise iris or fingerprint scans to verify users' identities and flight information (Baratti, 2020; International Airport Review, 2020). Instead of waiting in line to present an identification card and boarding documents, customers can go to a kiosk, and gaze briefly into the scanner or apply their fingerprint for recognition. It displays the person's name and photo as they are cleared to pass through the checkpoint (Flager, 2020; Mazza, 2020).

Real-Time Monitoring, Screening Detection, and Thermal Technologies

Pandemic-free air travel requires a pandemic-free airport, where infectious disease detection is a crucial factor. New technologies may be able to deliver this capability at an affordable cost (Tabares, 2021). For example, GE Aviation introduced the Health Application ID for the aviation sector, incorporating blockchain technology for safe airline travel and to restore passenger confidence (Businesswire, 2020b; Reuters, 2020a). The technology enables airlines, airports, and related transportation operation areas to set test result protocols and check compliance to new COVID-19 medical screening for employees and passengers (Bloomberg, 2020; Gavine, 2020). This application uses the Microsoft Azure Blockchain Service and related technologies that create a protocol to embed passenger identity information, ticket information, and medical screening results into the boarding process in a highly secure environment (Bloomberg, 2020; Nelson, 2020).

At Delhi Airport, India, all bags go through a UV tunnel as a new safety measure to ensure a safer environment (Phadnis, 2020). This solution enables the air coming inside the terminal to go through air handling units fitted with UV lights. The air is then disinfected, by going through a high-efficiency particulate air (HEPA) filter (Barnes, 2020; Frey, 2020). In addition, real-time and tracking solutions are being adopted to map passengers' complete journeys, taking measures to ensure social distancing by indicating which part of the airport is more congested (Hussey, 2020).

Despite the lack of accuracy, and the fact that having a temperature is not necessarily a conclusive indication that a person has corona virus, the use of infrared temperature scanners and cameras is on the rise (U.S. Food and Drug Administration [FDA], 2020). The technology is already being used at major airports such as Hong Kong International Airport, London's Heathrow, Los Angeles International, Kuwait International, and others (PI, 2020). The advantage of the thermal cameras is that human screeners do not have to touch or stand near passengers. Instead, screeners can monitor a television screen from a distance to see passengers' thermal images and temperatures (Nguyen et al., 2010; PI, 2020; Roxby, 2020). With thermal cameras at airports, a passenger who generates an unusually high temperature is automatically denied entry and then directed to a separate area where nurses or other trained professionals can perform a more thorough examination (Martín, 2020).

Airbus and Koniku Inc. are extending research activities to include biological hazard detection capabilities with a disruptive biotechnology solution (Airbus, 2020). The technology, which was initially focused on the contactless and automated detection, tracking, and location of chemicals and explosives, is now being adapted to detect COVID-19 contamination and other biological hazards (GBP Aerospace and Defence, 2020; Intelligent Aerospace, 2020). Based on the power of odour detection and quantification, this technology uses genetically engineered odorant receptors that produce an alarm signal when they come into contact with the molecular compounds of a hazard or threat (Airbus, 2020).

Many start-ups in the aviation sector, namely, air travel techs, are helping the industry to foster emerging innovations. For example, Nanoscent, an Israeli start-up, developed a device to detect coronavirus in patients' nose-breath (Reuters, 2020b; Solomon, 2020). This device integrated a chip that allows electronic devices to smell odour to help detect the reaction of the body to coronavirus. A combination of hardware, software, and sensors developed by the firm can be used for mass 30-second screenings, at stores, hospitals, and airports or border entries (The Science Times, 2020). The technology includes a disposable plastic bag attached to an exhaling pipe that goes into the nostril and includes a recorder equipped with a pneumatic device to clean the sensor after every use (Nanoscent Labs, n.d.; Solomon, 2020).

Apps and Devices for a Digital New Normal

Digital transformation based on devices and apps can create value by using real-time services and procedures via smart data capabilities (Halpern et al., 2021). Mobile boarding passes, virtual wayfinding, and near-field communication apps greatly reduce unnecessary touching and contact (Pallini, 2020).

Airlines, such as SpiceJet in India, believe the sector will adopt a 100% e-check, in which even the baggage tag will be scanned electronically through mobile phones (Phadnis, 2020). In addition, mobile applications can be further enhanced to provide wait-time tracking, notify of boarding calls and zones, allow payments, optimise queues, and ensure a safe distance between groups/passengers around check-ins, boarding gates, bathrooms, stalls, and security areas (Airlines IATA, 2020).

Newly emerging technologies such as the Internet of Things (IoT), AI, machine learning, and blockchain enable integrative connections and smart data-based devices to provide more connected services into mobile communications. For example, common pass web applications, digital health apps that enable travellers to present standardised and verifiable proof that they have tested negative for COVID-19, have been adopted by companies such United Airlines, offering integrated services between Newark and London, and Cathay Pacific trips from Hong Kong to Singapore (Financial Review, 2020).

The IATA is currently working on the production of new standards to allow the remote use of self-service kiosks from mobile devices and integrations based on the One ID initiative (Future Travel Experience, 2020c). One ID, a mobile app, appears to be a critical tool for passengers, introducing an opportunity for the passenger to further streamline their journey with a document-free process based on identity management and biometric recognition (FTE, 2020c; IATA, n.d.). In addition, ACI (2020) has launched a new smartphone app which provides passengers with information about health measures, in place at individual airports around the world, as a result of the COVID-19 pandemic (see Fig. 5).

Fig. 5 A range of smartphone apps are now available. (Source: Photo by Pexels, used with permission)

Aggregating Value Towards a Safer Journey: Policies, Practices, and Innovations Integration

Although many new technologies have been developed to support the aviation sector to recover and to bring travellers back, it is also necessary to adopt policies and procedures within the integrative frameworks. Based on policies and practices suggested by organisations such as ACI, IATA, and ICAO, we summarise the safety and health measures integrated with emerging technologies that may lead to safer travel experiences (see Table 1).

Innovation and digital change are more than just the use of technology (Halpern et al., 2021). Several factors influence emerging solutions for a safer journey during a pandemic, including strategic planning, collaboration, innovation in business models, and integrative frameworks (Nguyen et al., 2010). The innovations proposed, together with other measures, can provide a healthier and safer environment in the aviation sector.

Table 1 Integrative propositions for a safer journey: policies, practices, and emerging innovations (airports and airlines)

Policies and practices		Emerging innovations supporting operations
Trained staff to execute operational plans	⇨	E-learning and extended reality for safety procedures
Consistent processes and procedures for sanitation, disinfection, and deep cleaning practices	⇨	Autonomous cleaning and germ-killing robots, Antimicrobial security trays and equipment surfaces, Ultraviolet tunnels, Sanitising booths, Sanitising sprays
Security and facilities working towards seamless journeys within airports	⇨	Multi-sensor surveillance systems, Health applications ID based on blockchain, Real-time and tracking solutions
Implement measures for health screening and detection	⇨	Thermal cameras, Infrared temperature scanners, Luggage inspection by face recognition, Smart textiles for health monitoring, Computed tomography scanners, Nose-breath devices for virus detection, Wearable patch to monitor biomarkers, Odorant receptors to detect compounds of hazard threats
Health procedures for arrivals, check-in, embarkation, and disembarkation	⇨	Touchless kiosks, Low-touch walk-through systems, Biometric identity to check-in, Immigration and boarding by scanning, Mobile boarding passes
Implement measures to ensure health and safety for crew and passengers on-board	⇨	Biotechnology barriers for aircraft cabin security, Aircraft cabin safety control systems, Personal protection windows and curtains, Personal Protective Equipment (PPE) with biofilters and IoT sensors
Providing transparency and communications with travellers	⇨	Virtual wayfinding and near-field communication, Smartphone apps providing health measures to passengers
Improvements in finance/purchasing procedures	⇨	Biometric payments, Touchless vending machines, Pre-purchase apps based on pickup click and collect

Conclusion

The ongoing COVID-19 global pandemic has affected the economic sector and directly impacted on various industries (Nižetić, 2020; Serrano & Kazda, 2020). The aviation sector is no exception as this industry involves global connections, markets, and the movement of a high volume of people into airports and aeroplanes for business, tourism, and other activities. Airlines and airports need to adopt short and long-term measures to establish healthier and safer environments, to change travellers' behaviours and their intention to travel. Based on a bio-safety and security perspective, emerging innovation can support the sector to create greater confidence for travellers and employees.

This chapter aimed to provide an overview of the emerging safety and security innovations as critical and integrative solutions to support airports and airlines. Various examples from around the world were presented to demonstrate how major airports and airlines are adopting emerging technologies to aggregate value and support the *new normal* context.

The adoption of new technologies is necessary for a readiness approach supporting the future of the aviation sector. Together with adequate policies and procedures, advancement in innovation includes touchless devices, real-time data analytics, screening, cleaning, and communication technologies.

The potential to foster emerging innovations together with health responsibilities and appropriate use of industry standards are key elements to create a safer journey (Tabares, 2021). The aviation sector is continuously exploring practices and measures to reset passenger air travel. However, this atypical and critical moment requires more integrative measures and processes, including strategic planning, collaboration, new business models and integrative frameworks. In addition, in the context of airports and airlines, openness to diverse collaboration with external partners will be imperative to transform new ideas into useful solutions.

This chapter identified and described technological safety and health practices to aggregate value towards a safer travel experience. In addition, the chapter has provided insights into combining emerging innovations with policies and practices to create integrative frameworks.

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