

Airport Management in the 21st Century: Innovation, Security, and Sustainability

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An educator and professional in the field of Airport Management Operations whose life has been shaped by perseverance, continuous learning, and a deep commitment to service. Tested by time and strengthened through experience, she believes that education is a powerful instrument for personal growth, leadership, and nation-building. As a teacher, she is dedicated to nurturing the knowledge, skills, and character of her students. Her presence in the classroom reflects her passion for guiding future aviation professionals toward excellence and responsible citizenship. Despite the challenges and demands of the profession, she remains steadfast in her mission, demonstrating patience, resilience, and unwavering determination.

Inspired by the pursuit of truth and lifelong learning, she continues to develop herself both professionally and personally. Her experiences have cultivated in her a disciplined passion and a strong sense of purpose, enabling her to contribute meaningfully to the advancement of aviation education and the development of competent future leaders. Guided by courage, conviction, and integrity, she strives to be an effective educator, lifelong learner, and servant leader. Through her vocation, she seeks to make a lasting impact on her students, institution, and country, embodying the values of excellence, responsibility, and dedication in all her endeavors.

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The 21st century has transformed the scope of airport management from simple oversight of the 21st century's simple administrative function of the airport into a multifaceted management discipline that includes government regulation, technology, environmental issues and customer service. Due to the increasing number of passengers using air transport as their primary mode of transport, airport managers now have much greater responsibilities than simply ensuring that operations are efficient; they also have to take into account improvements to passenger experiences and initiating sustainability measures.

One of the primary topics within airport management today is the application of technology to improve operations. Technology has changed the manner in which airports operate from; check-in procedures are automated, passengers are now being screened using biometric authentication and there are now tools that allow airport

management to access real-time data, which can be used to improve passenger check-in; improve the efficiency of airport operations.

Airport management also includes issues related to safety and security. Airports must implement security measures that are designed to protect passengers from harm and increase passenger confidence in airport operations while striving for operating efficiency.

Another critical issue facing airport management today is sustainability. As part of their efforts to maintain the safety of their passengers, many airports are searching for environmentally responsible alternatives to the traditional methods of operation. Many are actively working to reduce the carbon emissions associated with the operation of their airports, while others are exploring every possible way to conserve and develop resources wisely.

Infact, understanding the historical development of airport management is critical in understanding how airport management has evolved (Chatterjee, 2024). The evolution of airport management is a reflection of the evolution of society, technology, and the aviation industry. Understanding the historical evolution will assist airport managers in identifying the current and future challenges and opportunities they face in balancing growth, safety and security with sustainability issues. The evolution of airport management and technology has been driven by technological advancements and societal changes. The early airports were hosted by basic operations like the take-off and landing of an aircraft, however following World War II and the immense growth of the aviation industry in that period; an increasing number of airports required comprehensive management systems. Aviation also triggered other technological advances. The development of jet aircraft in the 1950's along with escalating passenger demand resulted in the enhancement of airport operations and infrastructure.

From early radio communication systems utilized at airports through today's very sophisticated air traffic control systems have been keys to the continued evolution of airport facilities. Innovation through the incorporation of new technology is not limited to just the above mentioned operations of airport performance; transformative solutions have also been introduced into the automated baggage handling at airport terminals, airport security screening and passenger check-in. The introduction of these new technologies not only improved the efficiency of airport operations but also improved the security of airports. Most airport security industry professionals

attribute the transformation of airport security systems to the increased risk to airport security post September 11, 2001.

As the management practices of airports have continued to evolve so has the increasing focus on customer service and sustainability. The modern airport is continuously attempting to successfully balance their operational efficiencies and meeting the needs of their customers while also providing a sustainable environment for their clients. The historical perspective presented here will provide a relevant foundation for understanding the innovation currently taking place in the airport technology sector and for addressing the issues of sustainable development and security, while improving the overall passenger experience.

Innovations in Airport Technology

Innovations in airport technology are changing the way airports function and how the travelling public. Smart Airports are a growing trend that demonstrates how technology (e.g., automation, artificial intelligence) is evolving airport management. Automation has given airports the ability to expedite processes such as check-in, baggage handling and many other aspects of travel, thus resulting in shorter wait times for passengers in both the check-in and boarding areas, while also providing a reduction in the number of employees required to perform various tasks.

In addition, many airports are now integrating artificial intelligence (AI) applications into their operational systems, which will enable airports to make better use of their resources and provide timely and informed decision-making when allocating those resources, through the assessment of real-time data.

The use of biometrics systems will also provide a significant improvement over existing methods for identifying individual passengers at an airport, by allowing for the securing, comfort and expediency in the identification of passengers through the combination of biometric identification with an operational system. This will result in quicker security clearance and ease of boarding for passengers.

The ongoing development of smart airports is expected to continue for the foreseeable future, as the next step in smart airport evolution will be the development of environments that create a more comfortable atmosphere for passengers and an operationally effective environment for airport operations. What has now been determined by airports is to utilize analytical data to identify how passengers behave, and then to provide the appropriate services based on the needs of specific passengers, leading to enhanced travel experiences.

The evolution of these technologies will transform airports into complex multi-functional integration centres that provide services to meet the needs of today's and future generations of air travellers.

The evolution of the way technology impacts how airports operate has led to an increased interest in the extent to which airports can provide enhanced passenger experiences through the use of technological advancements. As airports identify the extent to which technological advancements provide enhanced comfort and convenience for passengers, they will also provide insight into the future direction of the air travelling industry.

Improving the Passenger Experience

Improving the passenger experience has become one of the primary objectives of airport management, as a result of the increased growth in demand for air travel and the enhanced importance placed on providing quality customer service. Consequently, airports have taken the time to assess their customers' needs and develop numerous innovations that will ensure that their customers have a faster and more enjoyable experience while travelling through an airport. As an example, mobile applications provide travelers with ability to verify the status of their flights, navigate through an airport's layout, and receive instantaneous updates regarding delays and/or gate changes. Not only are digital solutions such as these useful for alleviating stress and providing an expeditious way to travel; they also help eliminate stress.

In addition to digital solutions, another important way that airports are improving the experience of their customers is by utilizing feedback mechanisms. More and more airports are using social media platforms and surveys to solicit and gather feedback from travelers regarding their experiences. Data from this type of communication is invaluable for airport operators because it identifies areas for improvement and ultimately allows operators to implement changes that are consistent with the preference of their customers. In responding to customer feedback, airports demonstrate their commitment to meeting the needs and expectations of their customers thereby enhancing the overall travel experience for all travelers.

While improvements to passenger experiences at airports continue to take place, they must also address security challenges currently being faced by airports on a daily basis. Striking the right balance between providing an efficient and seamless experience for passengers while ensuring their safety is a difficult challenge. Security measures will

continue to evolve as technology and customer service practices evolve so that the airport experience for all passengers can continue without interruption while ensuring the safety of the traveling public. The intersection of enhancing the passenger experience and addressing current security challenges illustrates the complexity involved in the administration of airports in today's society and will help to set the stage for future exploration into the evolving airport security landscape.

The Evolving Security Landscape At Airports

Changes to the security landscape in airports began as terrorism became a growing threat to the airline industry. The change in the threat posed by global terrorists has mandated the continual evolution and enhancement of security measures at airports. Both the rise of terrorism, the increase in cyber threats and the risk of insider threats are just a few examples of changes taking place to the evolving security landscape. Traditional methods of maintaining security in airports (i.e., metal detectors, baggage screening) are now augmented with advanced technologies such as biometric identification, and machine-learning algorithms. Current technologies enable improved surveillance and quick reaction to potential threats; thus, providing a multi-faceted approach to security.

A key issue affecting airport management when trying to implement security measures is finding equilibrium between the passenger's convenience and the need for stringent security measures. Security measures employ and preserve secure environments for the travelling public but may also lead to excess wait times and increased anxiety while travelling. Airports will therefore need to find innovative solutions that will increase safety while not compromising on providing comfortable and efficient processes through which passengers will travel. For example, by using predictive analytics to identify peak volumes/traffic times, airports are able to better manage passenger queues and minimize the accumulation of passengers through the use of efficiently managed airport checkpoints.

As technology continues to evolve at a rapid pace, the legal and regulatory framework that governs airport security must evolve as well. Governments and global governing bodies are developing a series of guidelines which address new emerging technologies that provide airline and airport operators additional avenues to provide security and manage the complexities associated with evolving threats. For airport managers to effectively integrate new innovations to these security measures while still maintaining their commitment to providing positive travel experiences for their

passengers, it is essential that they understand how this regulatory framework impacts their operational activities. The analysis of the regulatory frameworks will clarify how airport practices will be defined in the 21st century.

The Airport Security Regulatory Framework

Airport security, as it pertains to airports, is/has been subject to an extensive and evolving law and regulatory framework that consists of worldwide legal jurisdictions. The laws that govern airport securities include but are not limited to, national laws of the jurisdiction in which the airport is located and international laws (conventions, laws, treaties and agreements) which impose restrictions on countries with regards their expectations of securing airports worldwide to an internationally accepted standard while having the ability to ensure that they individually have appropriate security measures that are suitable for that country. The ICAO and EU have set standards for international civil aviation authorities to comply with. Civil aviation regulations dictate how the national government will build its security policies for airports. To gain insight into modern-day airport management, one has to consult numerous reports and analyses that provide details regarding current market trends, passenger behavior and emerging technology to determine best practices so that airport administrators, policy makers and researchers can develop innovative business practices (Farrah & Mierzwinski-Urban, 2019).

Complying with the regulations includes having multiple checklists of regulatory compliance that will also require an extensive understanding of the series of security procedures that must be included in the multiple checklists. Airports must ensure to consistently evaluate the security procedures they have established to ensure they comply with not only the national regulations but would also comply with the international regulations. Not complying with the regulations can have dire consequences for the airport operator such as penalties or added oversight by the regulating body over the airport or loss of public image due to suspension of their operations. Therefore, it is crucial that the airport operators understand what national and international regulations and compliance issues they may be subjected to in the areas where the airport is located.

As regulatory authorities implement additional security measures, airports are being forced to look for sustainable approaches to their business operations. Technologies currently in use by airports to improve security measures while also improving sustainable efforts include methods to improve screening processes and reducing

waste emanating from airports and airlines. The combination of these two views of sustainable operations and security measures demonstrate that airports need to be more flexible in the management of their operations based on existing regulatory guidelines and also the sociocultural trends of the communities they are headquartered within, regarding environmental protections in their overall community. The integration of the two viewpoints of airport management are integral to future airport management best practices (Angermeir et al,

As we continue to evaluate business operations within the 21st Century, the implementation of sustainability as part of an airport's operation has increased due to the increasing awareness of global climate change within the aviation community. Airports are using numerous programs as they attempt to create less of an effect on the environment due to their operations while continuing to run an efficient business. With the implementation of sustainable practices being established at many airports (i.e., Energy Efficiency, Waste Management, Water Conservation), alternative energy options are becoming more desired methods of elevated electrical energy use (i.e., solar and wind). A great example of alternative energy use is the addition of solar panels on rooftops of airports, as well as the construction of solar power generating facilities that are adjacent to the airport, which have all reduced the carbon footprint the airport contributes to the atmosphere.

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