



Impact of Applying the Artificial Intelligence in Airports' Operations (Applied on Egyptian International Airports)

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Abstract:

The aviation sector may benefit the most from Artificial Intelligence (AI), which has the potential to alter the business. As a result of AI and aviation breakthroughs, smart airports have evolved. The purpose of this research is to look into the significance of applying AI at Egypt's international airports, like the new capital airport. According to this conceptual framework, AI-powered services and systems enable smart airports to be more robust, efficient and controllable, all while being managed by real-time monitoring and analytics. Smart sensors also help to regulate the airport's ambient conditions, automate passenger-related tasks and improve airport security. In airport aviation support activities, airports and airlines are also experimenting with robotic technology.

Keywords: Automated services, Smart airports, Intelligence operating system.

Introduction:

Despite the importance of the human element as a cornerstone in the field of service provision in general, the benefit of modern technology has become an irreplaceable requirement, particularly with all service fields relying on technology and its applications in carrying out their work. Many information technology companies around the world have begun to provide many technological applications based on the idea of AI, that is, the concept of the machine doing logical thinking, data analysis, and problem-solving in a way that simulates the human mind, which can be used in a way (Dožić, 2019) strong in analyzing a large amount of data and producing a large amount of information and results that benefit the tourism industry and its development, while others believe that this will have a negative impact on tourist employment in the future (Dewi, 2020).

As a result, the idea of smart cities and smart airports was born. Smart airports arose as a result of the widespread adoption of the Internet of Things (IOT) and Industry 4.0, as well as increased commercial flight frequency globally. Smart "things" are installed in modern airports to improve service reliability and reduce human error in critical areas such as runway maintenance. And ensure that customers have a positive experience and to support airport operations, smart airports rely on connected technologies such as AI. This includes all processes involved in making all passengers' airport experiences as pleasant as possible (Alansari, 2019).

AI and its cognitive data interpretation technologies have the potential to simplify and automate analytics, machine maintenance and customer service. In addition to a variety of other internal processes and tasks (Bawack et al., 2021) AI is essential for the airport itself. Cost reduction, design cycle time reduction, copying, prototyping, optimization, storage, production and product renewal are all examples of cost reduction. All of these factors are expected to propel the aerospace industry forward over the next 15 years. Such as the Intelligent Tracking research published by SITA, an air transport information technology company, verified that using modern technology such as artificial intelligence to manage baggage at airports over the next decade will make wrong baggage handling an uncommon occurrence (Chantry et al., 2021).

2. Literature Review

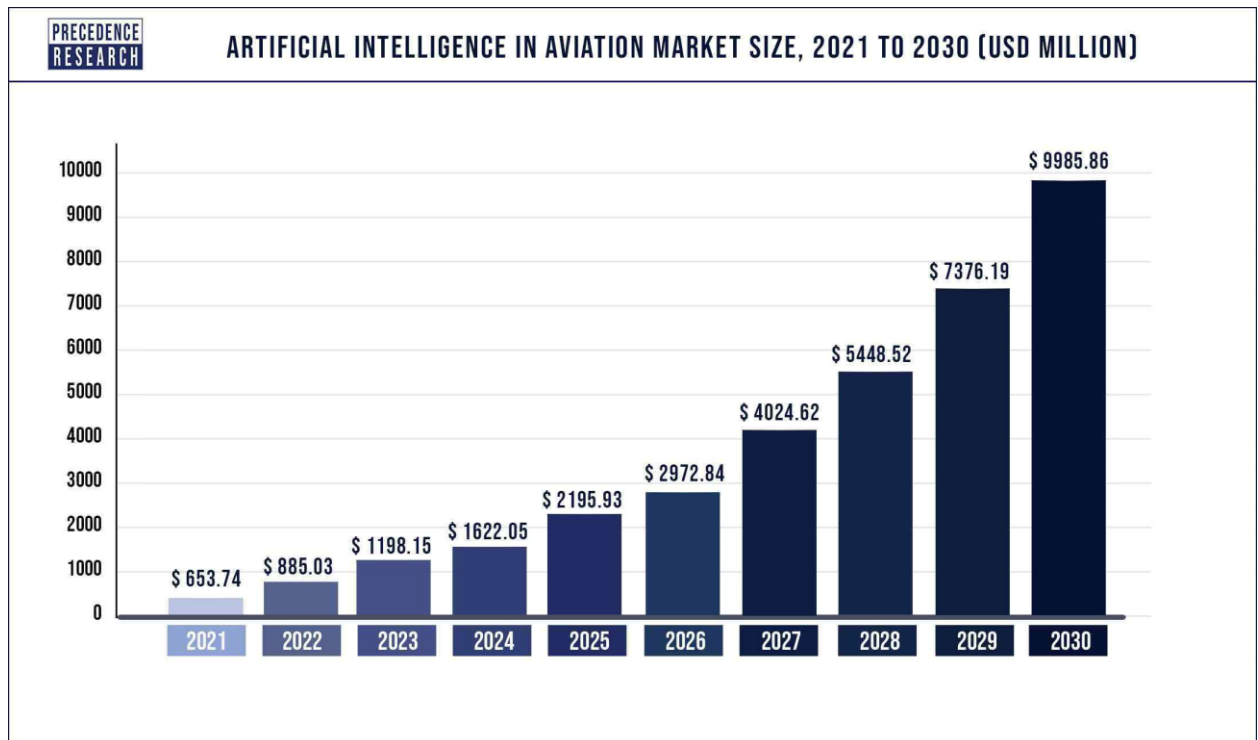
2.1. The Technology in Aviation Industry

Mobility and its transportation pillars (air, inland and maritime) are at the heart of our socio-economic fabric, support social connections and enable access to goods and services such as trade, employment, health care and education. Mobility by air, road and water in today's world is all about efficiency, speed, interconnectivity and accessibility for all. This, however, raises the issue of sustainability. According to the United Nations, cities will house two-thirds of the world's population by 2050 (Efthymiou et al., 2022).

Furthermore, innovation in technology and approaches (for example, by redefining travel efficiencies) is critical to redefining mobility and cutting-edge technology, such as self-driving cars and ultra-light materials, opens up possibilities for transforming the mobility system by enabling new business models and mobility services. Unmanned aircraft innovations, artificial intelligence, biometrics, robotics, blockchain, alternative fuels and electric aircraft are just a few examples. As a result, aviation is uniquely positioned to support the innovation discourse and its potential impacts on new mobility (Dalkilic, 2017).

Aviation technology is a broad field that includes a wide range of equipment. Flight operations, flight training, aircraft maintenance, aircraft security and airports all use hardware and software. Technology developed for aviation is frequently more advanced than technology developed for other industries (Li et al., 2021). There have been numerous technological advancements and innovations like reactive machines, theory of mind and self-aware. Over time, this has been incorporated into the aviation industry. These advancements have been made to improve the functionality, ease of operation and safety of the aviation industry (Alam, 2016).

AI is the ability of a computer or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence and discernment. Furthermore, the increasing use of AI to improve customer service will create new market opportunities (Figure 1). Furthermore, improved operational efficiency in the aviation industry with the help of AI will act as a market driver, boosting new opportunities during the forecast period. Some of the AI applications in aviation that will create more opportunities in the future include surveillance, flight operations, virtual assistance, smart logistics, training, smart maintenance, dynamic pricing, manufacturing and others (Brandoli et al., 2021).

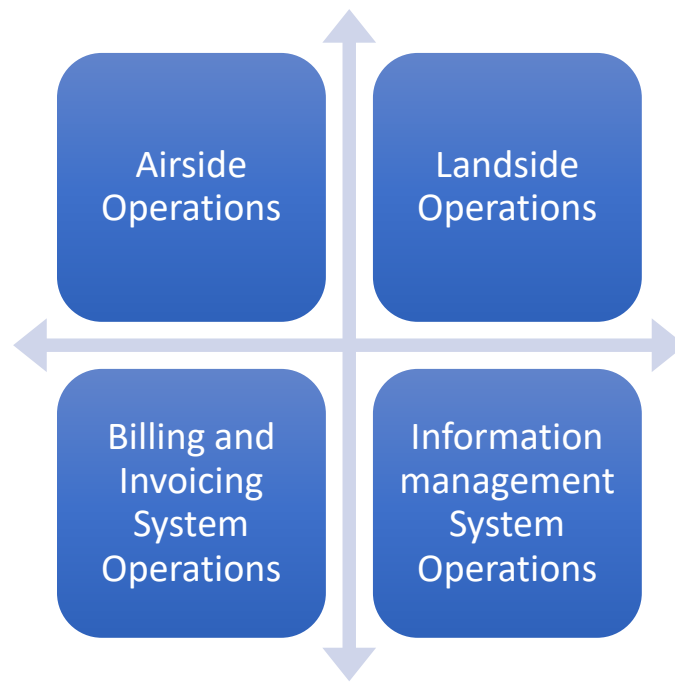


Source: Journal of the Academy of Marketing Science (2021).

Figure 1: The global artificial intelligence in aviation market size was estimated at US\$ 653.74 million in 2021 and it is expected to surpass around US\$ 9,985.86 million by 2030 with a registered Compound Annual Growth Rate (CAGR) of 35.38% from 2022 to 2030.

2.2. Artificial Intelligence (AI) Technology in Airport:

Airport efficiency is essential in today's air transportation system. Airport operations are being strained as the number of flights and passengers increases. This must be done while maintaining punctuality, performance, safety, travel, tourism and hospitality companies have used robots; AI and service automation in a cost-benefit analysis using an Airport Operations Centre (APOC) to manage integrated airport operations is a critical step in optimizing the use of all airport resources and facilities, reducing aircraft turnaround times and flight delays. Furthermore, ensuring airport capacity reliability during peak times and in all weather conditions. Every aspect of an airport's operational life significantly impacts the airport experience of any passenger (Naumov, 2019). Long delays, insufficient security clearances and general chaos could result from failing airport operations. It will also jeopardize the safety of planes, passengers and employees. Airport operations are typically classified into four types (Lukanova & Ilieva, 2019) (Figure 2).



Source: Journal of Air Transport Management (2021).
Figure 2: Four Airport's Operations Categories.

2.2.1. AI in Airside Operations

The use of artificial intelligence (AI) and machine learning (ML) technology is projected to improve air traffic management and predictive maintenance in the near future adoption of AI for observation tasks such as time series analysis, natural language processing and computer vision. Furthermore, airlines bear hefty expenditures as a result of delays and cancellations, including maintenance costs and compensation for passengers detained in airports. Predictive analytics applied to fleet technical assistance is a potential solution, with unscheduled maintenance accounting for approximately 30% of overall delay time (Lui et al., 2021). Using AI techniques in concert with a physical understanding of the environment can considerably increase forecast quality for several types of high-impact weather, National Oceanic and Atmospheric Administration (NOAA) researchers discovered. AI is largely acknowledged as making an important contribution to the fast growing field of computational sustainability. This will aid in forecasting storm duration, severe hail or wind, precipitation categorization, aviation turbulence forecasting and renewable energy forecasting (Fuad et al., 2020).

- Therefore, propose 1 that the use of AI will increase the level of safety and security by predicting what will happen.

Furthermore, flight performance and crisis management one of the most significant characteristics for aerospace Original Equipment Manufacturer (OEMs) is fuel efficiency, which may be increased with the use of artificial intelligence. Any little increase in fuel efficiency can have a substantial influence on aircraft emissions, which can be accomplished by creating lightweight aircraft components. AI supports pilots during flights by assessing vital data such as the fuel system, system state, weather conditions and other major parameters that may be reviewed in real-time to optimize a flight path (Karp, 2020). The automation of the airline cockpit will help to liberate the pilot's attention from difficult control chores. Automation also helps to improve flight path control, system monitoring displays and diagnostic assistance systems, all of which can

help to improve the support and maintenance of aircraft system states. Image analysis from radar or camera-based devices in particular. Automation is also important for providing a smooth interchange of information and enhanced coordination among all actors, including the airborne side, according to (European Union Aviation Safety Agency, 2020). Also, some crew management solutions address the tiredness risk that pilots confront as a result of repeated time zone shifts, lengthy duty days, scheduling changes and other "perks" of working in the airline sector. For example, developers of Jeppesen's Crew Rostering system began combining bio-mathematical tiredness models into flight crew scheduling software.

- Therefore, propose 2 that AI utilization in international airports mitigate risks during the planning process by depending on data regarding potential problems.

2.2.2. AI in Airport Billing System Operations

AIS, Damarel Systems International LTD, iFIDS.com Inc., Amadeus IT Group Each flight handled by an airport provides a set amount of money for the airport, which is paid by the airline flying the aircraft. Payment for any type and size of aircraft is available using aeronautical invoicing systems. It accepts cash and credit in a variety of currencies. The billing also includes The Air Traffic Control (ATC) services, an airport can calculate the aeronautical charge and issue an invoice with a bill based on the aircraft type and weight as well as the ground services offered. It is computed using the following information. Registration of aircraft, airport parking time airport departure and/or landing location, times at various sites of entry or exit. Data is entered or imported from ATC. Based on this knowledge, the airport calculates the charges and sends the bills.

- Therefore, propose 3 that the application of AI will provide the airport with the maximum increase in revenues while decreasing expenditures.

Also, advanced approaches such as AL, ML and predictive and prescriptive analytics are being employed throughout the value chain. All of this boils down to selling the right product to the right consumer at the right time and through the appropriate channel, often known as Revenue Management (RM) (Boffey, 2019). RM is based on the premise that customers perceive product value differently and hence the price they are prepared to pay fluctuates according to the target groups they belong to and the moment of purchase, AI is used by RM specialists to identify routes and change prices for certain markets, find efficient distribution methods and manage seats in order to maintain the airline competitive while also being customer-friendly (RapidMiner Team, 2022); (Czilik, 2020).

- Therefore, propose 4 that improve the efficiency of all operations through the use of AI.
- Therefore, propose 5 that Forecasting demand for infrastructure needs using regional consumption data analysis and investment planning

2.2.3. AI in Airport Information Management System Operations

The breadth of an Airport Management Information System (AMIS) goes much beyond conventional needs due to the unique complexity of the airport industry and the substantial macro-economic, social and environmental effects of aviation within a larger region (ABOMIS Team, 2022). Data security is the protection of systems and information from

serious dangers such as cyber warfare, terrorism and espionage. Furthermore, AI software such as Coseer by Arbot Solutions, employs algorithms to analyze natural language or unstructured text to speed up and simplify customer support personnel' activities (TAV Technologies Team,2022).

Airlines can improve customer service by using data analysis to learn about airport and flight experience pain spots. Using AI for feedback analysis and market research, according to Briana Brownell, founder and CEO of Pure Strategy Inc., enables airlines to make informed decisions and satisfy customer expectations (Airport Technology Writers, 2021). When it comes to travel marketing, AI touches on numerous points along the client experience. Modern travel marketing software includes AI and ML, which can handle everything from "understanding" a customer's preferences to projecting flight fares on a certain day (Skyway Magazine, 2019).

In addition, in the face of increasing competition for customers, travel marketing for airlines demands more than just low pricing. Offering a wonderful client experience and having a highly recognized brand perception is crucial in this industry since, unlike other travel firms, airlines demand a higher level of security and know-how than any other (Marks and Rietsema, 2019).

- Therefore, propose 6 the use of AI aids in making faster and more accurate decisions.
- Therefore, propose 7 that utilize AI to better understand customer preferences and to enhance the travel experience.

2.2.4. AI in Landside Operations

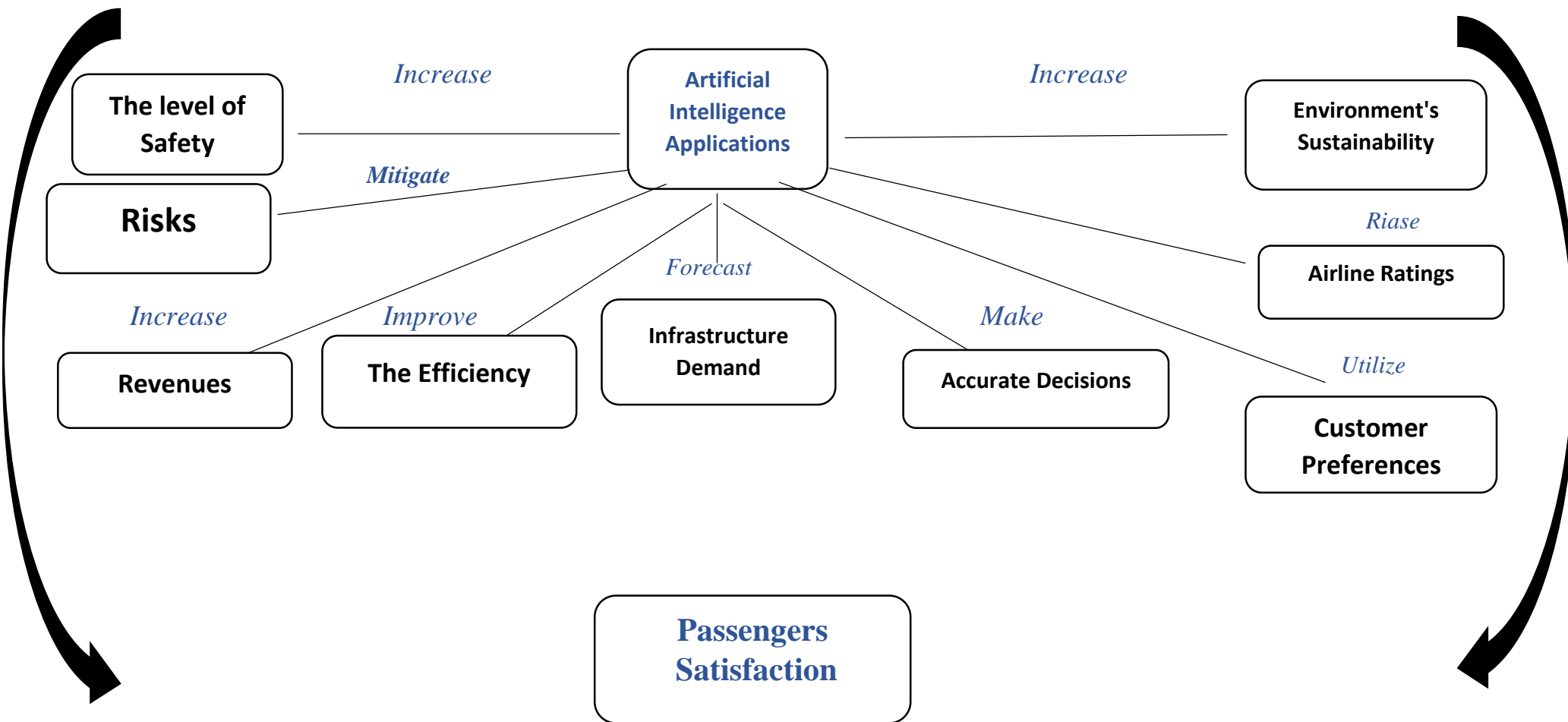
Immigration officials will be rendered obsolete by 2024. They will be replaced by multipurpose robots equipped with AI and cutting-edge detection technology. It can also interact with visitors and provide answers to inquiries on taxation, policy and currency exchange rates. People will be scanned as they walk through an AI-powered security system without having to remove their shoes and belts or empty their pockets (Donadio et al., 2018). Airports had already begun testing an intelligent virtual aquarium entrance. Travelers would pass via a small fish-filled tunnel. As they looked about, cameras captured every angle of their features consider how AI may handle passenger movement from the time arrive at the airport until depart. Self-driving automobiles with your bags could meet you at the curb (Hong et al., 2021), as well as at the fish swimming around them. The car is outfitted with clever sensors that detect its surroundings. It can precisely position itself, detect obstructions and make decisions about what to do (Joose & Evers, 2017).

- Therefore, propose 8 that AI in international airports can be utilized to improve and raise airline ratings.

The automation of the airlines' cockpit will help to liberate the pilot's attention from difficult control chores. Automation also helps to improve flight path control, system monitoring displays and diagnostic assistance systems, all of which can help to improve the support and maintenance of aircraft system states. Image analysis from radar or camera-based devices in particular. AI/ML could potentially aid in disaster recovery planning, such as in the event of a C2-link failure. Furthermore, AI/ML techniques are projected to improve and simplify present positioning sensors, data aggregation and overall function performance in autonomous localization/navigation (without GPS) systems (Pegasus Airlines, 2022).

- Therefore, propose 9 that piloting AI in the cockpit will help protect the environment and increase sustainability.

3. Conceptual Framework



Model1: Summarize the preceding proposition

4. Discussion and Conclusion

AI in airport operations from different applications in this study AI-powered air operations, AI-powered information systems, facial recognition, security robots, automatic inspection systems, baggage examination and autonomous tractors are among the most critical. Furthermore, through predictive and educative aircraft maintenance, AI-powered automation and self-service solutions improved personnel workflow and raised air safety, making intelligent pricing and market positioning decisions based on data and pricing is also dynamic. This research contributes to perceptions of employing AI apps in travel operations by highlighting two factors, the benefits and the disadvantages of AI reliance on machines, replacing low-skill jobs, and restricted work. AI benefits include solving complicated management problems, saving time and money, completing duties flawlessly, improving business revenues, allowing airports to improve safety and security and expanding market share. As a result, the industry can increase its investment in the AI industry (Pencarelli, 2020).

Furthermore, industry analysts predict that more than 52% of airline service providers will utilize AI-enabled products to improve customer experience during the next five years. As a result, the global aviation industry is growing at a breakneck pace. Over the next three years, the number of passengers is predicted to double. This additional demand could put a pressure on the present systems in use at airports throughout the world. However, AI can readily meet the need without altering aircraft operations or finance. It can also keep track of security records, control costs, improve customer happiness and increase profits (Dewi, 2020).

4.1 Theoretical Contribution

The study has a manifold contribution. This research was Egypt's first study on the application of artificial intelligence in the context of the airport industry. Marzouki (2021) and Hebat Allah. (2020) literature by adding new AI applications never mentioned before recently implemented in some airports and new emerging markets, especially Egyptian airports. Through this study, it was found that some of the applications of AI have been applied in all sectors of the airport around the world. However, not all AI applications were implemented in a single airport, as some airports had shortfalls in some applications. This context contributes to the current literature by highlighting the application of AI in emerging airports/airports.

4.2 Managerial Implications

The study throws light on the managerial implications for international airports, particularly Egyptian airports. First, despite the Egyptian government's efforts to implement AI techniques. Egypt's tourism service providers are not qualified to adopt AI approaches because the technology is still in its early stages, according to the findings, which also highlighted a lack of a defined vision and a lack of excitement among leaders. Second, suitable technological infrastructure as well as skilled human cadres is in short supply. Third, assistance in the establishment of vocational tourist training programs for new emerging market employees, with an emphasis on the development of employees' skills and technological capacities. As

a result, they can react to and deal with AI strategies in a more efficient and effective way. According to the research, building tourism education courses that are in accordance with the current technological transformation and connecting to all new technology applications such as AI is also advised. Tourism service providers in emerging areas, such as Egypt, must be kept up to date on technological advances in tourism information technology.

5. Limitations and Future Research

There are significant limitations to the current analysis. First, the study focuses on the need of using AI technology in airport operations; propose raising awareness about the significance of using AI. The study also examines a restricted selection of AI applications. As a result, advocate adding more new applications for future research. Despite these constraints, the research recommends that AI technology be implemented at Egyptian International Airport is an example of an emerging market.

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اثر تطبيق الذكاء الاصطناعي على عمليات المطارات (يطبق على مطار العاصمة الاداريه الدولي)

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ملخص البحث

قد يستفيد قطاع الطيران إلى أقصى حد من الذكاء الاصطناعي ، الذي لديه القدرة على تغيير الأعمال. نتيجة لاختراقات الذكاء الاصطناعي والطيران ، تطورت المطارات الذكية. الغرض من هذا البحث هو النظر في أهمية تطبيق الذكاء الاصطناعي في المطارات الدولية في مصر. وفقاً لهذا الإطار المفاهيمي ، فإن الخدمات والأنظمة المدعومة بالذكاء الاصطناعي تُمكن المطارات الذكية من أن تكون أكثر قوة وكفاءة ويمكن التحكم فيها ، كل ذلك أثناء إدارتها من خلال المراقبة والتحليلات في الوقت الفعلي. تساعد المستشعرات الذكية أيضاً في تنظيم الظروف المحيطة بالمطار ، وأتمتة المهام المتعلقة بالركاب وتحسين أمن المطار. في أنشطة دعم طيران المطارات ، تقوم المطارات وشركات الطيران أيضاً بتجربة التكنولوجيا الروبوتية .

الكلمات المفتاحية: خدمات مؤتمتة ، مطارات ذكية ، نظام تشغيل ذكي